CITY OF KELOWNA

BYLAW NO. 11692

Amendment No. 18 to Subdivision, Development and Servicing Bylaw No. 7900

The Municipal Council of the City of Kelowna, in open meeting assembled, enacts that the City of Kelowna Subdivision, Development and Servicing Bylaw No. 7900 be amended as follows:

1. THAT **SCHEDULE 4 – CITY OF KELOWNA DESIGN STANDARDS** be amended by deleting it in its entirety and replacing it with a new **SCHEDULE 4 – CITY OF KELOWNA DESIGN STANDARDS** as attached to and forming part of this Bylaw as Attachment "A";

2. AND THAT **SCHEDULE 5 – CONSTRUCTION STANDARDS 2. STANDARD DRAWINGS** be amended by:

    a) deleting Standard Detailed Drawings, Hydrant, SS-W4 in its entirety and replacing it with a new Standard Detailed Drawings, Hydrant, SS-W4 as attached to and forming part of this Bylaw as Attachment "B";

    b) adding new Standard Detailed Drawings in their appropriate location as follows:

        i. AC Watermain Crossings, SS-W52;
        ii. Pressure Reducing Station, SS-W53a; and
        iii. Pressure Reducing Station, SS-W53b;

        as attached to and forming part of this Bylaw as Attachment "C";

    c) deleting the the following Standard Detailed Drawings:

        i. Manholes, SS-S1a;
        ii. Manhole Frame and Cover, SS-S1b;
        iii. Inside Drop Manhole, SS-S4;
        iv. Sanitary and Storm Sewer Service Connection, SS-S7;
        v. Inspection Chamber for 100 to 200 Sanitary Sewer or Storm Drain Connection, SS-S9;
        vi. Storm Drain Outlet with Safety Grillage, SS-S13B; and
        vii. Flow Control Chamber (with Sediment & Grease Trap), SS-S55;

        and replacing them with the new Standard Detailed Drawing in their appropriate lcoation as attached to and forming part of this Bylaw as Attachment "D"; and

    d) adding a new Standard Detailed Drawings, Adjustable Manhole Frame and Cover, SS-S1c, in its appropriate location, as attached to and forming part of this Bylaw as Attachment "E".

3. This bylaw may be cited for all purposes as "Bylaw No.11692, being Amendment No. 18 to Subdivision, Development and Servicing Bylaw No. 7900."

4. This bylaw shall come into full force and effect and is binding on all persons as and from the date of adoption.

Read a first, second and third time by the Municipal Council this

Adopted by the Municipal Council of the City of Kelowna this

Mayor

City Clerk

Attachment "A"

SCHEDULE 4

OF BYLAW 7900

CITY OF KELOWNA

DESIGN STANDARDS

GENERAL

This latest update of Schedule 4 of Bylaw 7900 - City of Kelowna Design Standards is based on the Municipal Infrastructure Design Guidelines 2014 as prepared under the auspices of the Master Municipal Construction Document Association (MMCDA), which is an association of British Columbia Municipalities, Regional Districts, Contractors and Consultants. The purpose of the Design Standards is to provide a standardized set of guidelines to be utilized by consultants and City staff involved with design and construction of municipal infrastructure. Users of this Schedule should note the following:

- These Standards are considered a "living document" and will be updated on a regular basis to reflect evolving industry advancements, new materials, improved methods and best practices.
- The contents of this manual are intended to complement the following documents:
    - MMCD Specifications and Standard Detailed Drawings.
    - City of Kelowna Schedule 5 – Supplementary Specifications and Supplementary Standard Detailed Drawings.
    - Policy 265 (Engineering Drawing Submission Requirements).
    - Policy 266 (Approved Products List).
- Links to other documents have been provided to augment the material included in these Design Standards.

This manual is not intended to be a substitute for sound engineering knowledge and experience. It is the designer's responsibility to exercise professional judgment on technical matters in the best interests of the owners and users of the infrastructure. Standards contained herein are provided to assist in making these judgments, but should not be used as a substitute. Since the standards are general, they do not, and cannot, cover all particular cases.

DISCLAIMER

This manual is not intended to be used as a basis for establishing civil liability.

0.0 General Design Considerations

0.1 Sustainability and Asset Management

Development of appropriate design guidelines for municipal infrastructure involves consideration of the principles of sustainability and asset management. These principles include the following:

- Improve and enhance quality of life.
- Minimize negative impacts on health, safety and the environment.
- Investigate the impacts of potential actions to manage and mitigate risk.
- Consistently make informed long-term infrastructure decisions.
- Minimize overall life cycle investment.

Some of the above principles involve conflicting priorities, for example, undue concentration on financial economies may have adverse impacts on environmental protection and life cycle costs of infrastructure.

A balanced approach to design of municipal infrastructure requires careful consideration of all of the above principles.

0.2 Independent Utilities

Independent utilities are those not normally supplied by municipal or regional authorities and are not included in these guidelines. Independent utilities include:

- Electrical power
- Communications (telephone, data, fibre optics and cable)
- Gas

Design of municipal infrastructure must include consideration of the above utilities. Design of these utilities is normally carried out by the utility owner and coordinated for conflicts by the municipal designer and/or the local authority.

In new urban developments, all wiring is generally to be underground as per Policy 101 – Conversion of Overhead Power Lines to Underground Installation. This excludes electrical transmission lines, which are normally located in separate rights-of-way.

0.3 Utility Rights-of-Way

Utility right-of-way locations should be selected to avoid environmentally sensitive areas, such as, watercourses, wetlands, wildlife migration corridors and forested areas, as outlined in the Official Community Plan (OCP).

Where the location of a municipal utility in a right-of-way is approved by the City, the minimum desirable right-of-way widths are as follows:

Table 0.3 Right-of-Way Widths

Service Type	Right-of-Way Width
Single service	Twice the depth from surface to the crown of the pipe plus trench width (4.5 m minimum width).
Two services within the same trench	Twice the depth from surface to the crown of the deeper pipe PLUS trench width (5.5 m minimum width).
Two or more services adjacent to one another but in separate trenches	Cumulative widths for single services (noted above) PLUS any difference to provide the required separation (6 m minimum width).
When the service is within a road allowance, and the distance from the property line to the centre of the service is less than one half of the width indicated above for a single service, the difference should be provided as right-of-way on the adjacent property.	
The rights-of-way noted are desirable but in some cases may not be practical and alternative combined right-of-way corridors may be required as approved by the City Engineer.	

In all cases, the width of rights-of-way should be sufficient to permit an open excavation with side slopes in accordance with the WorkSafeBC Requirements for excavation and trenching safety, without impacting on or endangering adjacent structures.

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

The designer should provide cross sections indicating the minimum safe distances to adjacent building footings based on a safe angle of repose from the limits of the excavation.

Where a utility is located within a right-of-way, and valves, valve chambers, manholes, or other appurtenances which require maintenance are located within a right-of-way, maintenance road access from a public road must be provided. The maintenance access must be sufficiently wide and structurally adequate to support the maintenance vehicles for which the access is intended.

0.4 Utility Separation

Requirements for separation of sanitary or storm sewers from water mains are as follows, unless otherwise indicated by Interior Health (IH).

0.4.1 Horizontal Separation

At least three (3) metre horizontal separation (pipe wall to pipe wall) should be maintained between a water main and either a sanitary sewer or a storm sewer.

In special circumstances where 3.0 m separation is not possible, a smaller separation than 3.0 m may be permitted upon approval from Interior Health.

The designer shall obtain Interior Health approval for all water main designs prior to commencement of construction.

0.4.2 Vertical Separation

Where a water main crosses a sanitary sewer or storm sewer, the water main should be above the sewer with a minimum clearance of 0.45 m and installed in accordance with Interior Health requirements.

0.4.3 Sewers in Common Trench

In special circumstances when typical separation cannot be reasonably achieved (i.e. hill side development, rock excavation), storm and sanitary sewers may be installed in a common trench provided that the design has taken into account:

- Interference with service connections,
- Stability of the benched portion of the trench,
- Conflict with manholes and appurtenances.

The horizontal clearance between sewer pipes should be not less than 1.0 m. Separation between manholes should be not less than 0.3 m.

0.5 Trenchless Technologies

Installation or rehabilitation of pipelines using trenchless methods may be indicated. The MMCD Specifications Section 33.05.23 Trenchless Sewer Pipe Bursting; and MMCD Specifications Section 33.05.24 Cured in Place Pipe Liners are two examples of trenchless applications.

Circumstances favouring trenchless installation include:

- Installation or rehabilitation in heavily built-up areas,
- Stream crossings,
- Railway crossings,
- Highway crossings.

Available technologies include the following:

- Slip-lining
- Cured-in-place pipe (CIPP)
- Pipe bursting
- Horizontal directional drilling (HDD)
- Micro-tunnelling
- Pipe jacking

0.6 Seismic and Geo-hazard Design Standards

Underground utilities are at risk of damage caused by seismic events, soil liquefaction and land slides. The most significant seismically-triggered geo-hazard that underground utilities are exposed to is horizontal ground displacement from landslides and soil liquefaction induced lateral ground displacement. Seismic design standards must be considered in seismically active zones with a potential for landslide or soil liquefaction. This becomes even more critical when considering a shared fire flow and potable water distribution system, which, during a severe seismic event, is required to remain functional if it is to be relied upon to provide fire suppression throughout the community.

The design shall consider the stability of the soils present, as well as establishing the site's susceptibility to lateral ground displacement during seismic activity.

This section does not cover seismic design considerations of larger size chambers (typically in excess of 10 m^2 in footprint), pump station structures, storage tanks, reservoirs and similar large components of the water and sanitary systems. These structures, along with seismically resistant pipe connections, shall be individually assessed by civil, geotechnical and structural engineers using the latest edition of BC Building Code and Application of the Seismic Guidelines for Government to meet post-disaster requirements and other specialty seismic standards applicable to buried and above ground structures.

0.7 Referenced Standards

All referenced standards contained within (i.e. AWWA, BC Building Code, Water Supply for Public Fire Protection, etc.) are to be the most recent version unless specifically noted otherwise.

0.8 Record Drawings and Operation and Maintenance Manuals

Record drawings are to be prepared and submitted in accordance with Policy 265 (Engineering Drawing Submission Requirements).

Operation and Maintenance Manuals are to be prepared and submitted for pump stations, lift stations, PRVs, reservoirs, valves, air valves and appurtenances as described below:

Supply two (2) paper copies and one (1) electronic copy of operating and maintenance manuals prior to substantial completion.

Bind contents in a three-ring, hard covered, plastic jacketed binder with the name of the facility to be embossed onto binder cover and spine.

Each section shall be separated from the preceding section with a plasticized cardboard divider with a tab denoting contents of the section.

Contents to include:

- Title sheet, labelled "Operation and Maintenance Instructions", and containing project name and date.
- List of contents.
- Reviewed shop drawings of all equipment.
- Equipment list showing all model and serial numbers.
- All equipment manufacturers manuals.
- Record drawings of all mechanical, electrical, control and alarm installations.

- Full description of system operations including: design points, designed pump and system curves, ultimate capacity, area served and any relevant design criteria relevant to the operation of the system.
- Full description of entire mechanical, electrical and alarm system operation.
- Names, addresses and telephone numbers of all major sub-contractors and suppliers.
- Commissioning report showing pressures, flows, current drawings for all possible operating conditions.
-

0.9 Interpretation

If there is any inconsistency or conflict between the provisions of these Design Standards and the Standard Drawings the Design Standards shall govern.

1. WATER DISTRIBUTION

CONTENTS

1.1 General

These guidelines are not intended to be a substitute for sound engineering knowledge and experience. Water distribution system designs should be prepared under the direction of a design professional who has the appropriate experience and is registered with Engineers and Geoscientists British Columbia.

Water for Kelowna is provided by the City of Kelowna Water Utility and four major water purveyors.

- Black Mountain Irrigation District
- Glenmore Ellison Improvement District
- Rutland Water Works

These design standards apply to the City of Kelowna Water Utility and are in general conformance with the four major water purveyors. The Purveyors requirements may differ in some instances so it is the responsibility of the designer to confirm with the independent water purveyors regarding their specific requirements. The location of water infrastructure within roadways shall be in accordance with these standards.

1.2 Metering

Water meters tend to reduce per capita water demand and are required as per the City of Kelowna Plumbing Bylaw, Water Use Regulation Bylaw and Water Purveyors bylaw(s).

1.3 Per Capita Demand

Use the following per capita demands for future residential requirements:

- Average annual daily demand (ADD): 900 litres per capita per day (L/c/d)
- Maximum day demand (MDD): 1800 litres per capita per day
- Peak hour demand (PHD): 4000 litres per capita per day

Design population density:

Single Family	3.0 people/dwelling
Multi-Family	2.0 people/dwelling

1.4 Non-Residential Demand

Commercial, industrial and institutional demands should be determined using specific data related to the development or zoning. In the absence of such data, or municipal regulations, use the following for maximum day demands for single story buildings (MDD):

Commercial or institutional:	22,500 litres per hectare per day
Industrial:	100,000 litres per hectare per day

Note that the above rates do not include outdoor irrigation and assume that all connections are metered.

1.5 Fire Flows

Fire flows shall be determined in accordance with the requirements of the current edition of "Water Supply for Public Fire Protection - A Guide to Recommended Practice", published by Fire Underwriters Survey.

The following minimum fire flows must be met for the noted zones under peak daily flow conditions (Table 1.5):

Table 1.5 Minimum Fire Flow Requirements

Developments (without sprinklers)	Minimum Fire Flow
Single Family &Two Dwelling Residential	60 L/s
Modular / Mobile Home	60 L/s

Three & Four Plex Housing	90 L/s
Apartments, Townhouses	150 L/s
Commercial	150 L/s
Institutional	150L/s
Industrial	225 L/s

The Design shall not use a fire flow greater than those listed in Table 1.5 to design their onsite fire protection systems. The maximum available fire flow for site development is the lesser of the actual available fire flow at the service connection or the fire flows in Table 1.5.

Subdivisions and main extensions may utilize hydraulic information from water model as provided by the City.

Actual required fire flows shall be determined for all new developments.

1.6 Design Flows

Unless otherwise indicated by the City Engineer, system design flows should be based on the ultimate population and fully developed non-residential land as anticipated in the Official Community Plan (OCP).

Total design flows (Q_{design}) are to be the greater of the following:

Q_{design} = MDD+FF Maximum Day Demand plus the Fire Flow, or

Q_{design} = PHD Peak Hour Demand

1.7 Water Pressure

The water system must be designed to provide domestic water at the building main floor elevation on each Parcel as follows:

Maximum allowable static pressure	830 kPa (120 psi)
Minimum static pressure	275 kPa (40 psi)
Minimum system pressure at Peak Hour Demand (PHD)	275 kPa (40 psi)
Minimum pressure in system during design Maximum Day Demand and Fire Flow (MDD+FF)	140 kPa (20 psi)

For large lot and hill side development the designer shall be responsible to identify suitable building elevations for all buildings based on available hydraulic pressure. Determination of pressure limits should include consideration of property elevations relative to street level. Designer to note properties on service cards and record drawings where pressure at service connection exceeds 75 psi.

Where the maximum pressure exceeds 515 kPa (75 psi), design must identify service connections that must be individually protected by pressure reducing valves located in the buildings being served.

1.8 Hydraulic Design

Where there is an existing hydraulic network in place, the City will provide any available information for assistance in designing changes to the network. Depending on the complexity and extent of the proposed distribution system, the City may require a hydraulic analysis design showing flows and pressures.

Use a proven network analysis computer model based on the Hazen-Williams formula:

$$Q = \frac{CD^{2.63} S^{0.54}}{278{,}780}$$ Where:

Q = Rate of flow in L/s
D = Internal pipe diameter in mm
S = Slope of hydraulic grade line in m/m
C = Roughness coefficient (Table 1.8)

Table 1.8 Roughness Coefficients for Various Pipe Materials

Pipe Material	C Factor
PVC	130
Cement Lined Ductile Iron, Cement Lined Steel, Asbestos Cement	120
Cast Iron	100

It should be noted that the values listed in the above table are for pipe losses only and do not include losses associated with fittings, tees and valves which also require design consideration.

The maximum allowable design velocity shall not exceed the following:

Pump Supply, Reservoirs and Trunk Mains 2.0 m/s

Distribution Lines
- At Peak Hour Demand (PHD) 2.0 m/s
- At Maximum Day Demand (MDD) plus Fire Flow (FF) 4.0 m/s
-

Designers are responsible for assuring that surge and transients pressures are accounted for in their design.

When water mains cross railroads, major regional roads including Provincial highways, or watercourses, a steel casing pipe must be provided and must be designed to all applicable static, dynamic and seismic loadings and all other requirements of the authority having jurisdiction. The water main must be constructed with the appropriate spacers to support the pipe and prevent sagging or uplift (floating) inside the casing pipe. The water main inside the casing must be joint restrained. Service connections crossing highways and railroads are not recommended and require approval from the City Engineer.

1.9 Minimum Pipe Diameter

Distribution mains:	200 mm*
Fire hydrant connections:	150 mm
Service connections:	19 mm CU / 25 mm PE

Service diameter for buildings with sprinklers to be determined on a case by case basis based on fire flow demand.

* For looped distribution mains with lengths less than 500 m in residential subdivisions, the diameter can be reduced to 150 mm, providing that fire flow requirements can be met.

* Subject to approval of the City Engineer, distribution main minimum diameter in residential areas may be reduced to 100 mm provided that the main terminates in a short residential cul-de-sac, has a length less than 80 m, serves no fire hydrants or fire sprinkler systems and where no further extension is planned.

* In separated water systems where irrigation and fire flow are separated from domestic (potable) water, the minimum pipe size for the domestic water system may be 100 mm.

For commercial/industrial/institutional areas, the minimum allowable water main size shall be 200 mm diameter.

1.10 Dead Ends

Water mains must be looped wherever possible. Where dead ends are unavoidable, and approved by the City Engineer, blow-offs shall be provided (see Section 1.16 for sizing).

The maximum length of any permanent non-interconnected water main is 200 m. All mains exceeding 200 m in length, unless it is a temporary situation, must be looped.

Where the water system network is deficient, installation of additional water main capacity may be required and may necessitate the provision of rights-of-way in favour of the City.

1.11 Minimum Depth of Cover

The cover over any water main must not be less than 1.5 m from pipe crown to surface. U-bends should be used to avoid conflict and maintain minimum depth of cover. Rigid insulation may be used to provide protection to the water main from freezing for short sections of water main (< 4 m) with approval from the City Engineer, as per manufacturer's recommended guidelines for Utility line insulation (ex. DOW Tech Solutions 602.0 Styrofoam Brand Highload Insulation for Buried Utility lines).

1.12 Grade

Water mains must be designed with a rising grade wherever possible, to minimize high points in the main. Grades should be straight lines between defined deflection points. Elevations should be recorded on record drawings.

The minimum grade of water mains shall be 0.1%. Grading should be designed to minimize the number of high points and maintain continuous grade.

When the slope exceeds 15%, provide anchorage, joint restraints, trench dams and trench drainage as per standard MMCD drawing G8. Provide geotechnical engineering report where appropriate that assesses slope stability.

1.13 Corrosion Protection

Where there is a potential for encountering corrosive soils, a geotechnical corrosion analysis on the alignment of any proposed metallic water main or metallic appurtenances shall be conducted to determine the corrosiveness of the native soils and the suitability of metallic pipe and appropriate corrosion protection measures. One example is MMCD Specification Section 26 42 13, Cathodic Protection.

Regardless of soil condition, all metallic pipe shall be installed with poly-wrap as per the manufacturers recommended procedures.

Petrolatum tape and paste shall be used to wrap all nuts and bolts on buried metallic fittings and joint restraint fasteners.

Metallic water main with less than 400 mm diameter are not permitted.

1.14 Valves

In general, valves should be located as follows:

- In intersections, either in a cluster at the pipe intersection or at projected property lines to avoid conflicts with curbs and sidewalks:
    - 3 valves at "X" intersection;
    - 2 valves at "T" intersection;
    - Or as directed by the City Engineer, in order to allow for the isolation of specific sections of the main, minimize service disruption and/or facilitate network operation and maintenance.
- Not more than 200 m apart (except on trunk mains greater than 300 mm diameter, where spacing can be increased upon approval of the City Engineer). Where possible avoid the use of inline valves.
- In locations and at a frequency so that not more than two hydrants are out of service when a section of the main is turned off. An isolation valve is required for each hydrant, typically flanged to the hydrant tee.
- Not more than 20 service connections isolated.

In order to permit the use of pigging cleaning methods the valve sizing and type selection should be as follows:

- The valves shall be the same diameter as the water main.
- All valves shall be gate valves. Butterfly valves with appropriate chamber sized for maintenance and replacement may be used in special circumstances for water mains greater than 400 mm with approval from the City Engineer.

1.15 Hydrants

Fire hydrants should be located in general at street intersections and as follows:

- Not more than 150 m apart in single family residential areas measured along road centre line.
- Not more than 100 m apart in higher density residential, commercial, industrial and institutional areas.
- Hydrant locations as per BC Building Code for all buildings.
- In accordance with "Water Supply for Public Fire Protection - A Guide to Recommended Practice" (latest edition), published by Fire Underwriters Survey.
- 1.5 m back from curb or 0.5 m back of sidewalk to centre line of hydrant.
- Minimum 1.0 m clear of any other utility structure in all directions.

- Minimum 3.0 m clear in direct line with hose connections.
- At property lines in mid-block locations.
- SRW required where open cut excavation to base of hydrant assembly extends into private property.
- Bollards or concrete barriers for hydrant protection may be required at the City Engineer's discretion.

Hydrants shall not be located on sidewalks. Where this is not possible and with approval from the City Engineer, a minimum distance of 1.5 m must be maintained between the front of the pumper port and the back of curb, in accordance with the Transportation Association of Canada Manual for Canadian Roads.

On arterial highways with, or designated to be constructed with, a raised median, fire hydrants shall be installed on both sides of the highway with each side treated exclusively for spacing requirements.

1.16 Blow Offs and Blow Downs

Blow-offs shall be provided at the terminal ends of all water mains whether permanent or temporary to facilitate scouring velocities during flushing. Blow-off sizes are:

- 50 mm dia. for 100 mm dia. water mains (see Drawing SS-W8A)
- 100 mm dia. for 150 mm dia. and larger water mains (see Drawing SS-W8B)

Where practical, and approved by the City Engineer, a hydrant may serve a secondary role as a blow-off.

On all mains greater than 300 mm diameter, install blow downs at the lowest point in the water main profile between the line valves.

1.17 Test Points

Test points shall be installed on all water mains in order to provide for the ability to collect water samples in accordance with AWWA C651 – Disinfecting Water Mains.

1.18 Air Valves

Combination air valves shall be installed at the summits of all mains. Air valves may not be required on water mains 200 mm diameter and smaller upon approval by the City Engineer for the following:

- Where active service connections are suitably located to dissipate entrapped air,
- Where the difference in elevation between the summit and valley is less than 600 mm and it can be shown that air pockets will be carried by typical flows.

Air valve sizes, subject to design analysis, are as follows (Table 1.18):

Table 1.18 Typical Air Valve Sizes

Water Main Size	Valve Size
100 mm to 300 mm	25 mm

350 mm to 600 mm	50 mm
Larger than 600 mm	Special design

Air valves must be vented to an appropriate secured above-grade location to eliminate any potential for cross connection in a flooded or contaminated chamber.

1.19 Thrust Restraint

Cast in place concrete thrust blocking and/or adequate joint restraining devices must be provided at bends, tees, wyes, reducers, plugs, caps, valves, hydrants and blow-offs. Bends at 5-degrees may not require thrust blocking and/or joint restraining devices provided they are properly engineered.

The restraint system must take into account potential future excavations in the vicinity of the water main. Design calculations must be based on fitting type, water pressure and soil conditions.

Precast thrust blocks are not permitted except in combination with joint restraints as approved by the City Engineer.

When required, provide the City Engineer with calculations for the thrust block/joint restraint design.

1.20 Chambers

Chambers or manholes should allow adequate room for maintenance, including headroom and side room. Access openings must be suitable for removing valves and equipment and permitting inspection cameras and pigging equipment. The chamber is to be provided with a drain to a storm sewer or ditch, complete with backflow prevention, to prevent flooding of the chamber. Rock pits may be considered subject to suitable soil and groundwater conditions and subject to approval by the City Engineer. A pumping system may be required for drainage.

Adequate venting should be provided. The City Engineer may require provision of forced ventilation, lighting, heating and dehumidification. Access and ventilation details must comply with WorkSafeBC requirements.

Insulation to prevent freezing should be provided where necessary.

1.21 Service Connections

Service connection size should be calculated on the basis of the designated land use including sprinkler systems and/or on-site hydrants, where applicable. The minimum size is outlined in 1.9 - Minimum Pipe Diameter.

All service connections to be made with service saddles at water main.

Multiple corporation stops must have a minimum spacing of 1.0 m.

The curb stop at the end of each service pipe must be located as per SS-W2. Where such locations will conflict with other services, the location may be revised with the approval of the City Engineer.

Each connection of 100 mm or larger shall be installed with tee and isolation gate valve on the service at the water main. The designer may choose to add an additional valve at property line to facilitate testing and tie-in procedures.

Services and curb stops must have a minimum depth of cover of 1.5 m and curb stops must be no deeper than 2.0 m. Valve boxes shall be used for curb stops greater than 50 mm diameter.

1.22 Alignments and Corridors

On straight roads, water mains should have straight alignments with uniform offsets between intersections.

For curved roads and alignments, where approved by the City Engineer, design joint deflections shall be limited to half the maximum deflection specified by the pipe manufacturer or through the use of 5-degree bends. Pipe alignment to be at a parallel offset with an established road right-of-way or property line.

Metallic marking tape labeled WATERWORKS is to be placed above all pipes at a depth of 0.45 m below finished grade in statutory rights-of-way or irregular alignments.

Water mains on new roads must be located as indicated in the applicable Standard Drawing typical cross-section.

Where a water main crosses private land, right-of-way requirements are as indicated in Section 0.3, General Design Considerations – Utility Rights-of-Way.

Clearance from sewer is as indicated in Section 0.4, General Design Considerations – Utility Separation.

1.23 Reservoirs

The following reservoir design standards apply to the City of Kelowna Water Utility and are in general agreement with the other four water purveyors in Kelowna. The designer should consult with the applicable water purveyor for specific design details.

1.23.1 Preliminary Design

Reservoir design shall include a preliminary design which is to be approved by the City Engineer before the detail design begins. Preliminary designs should cover the following issues:

- Site layout,
- Design standards,
- Volume,
- Shape,
- Number of cells,
- Geotechnical report on foundation conditions,
- Appearance.

1.23.2 Reservoir Capacity

Reservoir capacity must not be less than the greater of the following:

- One-day average annual consumption for the service area.
- Total Storage Volume = A + B + C
  Where:
  A = Fire Storage (from Fire Underwriters Survey guide)
  B = Equalization Storage (25% of Maximum Day Demand)
  C = Emergency Storage 25% of (A + B).

1.23.3 Reservoir Structural Design Codes

Design in accordance with the latest edition of the BC Building Code and one of the following specialty codes:

- ACI 350/350R: Code Requirements for Environmental Engineering Concrete Structures, and Commentary.
- PCA: Circular Concrete Tanks Without Prestressing.
- ACI 350.3/350.3R: Seismic Design of Liquid Containing Concrete Structures, and Commentary.
- AWWA D11O: Wire and Strand-Wound Circular Prestressed-Concrete Water Tanks.
- AWWA D115-06 Tendon-Prestressed Concrete Water Tanks.
- AWWA 0100-11 Welded Carbon Steel Tanks for Water Storage.
- AWWA D103: Factory-Coated Bolted Steel Tanks for Water Storage.

1.23.4 Reservoir Design Features

1. Seismic Loading: Design for the following:
    - Watertight structure and fully operational mechanical equipment, following a 475 year return period earthquake.
    - Repairable damage and no uncontrolled release of water following a 2475-year return period earthquake.
2. Two cells, each containing one-half of total required volume and capable of being drained and filled independently.
3. Reservoir to be below ground, unless approved by the City Engineer.
4. Each cell is to have an access opening and hatch in the roof for cleaning and maintenance with minimum dimension 900 mm x 900 mm. Opening to be located so that the overflow pipe is clearly visible inside the reservoir, when viewed from the opening.
5. For all access hatches, a survey mark inlaid inside showing the geodetic elevation is to be provided.
6. Finished elevation of the top of the hatch when closed to be 0.6 m above the finished elevation of the reservoir roof.
7. Access hatch(es) to have the following:
    - Aluminium 1/4" tread plate
    - Perimeter drain
    - Perimeter sealing gasket
    - Slam lock with aluminium removable sealing plug and opening tool
    - Flush lift handle
    - Gas spring assist cylinder
    - 90-degree hard open arm
    - Flush fitting padlock tang
8. The hatch must be reinforced for 1,465 kg/m² (300 lbs./sq.ft.) complete with hatch alarm.
9. All fasteners for the hatch to be made of 316 stainless steel.
10. Ventilation pipes or openings sized to handle appropriate intake and exhausting volumes of air for filling and drawing the reservoir. Ventilation pipes outlets to be screened.
11. Reservoir floor to slope to drain sump.

12. Drain sump to be a minimum of 1000 mm X 1000 mm X 400 mm, invert of drain pipe to be flush with sump floor, grating to be installed over sump.
13. Sub-drain under floor to collect and drain any leakage (may be connected to overflow pipe provided suitable measures are incorporated to prevent surcharging).
14. Overflow drain to be provided and sized to transmit the maximum pump discharge with all pumps running.
15. A stainless steel interior wall ladder is required from roof access to floor. All ladders to meet WCB regulations, supply attachment points for fall arrest equipment.
16. Top rung of the ladder to be the same elevation as the finished elevation of the reservoir roof.
17. Where public access could be gained to reservoir, install appropriate fall prevention railings.
18. Re-chlorination may be required based on demand forecasts. Chlorine residual analyser required.
19. All pipework within the reservoir to be PVC or fiberglass except overflow fitting which may be stainless steel to AWWA standards.
20. All metal parts within the reservoir including bolts, nuts, screws, anchors, ladders etc. to be 316 stainless steel. All welded stainless steel components located in the reservoir to be appropriately passivated.
21. Reservoir inlet pipe to terminate with a diffuser positioned opposite the reservoir outlet and a distance of ¾ the length of the reservoir from the outlet. Diffuser to cover ¾ the wall length.
22. Ports in diffuser pipe to be engineered to produce circulation within the reservoir during fill cycle.
23. Diffuser to incorporate removable end caps.
24. Backup high and low level control balls for each cell set at 40% and 95% levels, (not to contain lead or mercury).
25. The reservoir must be cleaned, disinfected and leak tested to AWWA and local authority requirements.
26. Gated black chain link perimeter fencing is required to address security and safety issues.
27. Landscaping acceptable to the City is to be provided including irrigation.
28. In special circumstances, at the request of the City Engineer, vehicle access road to the top of the reservoir roof to be provided.
29. Manuals to be supplied as per Section 0.8.

1.23.5 Reservoir Valve Chamber

Reservoir to incorporate valve chamber containing:

1. Chamber to include all valves associated with the reservoir operations.
2. Design in accordance with seismic codes noted above.
3. Entrance at grade large enough to permit safe removal of largest single piece of equipment.
4. Lifting beams and hoists where necessary to enable removal of equipment or components.
5. Floor drains and drainage system.
6. Separate inlet and outlet piping including check valves to separate inlet and outlet flows.

7. All inlet and outlet piping to incorporate a ¾ inch sampling port with isolating ball valve.
8. A 19 mm Schedule 80 PVC sample line with isolating ball valve for each cell terminating in the middle of a cell wall at the 50% level and extending 25% towards the centre of the reservoir.
9. A 50 mm 316 stainless steel schedule 80 pipe with isolating ball valve extending into each cell for connection of cleaning hoses.
10. A 19 mm stainless steel pipe with isolating ball valve extending into each cell connected to a pressure transmitter for level sensing.
11. Minimum 30 amp, 120 VAC electrical service.
12. Heat, light and ventilation to meet WCB requirements and to maintain minimum 5-degree C on coldest day. Insulate interior walls and ceiling as required.
13. All control wiring junction boxes.
14. A PLC control system to current Pump Operations standards.
15. Chlorine residual analyzer.
16. Interior and exterior of all steel piping to be coated to AWWA standards, or use 316 stainless steel.
    - Inlet piping – Mid Blue
    - Outlet piping – Dark Green
    - Drain piping – Gull Grey
    - All other piping – Mid Blue
    - Include flow direction arrows where appropriate.
17. Check valves to show direction of flow with white painted arrows.
18. PLC controlled modulating inlet valve where more than one reservoir serves a single zone.
19. PLC control to City of Kelowna SCADA system, including:
    - Security switches
    - Discharge and suction pressure transmitters
    - Temperature sensor
    - Flowmeter
    - Uninterruptable power supply
    - Radio or hard wire modem
    - External antenna
    - Operator interface panel
20. The modulating inlet valve shall:
    - Have non-contact 0 - 100% valve position indicator with 4-20 mA output.
    - Be hydraulically operated with pressure tank (minimum 40 psi) sized to operate valve for 3 cycles during power failure.
    - Be complete with a hydraulically operated diaphragm actuated globe or angle.
    - Pattern valve of 'Powertrol type'.
    - Pilot system to be protected by single continuous flow 100 micron filter.
    - Space for safe and convenient operating and maintenance access to all valves, piping, equipment and instrumentation.
    - Manuals to be supplied as per Section 0.8.

1.24 Pump Stations

The following Pump Station design standards apply to the City of Kelowna Water Utility. The designer should consult with the applicable water purveyor for specific design details.

1.24.1 Preliminary Design

Pump station design must include a preliminary design report which is to be approved by the City Engineer before detailed design proceeds. Preliminary designs should include the following issues:

- Location
- Capacity
- Number and type of pumps
- Preliminary piping layout
- Type and appearance of structure
- Foundation conditions
- Maintenance requirements and access
- Energy requirements
- Standby power
- HVAC
- Controls and monitoring

1.24.2 Capacity

Pumping capacity should be designed to suit the particular circumstances. In general, capacity should meet maximum day demand with the largest pump out of service and balancing storage online. If balancing storage is not on line, pumping capacity should meet peak hour demand with the largest pump out of service. Stand-by power should be provided, where sufficient reservoir storage does not exist, to allow the greater of maximum day demand plus fire flow or peak hour demand (MDDD+FF, or PHH) during a power outage.

1.24.3 Design Features

1. Structure, piping and mechanical systems designed in accordance with seismic codes for post-disaster structures.
2. Located above 200-year flood level or 1.0 m above highest recorded flood elevation.
3. Reinforced concrete, blockwork or brick construction, aesthetically pleasing.
4. Access doorways sized so that the largest single piece of equipment may be safely removed and replaced. Lifting hooks or rails with pulley blocks as required.
5. Adequate HVAC with filtered air inlet.
6. Standby power.
7. Adequate lighting.
8. Housekeeping pads for MCC's.
9. Electric motors to be-premium efficiency.
10. Motors to have thermal protection.
11. Motors 200 hp and above to have analogue vibration recording and protection.
12. All pilot, air relief discharge to be piped to floor drains to avoid standing water.
13. Air relief valves and pilot lines to be piped to floor drains.

14. Hydraulically operated pump control valves with isolation valves.
15. Flow meter and totalizers.
16. Spring return 'silent" check valves.
17. High pressure and surge relief valves with isolation valves.
18. Suction and discharge pressure gauges for each pump with isolation valves.
19. Mechanical pump seals.
20. Lockable roof hatches for motor and pump removal.
21. Water quality sampling ports.
22. Off road vehicle parking.
23. Landscaping to City Parks Department specifications.
24. Interior and exterior of pipework to be coated to AWWA standards. Exterior colours to be:

    - Inlet piping – Mid Blue
    - Outlet piping – Mid Blue
    - Drain piping – Gull Grey
    - All other piping – Mid Blue
    - Include flow direction arrows where appropriate.
    - Check valves to show direction of flow with white painted arrows

25. Pump system to be PLC controlled and connected to City of Kelowna Pump Operations SCADA system.
26. Control system to include but not limited to:

    - Security switches
    - Discharge and suction pressure transmitters
    - Temperature sensor
    - Uninterruptable power supply
    - Radio or hard wire modem
    - External antenna
    - Operator interface panel
    - Power meter without outputs to PLC
    - Phase loss protection
    - 5 spare fuses for all fuse holders
    - Current copy of PLC and MMI program to be left in control enclosure
    - (see Pump Operations Department for current standards).

23. Motors to be 600volt, 3 phase.
24. Hour meters and ammeters for each pump.
25. Power factor correction if required by Power Authority.
26. MCC, breaker boxes, receptacles to be labelled.
27. Station to be cleaned and dust free.
28. Separate or isolated room required for electrical.
29. Noise attenuation to suit the location and local authority.

30. Manuals to be provided as per Section 0.8.

1.25 Pressure Reducing Valve (PRV) Stations

The following PRV design standards apply to the City of Kelowna Water Utility. Designer should consult with the applicable water purveyor for specific design details.

PRV station design parameters should be reviewed and approved by the City Engineer before detailed design proceeds. PRVs are to be above ground stations housed in a suitable kiosk. Above ground installation to be located outside of road ROW or in approved location.

1.25.1 Preliminary Design Parameters

- Design Flows: peak hour, maximum day plus fire.
- Continuous, emergency or fire flow operation.
- Location.
- Kiosk details: structure and access, controls and monitoring, HVAC.

1.25.2 Design Features

- PRV to be above ground including electrical kiosk.
- Minimum chamber size: 4 m x 2 m x 2 m (inside dimensions).
- Minimum 30 amp, 120 VAC service.
- External kiosk and antenna.
- Forced air ventilation, heat and light.
- Isolating valves.
- Parallel pressure reducing valves sized for peak hour and maximum day plus fire flows.
- Air release valves.
- Water quality sample points.
- Sump drain to storm.
- Hatch as per Reservoir section.
- Off road vehicle parking.
- Manuals to be provided as per Section 0.8.
- Landscaping.
- Basket strainers upstream of each control valve.
- Upstream and downstream pressure gauges.
- Flowmeter.
- Interior and exterior of pipework coated to AWWA standards, or use stainless steel.
- PLC-controlled with connection to City SCADA system, including:
    - Security switches
    - Discharge and suction pressure transmitters
    - Temperature sensor
    - Flow meter and transmitter
    - Uninterruptible power supply (UPS)
    - Radio or hard wire modem
    - External antenna, height designed for communication connection (min. 6 m)
    - Operator interface panel.

1.26 Facility Site Requirements

Paved vehicular access must be provided to all reservoirs and pump stations. The minimum standard must be for an emergency access road as shown in the Standard Drawings, with drainage provisions as may be required.

Provision shall be made for vehicle turn-around and crane access.

Provide site grading and landscaping plans that identifies drainage issues, retaining walls and site safety issues.

2.0 Sanitary Sewers

CONTENTS

2.1 General

These guidelines are not intended to be a substitute for sound engineering knowledge and experience. Sanitary sewer system designs shall be prepared under the direction of a design professional who has the appropriate experience and is registered with Engineers and Geoscientists British Columbia.

Sanitary sewers are intended to convey wastewater only as specified in the Sanitary Sewer/Storm Drain Regulation Bylaw.

These guidelines apply to City of Kelowna sewage collection system only.

2.2 Per Capita Flow

In absence of sanitary sewer flow data, sanitary sewer design shall be based on an average daily dry weather flow (ADWF) of 300 litres/capita/day, except when used for the analysis of older areas (pre-1980), where a ADWF = 420 litres/capita/day shall be used.

For system design in undeveloped areas, ADWF shall be estimated based on current zoning as follows: (Table 2.2):

Table 2.2 Flow Values for Undeveloped Residential Areas

Zoning	Population/ Hectare (gross)	Population/Unit
Single Family	24-30	3
Multi-Family Low	65	2
Multi-Family Medium	120 (3 storey)	2
Multi-Family High	320-960 (4-12 storey)	2
Mobile Home	40	2

2.3 Non-Residential Flows

Average dry weather flows (ADWF) for non-residential areas should be based on specific data related to the development. In the absence of such data, use the following flow values which are based on zoning designations (Table 2.3):

Table 2.3 Flow Values for Non-Residential Areas

Land Use	Equivalent Population/Hectare (gross)	ADWF* (L/ha/day)
Commercial	83	25,000
Institutional	83	25,000
Industrial	83	25,000

*ADWF calculated at 300 Litres per day per capita

2.4 Peaking Factor

The peaking factor is the ratio of peak dry weather flow (PDWF) to the average dry weather flow (ADWF). Where possible, the peaking factor should be based on locally recorded flow data from similar developments. It is recommended that if possible residential equivalents not be used but that each customer type calculates peak flows independently. When using hydraulic modelling software it is recommended that diurnal patterns be used that reflect varying time of day flows from each customer class. In the absence of such data, the peaking factor is to be calculated using the design residential population and non-residential equivalent population, with the formula indicated below:

The ADWF is multiplied by the Peaking Factor to determine PDWF The Peaking factor is calculated as follows:

$$\text{Peaking Factor} = f \times \left(1 + \frac{14}{4 + \sqrt{P}} \right)$$

where: P = Population in Thousands

f = Reduction factor, applied as follows:

- New residential areas = 0.75
- Old residential areas = 0.85
- Commercial and Industrial area = 1.00

2.5 Infiltration

Design flow should include an infiltration allowance to cover groundwater infiltration and system inflows. For urban, suburban or commercial areas, the allowance should be based on the gross tributary area and the following:

- New system with pipes above groundwater table: 0.06 L/s/ha (5,184 L/d/ha)
- Old system (pre-1980) and/or pipes below groundwater table: 0.12 L/s/ha (10,368 L/d/ha)

The above values are based on systems where roof leaders and foundation drains are not connected to the sanitary sewer.

For older systems it is recommended that the above value be confirmed with flow monitoring since, in some systems, this value can be substantially higher.

For low density areas with large lots (>90 m frontage), or spaces between developed areas, the infiltration allowance should be based on the total sewer system pipe sizes and lengths, including sewer mains, service connections and building sewers, and the following:

- New system with pipes above groundwater table: 0.45 L/mm dia./100m length/hour
- Old system (pre-1980) and/or pipes below groundwater table: 1.0 L/mm dia./100m length/hour

2.6 Design Flow

Design flow Q (=PWWF) = (population and equivalent) x (per capita flow) x (peaking factor) + (infiltration allowance).

2.7 Pipe Flow Formulas

For Gravity Sewers use Manning's Formula: $Q = \frac{AR^{0.667}S^{0.5}}{n}$

Where: Q = Design flow in m^3/s
A = Cross sectional area in m^2
R = Hydraulic radius (area/wetted perimeter) in m
n = Roughness coefficient, where:
$n_{concrete}$ = 0.013
n_{PVC} = 0.011

Pipes shall be designed so that the sewer flow does not exceed d/D=0.67 for pipes 250mm diameter and less, or d/D=0.75 for pipes greater than 250mm diameter. (d=flow depth and D=pipe diameter).

For Sewage Force Mains use Hazen-Williams formula: $Q = \frac{CD^{2.63}S^{0.54}}{278{,}780}$

Where: Q = Rate of flow in L/s
D = Internal pipe dia. in mm
S = Slope of hydraulic grade line in m/m
C = Friction coefficient = 120 for all pipe

2.8 Flow Velocities

Minimum design velocities:

- Gravity sewers: 0.60 m/s
- Force mains: 0.75 m/s

Where steep grades result in velocities exceeding 6.0 m/s, sewer design must consider measures to prevent pipe and manhole erosion, movement and the effects of dynamic loading. Pipe anchors shall be installed on steeper grades in accordance with MMCD standard drawings.

2.9 Alignment

Except as indicated for Curved Sewers (Section 2.12), horizontal and vertical alignments should be straight lines between manholes for gravity sewers, and between defined deflection points for force mains.

Force main line and grade requirements are as indicated for water mains. Air release valves are required at high points.

2.10 Minimum Pipe Diameter

- Residential: 200 mm except for the upstream section where future extension is not possible, in which case 150 mm is acceptable provided it has a grade of 1% or greater.

- Commercial and Industrial: 250 mm except for the upstream section where future extension is not possible, in which case 200 mm is acceptable provided it has a grade of 0.6% or greater.
- Service connections: 100 mm
- Sewage force mains: 100 mm.

Gravity sewer mains shall be designed so that the sewer flow does not exceed d/D = 0.67 for pipe diameters of 250 mm and less, or d/D=0.75 for pipe diameters greater than 250 mm. (where d=flow depth and D=pipe diameter).

2.11 Minimum Grade

Minimum grades of gravity sewers are as required to obtain the minimum velocity of 0.60 m/s. If the calculated design flow is not expected to produce a velocity of at least 0.6 m/sec., then the minimum grade shall be calculated on the basis of the pipe flowing 35% full at a theoretical velocity of 0.6 m/sec.

Force main grades are as indicated for Water section of these design standards.

2.12 Curved Sewers

Where permitted by the City Engineer, horizontal and vertical curves may be formed using pipe joint deflections as follows (no deflection along the pipe barrel permitted):

- Minimum radius = 60 m.
- Constant radius throughout curve and constant offset to road centreline where possible.
- Joint deflection not to exceed 75% of maximum recommended by pipe manufacturer.
- Minimum design velocity = 0.9 m/s.
- Only one horizontal and/or vertical curve allowed between manholes.
- Curve locations to be accurately recorded on record drawings.

2.13Depth

Sewers should be of sufficient depth to:

- Permit gravity service connections to basements on both sides of the road.
- The minimum depth of the sewer main (from the surface of the road or ground to the top of pipe) is normally 2.0 m.
- Prevent freezing. Minimum depth is 1.2m (measured from the surface to the top of pipe).
- Allow for future extension(s) to properly service all of the upstream tributary lands for ultimate development.
- Clear other underground utilities.
- Prevent damage from surface loading.
- Maximum cover depth: 4.5 m, except under special circumstances and with the City Engineer's approval.

Pump services shall be used on low side where maximum cover would be exceeded.

2.14 Manholes

2.14.1 Manholes are required at the following locations:

- Every change of pipe size.
- Every change in grade, except as indicated in the Curved Sewers section.
- Every change in direction, except as indicated in the Curved Sewers section.
- Upstream and downstream end of curvilinear sewer mains.
- Every pipe intersection except for 100 mm and 150 mm service connections (see Section 2.16).
- Upstream end of every sewer line.
- Every future pipe intersection.
- All terminal ends, except as noted in section 2.14.3.
- 150 m maximum spacing.

Sanitary manhole rim elevation shall not be located in a low point that may be subject to ponding or storm water infiltration and shall be designed to be:

- Above the adjacent storm manhole rim and catch basin elevations.
- Above the surrounding ground elevation when the manhole is located off road to prevent inflow from ponding.

2.14.2 Hydraulic Details

Crown elevations of inlet sewers not lower than crown elevation of outlet sewer. When connecting a collector sewer main to a trunk sewer 300 mm or greater, the invert of the collector main must not connect lower than 0.75D (¾ of the pipe diameter).

Minimum drop in invert elevations across manholes:

- Straight run: 10 mm drop
- Deflections up to 45-degrees:-25 mm drop
- Deflections 45 to 90-degrees: 50 mm drop.

Drop manhole and ramp structures should be avoided where possible by steepening inlet sewers. Where necessary, provide drop structures as follows (table 2.14):

Table 2.14 Drop Structures

Invert Difference	Structure

Up to 0.45 m	Inside Ramp
0.45 to 0.90 m	Outside Ramp
Greater than 0.90 m	Outside Drop*
*Inside drop may be used if specifically approved by the City Engineer.	

Drop manholes and outside ramps must be installed in accordance with standard drawings.

The maximum deflection angle created in a junction is 90°.

Force main discharges should be directed into the receiving manhole outflow pipe. Manhole benching should be extended a minimum 200 mm above the force main crown. If a manhole drop cannot be avoided, an inside drop pipe is required as approved by City Engineer.

2.14.3 Temporary Clean-Outs

Temporary clean-outs may be provided at terminal sections of a main provided that all of the following conditions are met:

- Future extension of the main is proposed or anticipated within 3-years.
- The length of sewer to the downstream manhole does not exceed 45.0 m.
- The depth of the pipe does not exceed 2.0 m at the terminal point.

2.15 Odour Control

Odour control shall be considered in all sanitary sewer systems designs. Of particular importance are areas where sewage has the potential to go septic. This typically occurs within pump station wet wells or sanitary force mains where sewage age exceeds 4 hours. Once the sewage has gone septic odours can be released not only from the pump station but also from the air release valves on sanitary force mains and the discharge manhole. In this situation odour gasses can be released and cause a significant public nuisance. Hydrogen sulphide is also toxic and explosive and can pose a risk to human health.

By properly designing a sewer system, odours can be reduced and where they can't be avoided technologies exist to reduce or eliminate odour and dangerous gases.

The following criteria must be met in all sanitary sewer systems

- Dissolved sulphide maximum limit at any point in the system is to be 0.5 mg/l.
- Odour Criteria:
    - At 10 m from any gravity main, force main, manhole and lift station or other sewer facility (summer conditions, winds between 2-10 km/h), 1.0 odour units.
    - Where sewer facilities are close to houses, parks or walkways, 0.0 odour units.
- Analysis for odour and sulphides may be required.

- Odour Control provision shall be designed to accommodate both at 25% buildout and at 100% buildout.
- All lift station designs to include odour control or the provision for future odour control facilities.

When selecting the appropriate odour control technologies, the designer shall consider operating variables such as flow rates, power and consumables. It should be recognized that estimating the pre-treatment hydrogen sulfide gas concentrations is critical in evaluating the various technologies. All Odour Control treatment designs to be approved by the City Engineer.

2.16 Service Connections

Every legal lot and each unit of a residential duplex shall be provided with a separate service connection.

Lots are allowed one service connection per property. In special circumstances where the servicing of all buildings on existing Industrial or Commercial properties is not feasible, two services may be permitted if authorized by the City Engineer.

Service connections shall not be extended at an angle that exceeds 45° from perpendicular to the main, and in no case shall a service connection be placed so that it extends in front of any property other than the one being serviced.

Unless otherwise approved by the City Engineer, connections are to service all plumbing by gravity. Building elevations should be established accordingly. Pumped connections may be permitted if approved by the City Engineer prior to sewer design. Pumped connections shall be considered as an option to eliminate mains in rear yard rights-of-way.

2.16.1 Size

- Pipe size is to accommodate peak design flow.
- Minimum pipe size is 100 mm diameter for residential services and 150 mm for all other services.

2.16.2 Location and Depth

Connections to large lots are to be located at the lower portion of each lot. For urban developments, locate connections in accordance with standard drawings. Service connections must be installed at least 0.5 m horizontally from the water service and a minimum of 1.5 m from any side lot line.

Service connections shall not be extended at an angle that exceeds 45° from perpendicular to the main, and in no case shall a service connection be placed so that it extends in front of any property other than the one being serviced.

The minimum depth of a service at the property line must be 1.5 m provided that gravity service to the Minimum Building Elevation is available.

2.16.3 Grade

Minimum grade from property line to sewer main:

- 100 mm diameter pipe: 2.0%

- 150 mm diameter pipe: 1.0%
- Larger sizes: Grade based on minimum velocity of 0.75 m/s.

2.16.4 Details

Use standard wye fittings for connections to new mains. For connections to existing mains, use wye saddles or, where approved by the City Engineer, insertable tees may be used. The service connection centreline must not be below the sewer main centreline.

Service connections may be permitted into manholes provided:

- The connection is not oriented against the flow in the main.
- The connection enters the manhole so the service invert is no lower than the sewer main crown.
- Manhole hydraulic requirements are met.

Inspection chambers (IC) are required for all service connections unless the service is less than 2.5 m long and ties into a manhole. Service boxes are to be installed on every inspection chamber.

Inspection manholes are required on all industrial connections. Inspection manholes will be required for commercial connections at the discretion of the City Engineer. Inspection manholes shall be installed on private property as close to property line as practical to allow for access by the City.

Manholes are required at the main on service connections in accordance with standard drawing.

The maximum length of any service connection is 30 m. Connections exceeding 30 m in length will be treated as mains.

2.17Locations and Corridors

Sanitary sewers to be located within roadways, preferably along the centerline, as shown in the applicable standard road cross-section drawings. Manhole covers to be located outside of wheel path.

For curved roads and alignments, where approved by the City Engineer, pipe alignment to be at a parallel offset with an established road right-of-way or property line.

Servicing from roadways is required unless a depth of greater than 4.5 m would be required to provide gravity service. Rear yard sewers are to be avoided, and advance approval is required from the City Engineer.

Where the main may exceed 4.5 m depth of cover to provide a gravity service, the City Engineer may permit a design based on sewer pumps. Ideally, main floors should be designed for gravity service.

Where a sewer crosses private land, right-of-way requirements are as indicated in Section 0.3 - Utility Rights-of-Way.

Clearance from water mains as detailed in General Design Considerations Section 0.4.

Common trench with storm sewer per General Design Considerations Section 0.4, may be approved at the discretion of the City Engineer.

2.18 Lift Stations

The use of sanitary lift stations is to be discouraged. Any proposed use of lift stations must receive prior approval from the City Engineer. Sanitary lift stations should normally be located within a right-of-way outside the required road dedication.

This section covers both dry well and submersible sewage lift stations. Larger capacity sewage lift stations or lift stations with special design or siting requirements may require additional assessment and review of criteria.

Preliminary design must be approved by the City Engineer before detailed design proceeds.

2.18.1 Preliminary Design Requirements

System layout: Select location(s) to minimize the number of sewage lift stations and avoid lift stations wherever practical.

Capacity: The lift station must be designed to handle the ultimate flows of the designated catchment. Design must consider short, intermediate and long-term future flows.

Location and Layout: The location and layout of a lift station must include an assessment of the following basic design considerations:

- Type of station and impact on neighbours.
- Construction dewatering requirements.
- Access for construction.
- Access for maintenance.
- Aesthetics, noise, odour control and landscaping requirements.
- Security against vandalism and theft.
- Flood elevations. Station uplift design must be based on maximum load level.
- Proximity of receiving sewers, water mains, and adequate power supply.
- Minimizing energy requirements.
- Standby power and its compatibility.
- Soils. Geotechnical investigations must be undertaken prior to site approval.
- Convenience of operation and maintenance.
- Safety for operators and public.
- Capital and operation and maintenance costs.
- Radio Path assessment on existing and proposed building line of sight.
- Off street Parking (5 m x 7 m) shall be provided for pump maintenance.
- Fenced perimeter with 1.8 m high black chain link fencing. Fencing to MMCD standards.

- Above ground valve chamber with no ladder or platform requirement for maintenance access.

2.18.2 Design Features

Lift stations should be designed with a minimum of two pumps, each capable of handling the maximum flow condition. A mixer should be provided, or one pump equipped with an automatic flush valve.

Where the design flow exceeds the capacity of a single, commonly available pump, use three or more pumps with capacities such that there is always one pump available for standby.

(1) Pump requirements:

- Capable of passing solids up to 75 mm in size.
- Equipped with appropriately rated stainless steel chain and connecting rings.
- Equipped with hour meters.
- Easily removed for maintenance.
- Maximum motor speed: 1750 RPM.
- Explosion proof.
- Operate on a 347/600 volt electrical source (pump motors between 5 hp and 75 hp (max) and to be 600 volt 3 phase type).
- Able to operate alternately and independently of each other.
- Able to meet maximum flow condition with one pump in failure mode.
- Designed so that each motor does not cycle more than 4 times in one hour under normal operating conditions. For example, in a duplex pump station that is designed to alternate the pump starts, each motor can have a maximum of 4 starts in an hour which could result in a total of 8 motor starts per hour for this station.
- All pumps must be factory tested prior to installation.
- Wet well storage shall be sized assuming pump is fully submersed and will accommodate design flow with no storage in the pipe network.
- All internal piping and fittings shall be 316 stainless steel (Victaulic style) as per Approved Products List.
- Pump start water level to be set above the top of the pump casing to prevent buildup on pump and reduce level monitoring issues.

(2) Motor cables, power cables, etc., must be continuous from within the pump station to within the kiosk unless an adequate exterior pull pit and junction box is installed.

(3) Levels to be controlled by ultrasonic level transmitter with emergency high and low level balls. A radar level transmitter is required when lift station service is in an area that produces large amounts of "foam" or "steam" e.g. a laundry facility. Level transmitters to be accessible at the top of the wet well to be serviced without entering into the lift station.

(4) All auxiliary equipment and control panels must be mounted in a suitable kiosk adjacent to the station. The kiosk must be located a minimum of 3.0 m from the station lid.

(5) The control kiosk must be designed to contain all control and telemetry equipment on the front panel and all power equipment on the rear panel.

(6) Check valves must be ball lift check valves. All valving to be installed in an above ground kiosk.

(7) All stations require an explosion-proof exhaust fan which can be activated by manual switch, and which meets WCB requirements for ventilation in a confined space.

(8) The entrances to all stations must be waterproof and be provided with a suitable lock. The access must be a minimum 900 mm x 900 mm in size. The access hatch shall have:

- An aluminum ¼" tread plate
- A perimeter drain
- A perimeter sealing gasket
- A slam lock with an aluminum removable sealing plug and opening tool
- A flush lift handle
- A gas spring assist cylinder
- A 90-degree hold open arm
- A flush fitting padlock tang.

The hatch must be reinforced for 1465 kgs/m² (300 lbs./sq.ft.). All fasteners to be made of 316 stainless steel.

The entrance must be above ground level where feasible but, in no case, more than 300 mm above the ground.

(9) All wiring must be explosion-proof, Class 1, Division 2, and electrical design and installation is subject to the acceptance of the Provincial Safety Inspector. Metal stations must be protected by impressed current cathodic protection.

(11) All stations must provide an automatic generator for standby power in case of power failure. Provision for a telemetry system must be included for connection into the Municipality's Telemetry System. For small lift stations with an ultimate capacity less than 100 units, emergency storage may

be considered in place of standby power; emergency storage is to be based on 8 hours of average day flows.

(12) All equipment must be CSA approved and have at least a one year guarantee for parts and labour.

(13) Designer is to provide three copies of Operating and Maintenance Manuals (see Section 0.8).

(14) Wet well to have above ground valve chamber that houses the ball check and isolation plug valves for each pump as well as the air relief valve and flow meter. Valve chamber to have at a minimum 50 mm of insulation, 1000W intrinsically safe baseboard heater, door seals, floor drain back to the wet well with p-trap and the air relief drain ports piped to the Valve Chamber floor drain. A plug valve is required on the influent line and on each pump discharge. The valves must be outside the station and be complete with square operating nut and nelson box. Gear box on plug valves in the ground to be designed for submersion.

Mixer to be provided only when required for the purposes of odour control (no automatic flush valves).

(15) If a lift station is authorized, by the City Engineer, to be constructed in an area that may be subject to vehicle loads, the roof and cover of the pump station should be designed to withstand a loading of H-20 (highways standard). Roof design to also allow for fall arrest assembly on the roof (2X's the max arresting force, typically 1800 lbs).

(16) Provision(s) must be made for standby pumping from an external source. An adaptor flange ("Kamlock") complete with a quick coupling and lockable cap will be required.

(17) The area around the station and all associated equipment or building must be asphalted. The size of the area to be determined by the requirements for maintenance.

(18) Stations to be fiberglass unless otherwise approved by the City Engineer The surfaces of all steel components and fibreglass stations must receive at least two coats of two component white epoxy enamel. Concrete wet wells are discouraged but where approved, must be designed and constructed to prevent sulphide corrosion, and the concrete surface must be coated with at least 2 coats of blue epoxy and then an additional 2 coats of white epoxy. All steel piping and components to be 316 stainless steel.

(19) The wet well bottom must be sloped to direct all solids into the pump suction. The influent line must be located tangent to the wet well to encourage scouring of the wet well.

(20) The station shall be complete with an Uninterruptable Power Supply (UPS) to serve all alarms and controls.

(21) Separate starter enclosures must be provided for each pump.

(22) PLC control to be based on City of Kelowna standards.

(23) Station communication to be provided via radio transmission compliant with the City's telemetry system, and an antenna must be installed on a suitable mast or pole to ensure reliable transmission.

(24) An hour meter must be built into the panel for each pump.

(25) An amp meter must be provided for each pump.

(26) Minimum storage between the high level alarm and the start of overflow under the more critical of:

- Minimum 1 hour in wet well at average wet weather flow.
- Minimum 1 hour in wet well and influent pipes at peak wet weather flow.

Ensure operating level is above the top of the pumps to keep the pumps submerged (Minimum 1 m separation between the inlet pipe invert and pump stop level).

(27) Station to have a magnetic flow meter located in above ground valve chamber.

(28) Station to allow removal of pumps using hoist truck with 1.8 m (6') boom.

(29) Perimeter fencing is to be provided. The fence must be made of black chain link and installed with privacy slats. Fence to be minimum 1.8 m high with minimum 5 m wide opening for vac truck access.

(30) Landscaping, acceptable to the City, is to be provided including irrigation.

(31) Noise control may be required when criteria in Section 2.16 is exceeded.

(32) Odour control may be required when criteria in Section 2.17 is exceeded.

(33) Minimum barrel size must be 2440 mm (8') in diameter.

2.19 Force Main

As part of the lift station design, the following criteria must be noted in the design of force main systems: Design computations for force mains must be made using a 'C' factor of 120 (for PVC pipe) and then re-calculating the system curve using a 'C' factor of 145 to ensure adequate motor horsepower and pump characteristics. Show pump and system curves on design drawings.

2.19.1 Velocity

At the lowest pump delivery rate anticipated to occur at least once per day, a minimum cleansing velocity of 0.75 m/sec should be maintained. Maximum velocity should not exceed 4.0 m/s.

2.19.2 Air Relief Valve

An automatic air relief valve must be placed at high points in the force main to prevent air locking when the difference in elevation between the invert of the summit and the invert of the valley is greater than the diameter of the pipe. The air relief valve must be located in a chamber, complete with adequate and environmentally safe drainage and odour control, unless a suitable injected odour control agent is used at the Lift Station. Air valve must be vented and drained into the gravity sanitary sewer system at a manhole, where possible.

2.19.3 Termination

Force mains should enter the gravity sewer system so that the force main invert is not more than 200 mm above the crown of the pipe in the receiving manhole. A smooth, turbulent free transition must be incorporated. If the receiving manhole design does not allow this, then a manhole drop structure in accordance with the standard drawings is required.

2.19.4 Size

The minimum size for force mains is 100 mm diameter.

2.19.5 Materials

Force mains must generally meet the standards specified for water mains and in accordance with Schedule 5, however there are specific requirements for force mains that may supersede water main standards, as follows:

- Force main pipe must be identifiably different than water main pipe. Refer to supplemental specifications 5.1 Section 33 34 01S.
- Valves used on force mains, pigging ports or cleanouts shall be lubricated full port plug valves size on size sufficient for long term use in a corrosive environment. Plug valve gear boxes installed in the ground must be designed for submersion conditions.

2.19.6 Loads and Transient Pressures

All force mains must be designed to prevent damage from superimposed loads. Must also be designed to prevent damage from water hammer or column separation phenomena. Transient surge and cyclic surge analysis must provide at least a 75-year life of the pipe.

2.19.7 Corrosion and Odour

Corrosion and odour control is required when limited daytime flows, or long force main lengths cause the pumped sewage to remain in the force main for longer than 45 minutes.

2.19.8 Pigging Port

A "size on size" pigging port that is convenient for the City Operations to use and maintain must be incorporated in the force main outside of the Lift Station.

2.20 Noise Control

Noise levels for facilities must not exceed 65 dB at property line or 20 m away whichever is closer.

2.21On-site Sewage Disposal (Septic systems)

On-site sewage disposal systems will only be considered for properties that are:

- Not near or adjacent to the City's sanitary sewer system, and
- Greater than 1 ha in size.

Where permitted, site conditions and on-site sewage disposal systems shall meet the BC Public Health Act "Sewerage System Regulation" and Ministry of Health Special Conditions for placing septic systems with Environmental Control Zones. The City Engineer' approval is required for on-site sewage disposal systems.

2.22Low Pressure Sewers

Low pressure sanitary sewer systems servicing a group of properties is discouraged and requires approval from the City Engineer. Preliminary design must be approved by the City Engineer before detailed design proceeds.

BL8847 replaced Part 3 Drainage

DESIGN STANDARDS
3. DRAINAGE

3. Drainage

3.1 Run-Off Analysis

This section describes the methods acceptable to the City of Kelowna for use in the determination of the rate and amount of stormwater run-off for the design of storm drainage conveyance and storage facilities.

Hydrologic aspects of urban drainage (peak flows, volume and durations) directly affect the success of the design. Errors in analysis may result in under designing of facilities, oversizing them and incurring unnecessary expenditures, or both. In the interest of the public good, a conservative approach to all designs is warranted.

The hydrologic criteria needed to calculate basin runoff are rainfall, soil types, vegetation and ground cover, extent of development and land slope and shape. It is expected that the design consultant will use criteria that is justifiable for the location of the development.

Application of computer simulation models is recommended for all analysis and detailed design, however, the rational method may be used for pre-design analysis and for detailed design of minor systems with contributing areas less than 10 ha.

Rational Method

The Rational Method may be used for pre-design system analysis and for detailed design of minor system components with contributing areas less than 10 ha. The Rational Method shall not be used for the design of major system components or storage facilities.

The Rational Formula is expressed as:

$$Q = CIA/360$$

where; Q = peak runoff, m^3/s

C = runoff coefficient
A = area, hectares
I = rainfall intensity, mm/hr

Runoff Coefficient, (C).

C values should be established based on the proposed land uses, proposed developments and hydrogeological information. Calculations and justification for the determination of C values are to accompany development submissions. Developers and consultants are encouraged to look for ways to reduce the amount of Effective Impervious Area within their developments to reduce the amount of runoff generated and the costs associated with stormwater infrastructure. "Default" C values, as shown on Table 1 can also be used.

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

$$C_{avg} = \frac{\Sigma\ A_i C_i}{A}$$

where; A_i is the area with the same type of land use correlated to run-off coefficient R_i, and A is the sum total of all areas, A_i.

Rainfall Intensity, (I).

The value of the design rainfall intensity (I) for the Rational Formula is selected from the appropriate Intensity Duration Frequency (IDF) curve, with a duration chosen to coincide with the Time of Concentration. The Time of Concentration is the time required for run-off flow to become established and reach the design location from the furthest point within the contributing basin.

Time of concentration is the sum of two components, the "inlet time" and the "travel time".

The inlet time is the overland flow time for run-off to enter the conveyance system. It varies with size of the catchment area and surface imperviousness. In developed urban areas where paved surfaces drain directly to catch basins, an inlet time of 10 minutes shall be utilized for assessment of 5 year and smaller design storms. Inlet times for higher intensity design storm events are as follows:

Event	Inlet Time (min.)
5	10
10	9
25	8
50	7
100	5

For inlet times in rural areas, the overland flow time must be calculated using appropriate formulas.

The travel time is the length of time required for flow to travel within the conveyance system from the point of inflow to the location being analyzed.

Rainfall

Standard Drawing SS-S56 shows the rainfall intensity-duration-frequency (IDF) curve for the City of Kelowna which was developed from the Atmospheric Environment Service recording station located at the Kelowna International Airport. The IDF curve in tabular format up to one hour duration is show on Table 2. Design Storm Hyetographs are shown on Table 3.

Computer Simulation of Run-off

All minor storm drainage components draining areas larger than 10 ha. and all major storm drainage systems and storage facilities must be designed using computer modelling techniques. The selection and the proper application of computer models is the responsibility of the Developer and the

Consultant. It is necessary to utilize computer models which have the capability to generate hydrographs and which can route these hydrographs through a network of open channels, conduits and storage facilities showing volumes, hydraulic grade lines, the ability to simulate the minor and major system and their interrelation and the ability to simulate submerged and/or surcharged conditions.

3.2 MINOR SYSTEM DESIGN

An urbanized area will have two separate and distinct drainage systems, whether these systems are planned and designed or not. The "minor system" includes street gutters, catch basin inlets and the network of underground pipes and facilities associated with the collection, conveyance and water quality treatment of minor, or frequently occurring rainfall events.

Service Level

The storm mains shall be designed for free-flow conditions for the 1:5 year storm (the rainfall that has a 20% probability of occurrence in any given year). The interception capacity of the system of street gutters and catch basins must be compatible with the design capacity of the storm mains.

Streets, Gutters and Ditches

Urban Cross-Sections

The flooding depths for a 1:5 year storm, which will be permitted on streets, while the streets are acting as part of the minor drainage system, are as follows:

- There shall be no curb overtopping.
- Maximum depth of ponding at sag locations or inlets will be 150 mm.
- On local roads, the flow may spread to the crown except where curb over-topping will occur.
- On collector roads, the flow spread must leave one lane or a road surface equivalent free of water to ensure access for emergency vehicles (fire, ambulance).
- On arterial roads, the flow spread must leave one lane in each direction free of water.

Flow across urban road intersections shall not be permitted for storms with a return frequency of 5 years or less.

Rural Cross-Sections

Rural roads, gravel or paved, shall be constructed with swales or ditches that ensure adequate road subgrade drainage (in compliance with standard road design). Where ditching for minor drainage is provided, ditch design shall consider the following:

- Rip-rap as necessary to eliminate incising and erosion.
- Freeboard of 0.3 m.
- Free surface elevations permitting agricultural tile drainage where required.
- Stable side slopes.

- Road subgrade.

Catch Basins

To ensure that the capture or inlet capacity matches the storm main capacity, the spacing of catch basins on streets may be varied; however, they shall generally meet the following criteria:

- Spacing

    - Road grades less or equal to 3%, space 150 m maximum or 675 m^2 of paved area.
    - Road grades greater than 3%, space 100 m maximum or 450 m^2 of total area.

- Space catch basins to ensure no overflows to driveways, boulevards, sidewalks, or private property.
- Space at intersection so as not to interfere with cross walks.
- Side inlet catch basins are required for all curbed roads.

All catch basin leads are to be a minimum diameter of 200 mm and sized to convey the design inlet capacity.

All catch basin leads are to discharge into a manhole.

Storm Mains

Capacity

Hydraulic capacity shall be calculated using Manning's formula. A roughness coefficient of 0.013 shall be used for concrete and 0.011 shall be used for smooth plastic pipe.

Velocity

Minimum velocity shall be 0.75 m/s at the design flow rate.

Minimum Sizes

250 mmø

Location, Alignment and Grade

Storm mains must be located within the road right-of-way as noted in the applicable Standard Drawing Typical Cross-Section for that road.

When the storm main is required to cross private land(s), the right-of-way must be a minimum of 4.5 m wide, however, the width must be suitable to accommodate excavations based on WCB regulations for side slopes.

When a storm main is located within a statutory right-of-way and appurtenances which require maintenance are located within the right-of-way, the landowner/developer must ensure that maintenance access is available. For large structures or structures requiring an enhanced maintenance level such as oil/sediment chambers, control structures and pond inlet/outlet chambers, an access route adequate to support the maintenance vehicles is to be provided. The surface of the route may be gravel, pavers or asphalt depending on the location and the context of the site.

Depth of Cover

Provide 1.2 m in travelled areas and 1.0 m otherwise. However, these minimum's are to be used only when conflicts with other utilities will not occur and all upstream catchment areas are serviceable by gravity.

For Catch basin leads 0.9 m minimum cover shall be used. If 0.9 m is not available, design to protect from freezing and traffic loads, design calculations must be provided.

Curvilinear Mains

If horizontal or vertical curves are used to maintain a constant offset, the radius of the curve is to be no less than 1.5 times the recommended manufacturer's minimum radius of curvature. The design velocity must exceed 0.91 m/sec. and the curve midpoint and two quarter points are to be located by survey and shown on the as-constructed drawings with an elevation and offset of the invert at each point.

Manholes

Storm manhole spacing is to be related to pipe main size as follows:

250 and 300 mm diameter - 135 m maximum spacing;
over 300 mm to 600 mm diameter - 120 m maximum spacing, and
over 600 mm diameter - 100 m maximum spacing.

Manholes are required at:

- all grade or alignment changes (except curved sections)
- pipe size changes
- all intersecting mains
- all upstream ends of mains
- upstream and downstream end of all curvilinear mains unless a constant offset is maintained from the curb
- all catch basin connections
- outfalls to the major system (i.e. creeks, channels, lake) in order to isolate the upstream main to facilitate cleaning. The manhole is to be located as close as possible to the point of discharge.

Manhole sizing shall be in accordance with City of Kelowna supplemental "Standard Detail Drawing SS-S1a".

To ensure manhole construction will not cause a loss in hydraulic capacity, the design gradient shall be continuous through the manhole; otherwise, where the inlet is not at 180^{o} to the outlet, a minimum drop of 30 mm shall be provided;

BL10640 added the following:
Placement of manholes in existing or future wheel paths is to be avoided.

Ground Water Recharge Systems

To promote interception of pollutants and reduction in downstream impacts, ground water recharge systems must be utilized to the maximum extent possible as determined by a qualified professional experienced in this field.

Mains may be sized according to the required capacity taking 50% or the groundwater recharge capability into consideration. The groundwater recharge component must be calculated and justified by a qualified hydrogeologist/engineer experienced in this field. Minimum sizes of mains must still be utilized.

Storm Services

Minimum diameter of storm services shall be 100 mm.

Minimum Grades for storm sewer services shall be 2%.

Storm services to properties shall not be permitted from storm drains located in rights-of-way unless a clean-out is provided and the nature of the development will permit access to the right-of-way for inspection, maintenance and repair, as necessary.

Roof Leaders

Roof drainage leaders are to be connected to the storm service connection only where geotechnical requirements dictate the need. The evaluation of this requirement is to be included in the scope of the Hydrogeotechnical Study. Otherwise, roof leaders are to be directed to a splash pad for dispersal to the ground. Roof leaders shall not be directed onto driveways which drain directly onto city right-of-way or areas draining directly onto neighboring properties.

Foundation Perimeter Drains

Perimeter drains for buildings are required as per the British Columbia Building Code.

Foundation perimeter drains shall be connected by gravity via a storm service to the storm main provided that the elevation of the basement/crawlspace floor is at least 600 mm above the elevation of the storm main obvert, 600 mm above the anticipated or known high ground water table, or 600 mm above the 100 year hydraulic grade line within the main at that point, whichever is higher.

When the above provisions regarding the elevation of the storm main obvert or 100 year hydraulic grade line for gravity connection of foundation perimeter drains cannot be met, a backflow prevention device and sump pump system inside the building discharging to the storm main via a storm service shall be installed. A backwater or check valve and a siphon break must be installed in the sump pump discharge

line to prevent backflow into the basement. Discharge may be to the surface or a soak away pit, if geotechnical conditions permit.

As an alternative, the perimeter drains may be connected to a "Foundation Drainage Pipe". The "Foundation Drainage Pipe" is a small diameter pipe installed within the road right-of-way with connections from foundation perimeter drains only. This system will eliminate the potential of long term pumping due to fluctuations in groundwater table. Its point of discharge to the storm system shall be far enough downstream so that the basement floors it protects are 600 mm above the 1:100 year hydraulic grade line at the discharge point. In general, the design criteria will follow that as laid out in this document, however, minimum size is reduced to 150 mm.

Where hydrogeotechnical studies justify their use, dry wells or ground infiltration systems may be used as the storm water disposal method for connection of perimeter drains. These systems are to be designed and supervised by a Geotechnical Engineer.

Water Quality Treatment

Water quality treatment is required for frequently occurring events. All flows up to 50% of the 2-year (1 hour duration) post-development flow must be routed through some form of water quality treatment facility utilizing “best management practices” to remove suspended solids and floatables. The facility can be an in-ground structure which passes flow through or an above ground facility such as a treatment wetland. Wetlands can be incorporated into larger stormwater management facilities for the attenuation of large events. Allowable discharge criteria are identified in the City of Kelowna Sanitary Sewer/Storm Drain Regulation Bylaw number 6618-90.

Any form of water quality treatment must be designed to allow for future maintenance activities associated with the removal of the collected material and access to incoming and/or outgoing piping.

Lot Grading/Swales and Driveways

Lot grading shall be carried out in accordance with the BC Building Code, City Policy 265 and the following:

1. Swales shall have a minimum slope of 1 percent. Swales shall be lined with turf on a minimum 100mm topsoil or lined with a non-erodable hard surface. All such swales serving two or more parcels of property shall be designed to accommodate the anticipated flows and the right of way shall be sized accordingly (3.0 m minimum).

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

   - the drainage of the driveway serving the carport or garage is connected by gravity to a City storm sewer meeting the connection criteria, or

- is above the 100 year floodline, or

- the runoff water from the driveway may flow past the carport/garage without accumulating and entering. Properties utilizing this method must have an Engineer seal the design. All other relevant criteria of this document must also be met.

3.3 MAJOR SYSTEM DESIGN

Storm runoff generated by less frequent, higher intensity rainstorms may exceed the capacity of the minor system. Runoff from these events will pond in depressions and follow whatever overflow route is available. This network of ponding and overland flows is called the "major system". If the major system is properly planned, it can alleviate the potential inconvenience and property damage caused by large rainfall events.

MAJOR SYSTEM

The major system includes all drainage infrastructure which convey, detain, divert and intercept the 100 year design storm runoff. In general, all components of the major system must be designed to accommodate the flows generated by the upstream contributing area. The following section describes the major system provisions and technical requirements for use in planning and design of the major drainage system.

The depth of flooding permitted for the major event is as follows:

- For all classes of roads, the depth shall not exceed 0.3 m.

- One lane, or a 3.5 m width at the crown shall be free from flooding.

- Flooding is not permitted on private property

To meet the criteria for major storm runoff, sags or low points in roads or subdivisions must be designed with a safe overland outlet flow route.

Outfalls

Ministry of Environment approval is required on all storm water outfalls to natural watercourses or waterbodies.

Outfalls into lakes are to be constructed to have minimum bury according to the following:

- soft bottom, 0.6 metres to allow for seasonal sand erosion and deposition
- rock bottom, criteria to be confirmed by Coast Guard
- exposed pipes must be a minimum of 2.4 metres deep during lake "low water" to allow safe passage of deep keel vessels

Lake outfalls require approval from the Canadian Coast Guard.

Control Structures

Control structures, such as the one shown on Standard Drawing SS-S55 shall be used to provide consistent control for design storm flows of different return periods. These can be modified to include multi-stage inlets. For example, three orifices located vertically on a control structure are normally designed such that the lower, smaller orifice restricts frequent storms and the larger upper orifices control less frequent larger storms. Safe overflow must still be available above the highest orifice.

Considerations shall be given for the design of smaller sediment trap basins at the points of discharge to the detention/retention facilities. Normally, basin inlets shall be designed to provide sediment containment. Build up of sediment shall not restrict inflows and suitable designs shall be provided to allow ease of sediment removals.

BL10696 amended the following:

Culvert and Bridge Capacity

The following service levels are to be used for design:

Design Flood Frequency Road Class	Bridges, Culverts
Arterial and Collector	1:200 year flood
Local provision for overflow if on major channel	1:100 year storm plus

All culverts (or pipes with inlets or outlets), unless specified in table below, shall be constructed with headwalls & endwalls. The headwalls & endwalls shall be constructed with a free swinging, weighted grating. To protect against unauthorized entry, a locking mechanism which limits the range of movement of the grating is required.

Pipe & Culvert Table

Pipe Length	Pipe Diameter	Headwall	Endwall[2]	Grillage[1]	Reinforced Concrete Collar[2]
<20m	=<450mm				✓
<20m	>450mm	✓	✓	Inlet	
>20m	<450mm	✓	✓	Inlet	
>20m	=>450mm	✓	✓	Inlet & Outlet	
Any	=>450mm with intersections	✓	✓	Inlet & Outlet	

[1] Grillage, as per, MMCD S13
[2] Endwalls and collars, as per, MMCD S14 & S15.

Culverts (or pipes) discharging perpendicular to a watercourse may use alternatives methods to protect the end of pipe; provided, they are approved by the City Engineer.

Down Slope Cul-de-Sacs

Major flood routes must be provided on down slope cul-de-sacs.

Ground Recharge Systems

Ground recharge systems are not normally considered for major flood routing. However, given the soil conditions in the Kelowna area, geotechnical investigations may support the retention and ground infiltration of major events in some areas. Further details are provided in Section 4.

Ditch and Swale Construction

Velocity of flow in ditches and/or swales is not to exceed the limits given below for the various types of materials used as the conveyance surface.

Lining Materials	Maximum Permissible Velocity m/s
Fine sand	0.45
Fine gravel	0.75
Stiff clay	1.00

For velocities higher than the above maximums, the Rip Rap Design Chart Standard Drawing SS-S57 is to be used.

3.4 STORMWATER STORAGE

This section identifies the general design parameters and requirements that must be considered by development proponents in the planning and design of stormwater storage facilities.

Peak Flow Control

Control on peak flow rates and volumes in the City are necessary:

1. To minimize impacts on watercourses and downstream developments from flow increases which will result from land development, and

2. To maintain or lessen flows in watercourses so that creek channels and existing structures, such as bridges and culverts, will continue to operate without being flooded or damaged.

In consideration of the above, the City has the following objectives and requirements:

(a) Impact and expenditures to existing downstream users shall not be increased.

(b) Increases in peak storm flows and volumes to the watercourses and receiving waters shall be limited.

(c) The number of storage facilities shall be minimized. (Permanent detention will not be permitted under private ownership, unless incorporated on-site within a private development).

(d) Permanent storage facilities are to be owned and maintained by the City.

(e) Where land developments occur in advance of permanent detention facilities, the City may consider temporary storage facilities on an individual basis. Maintenance charges and responsibility for temporary storage facilities will be borne by the developer.

(f) Storage facilities may be surface or underground. Rooftop or parking lot storage may be considered, where appropriate.

(g) Private property owners are to indemnify the City from liability arising out of private facilities.

BASIS FOR DETAILED DESIGN
Level of Service

Developments near the lake and/or downstream of the Mill Creek diversion are required to provide water quality treatment for flows up to 50% of the 2 year event. Flows generated from rainfall events greater than this can be discharged directly to a receiving body of water provided the required minor and major systems exist and approval from the City of Kelowna and the Ministry of Environment is obtained.

Developments within other areas of the City of Kelowna are required to provide water quality treatment for flows up to 50% of the 2 year event and to provide storage up to the 100 year (plus 10% volumetric safety factor) event with a maximum outlet rate based upon the 5 year pre-development rate generated by the catchment area. The release rate is to be based upon the post-development outlet hydrograph mirroring the pre-development runoff hydrograph up to the 5 year level. Release rates not based on this criteria may be allowed by the City of Kelowna based on downstream conveyance system protection, stream protection, flood protection or water quality.

An overflow shall be provided to route any excess water to the designated one hundred year flood route. Such an overflow can be in the form of a spillway or may be incorporated in the flow control structure through oversizing of downstream pipes, provision of overflow pipes or such other arrangement as the designer may devise.

Geotechnical Considerations

Special geotechnical investigations to address issues related to the design of all stormwater management lakes and dry ponds are to be undertaken as part of the planning and design studies, and are a prerequisite to the final design of such facilities.

Wherever possible, the stormwater storage facility shall be excavated in natural, stable ground. Should topography dictate that a berm be constructed along one or more sides of the basin, the berm shall be designed by a qualified professional engineer registered to practice in the Province of British Columbia and with relevant training and experience.

Staged Construction - Standards for Interim Facilities

When stormwater management storage facilities are to be implemented in stages, the standards applicable to the design and construction of the interim facilities are to be generally in accordance with the standards set out herein for permanent facilities of that type. (e.g. Where an interim dry pond facility is proposed as a preliminary stage in the implementation of a stormwater lake, it shall be designed and constructed in accordance with the criteria and standards applicable to a permanent dry pond.)

DESIGN REQUIREMENTS COMMON TO

STORMWATER MANAGEMENT STORAGE FACILITIES

Land Dedication

Generally, the area of land covered by water when the basin is at the 5-year water level will be dedicated to the City. This dedication will also apply to all accesses to inlets/outlets, any structures and maintenance access routes to the facility.

Land that is adjacent to a basin which is subject to flooding as per the design standard established, but which is part of a privately owned developed parcel, will be required to carry rights-of-way, to allow for encroachment of water onto the affected land. The right-of-way documents shall be prepared by the development proponent, naming the City as grantee.

A restrictive covenant will be placed on lots abutting the facility to control lot development so as not to compromise design requirements at the HWL. This is to ensure an adequate freeboard is maintained.

Maintenance Access Requirements

An all-weather access for maintenance vehicles must be provided to all facility works. A vehicle access route shall also be provided to the edge of all SWM lakes suitable to carry maintenance vehicles and for use as a boat launch point. The access surface shall be a minimum of 4.5 m wide, shall extend into the

lake beyond the lake edge at normal water depth to a point where the normal water depth is 1.0 m, and shall be accessible from and extend to a public road. Sharp bends are to be avoided, and it shall have a straight run of 12 m or more leading to the lake edge (to permit a straight run in for launching of boats).

Emergency Overflow Provisions

The feasibility of an emergency overflow spillway is to be evaluated for each storage facility design and, where feasible, such provisions are to be incorporated in the facility design. The consultant is to identify the probable frequency of operation of the emergency spillway. Where provision of an emergency spillway or overflow route is found to be unfeasible, the design is to include an analysis of the impact of overtopping of the storage facility and the probable frequency of occurrence of overtopping. The functional requirements of the spillway, and the impact analysis for the absence of one, are to consider the possible consequences of blockage of the system outlet or overloading due to consecutive runoff events, such that the storage capacity of the facility may be partially or completely unavailable at the beginning of a runoff event.

Landscaping Requirements

Landscaping plans for areas bounding the facility shall be submitted as part of the Engineering Drawings. Landscaping of all proposed public lands included for purposes of the facility and of all proposed rights-of-way on proposed private property up to the design high water level, is to be part of the lake construction requirement and be dependant on the location and the context of the facility. The requirement for landscaping may be irrigated turf, constructed to the satisfaction of the Parks Department.

Sediment Removal Provisions

The facility design shall incorporate the ability for sediment capture and efficient removal for the control of solids which may be washed to the facility.

Maintenance and Service Manual

As part of the responsibility for design of a stormwater management storage facility the development proponent shall prepare and provide a maintenance and service manual for the facility.

Six complete copies of the manual are to be provided to the City of Kelowna prior to the time when the operation responsibility of the facility is transferred to the City of Kelowna, which will generally be at the time of substantial completion. The manual shall include complete equipment manufacturer's operation, maintenance, service and repair instructions, and complete parts lists for any mechanized or electrical equipment incorporated in the design.

The manual is to include, at a minimum, the following information:

(a) A copy of the approved Engineering Drawings relating to the Stormwater Storage Facility and appurtenances, updated to "As-Constructed".

(b) Schematic diagrams of the inlet and outlet arrangements, connections to and arrangement of upstream and downstream systems, including all controls, shutoff valves, bypasses, overflows, and any other operation or control features.

(c) Location plans for all operating devices and controls, access points and routes, planned overflow routes, or likely point of overlapping in the case of exceedance of the design containment volume.

(d) Stage Discharge Curves with clear relationships of the stages relative to surrounding features.

Signage for Safety

The design for SWM Facilities shall include the installation of signage to warn of anticipated water level fluctuations, with demarcation of maximum water levels to be expected for design conditions. Warning signs will be provided and installed by the development proponent.

Engineering Drawing Requirements

The engineering drawings for any SWM Facility are to include the following information, in addition to the physical dimensions:

(a) Stage-Volume and Stage-Area Curves;
(b) elevations at Normal Water Level (NWL), 5 Year Level and High Water Level (HWL);
(c) volumes at NWL, 5 year Level and HWL;
(d) freeboard elevation;
(e) notation indicating the lowest allowable building elevation for lots abutting the lake;
(f) contributing basin size (ha);
(g) measurements to locate submerged inlet(s), outlet(s) and sediment traps referenced to identifiable, permanent features which are not submerged at NWL.

DESIGN DETAILS FOR STORMWATER MANAGEMENT LAKES (WET PONDS)

Side Slopes

Areas normally or infrequently covered by water, from the design high water level down to a point 1.0 m below the normal water level shall have a maximum slope of 5 (horizontal) to 1 (vertical).

A slope of 3 (horizontal) to 1 (vertical) may be required from the 1.0 m depth point (below normal water level) to the pond bottom. The requirement for maximized slopes below water is an attempt to discourage the growth of unwanted vegetation.

In the case of constructed wetlands, benched areas above and below the NWL to encourage growth of aquatic and riparian plants is desirable.

Lake Bottom Material

For areas where the groundwater table is below the NWL, the lake bottom and side slopes are to be composed of impervious material with a suitably low permeability (e.g. with a permeability coefficient in the order of 1×10^{-6} cm/s).

For areas where the groundwater table is expected to be near or above the NWL, the lake bottom may be of a pervious material as dictated by geotechnical considerations.

Circulation Requirements

Narrow or dead bay areas where floating debris may accumulate are to be avoided. Inlets and outlets should be located with consideration of the need to maximize detention time and circulation within the lake water body.

The length of the wet pond relative to the width should not be less than 3:1 or greater than 6:1 so as to promote natural water circulation and avoid water quality deterioration associated with stagnant reaches within the facility.

Outflow Control Works

The outlet from a stormwater management storage system must incorporate appropriate means for control of outflow. In addition, the outlet works must include provisions for operational flexibility, and to address unintentional blockage of the outlet and the possible need to either stop outflow or increase the rate of outflow.

Drawdown Provisions

The means should be provided to permit discharge from storage facilities at the maximum rate of flow which the downstream system can accommodate after storm runoff peak flows have passed and the flows from other contributing areas have decreased or ended. The rate of discharge to be provided for drawdown purposes is to be sufficient to restore availability of storage capacity of facilities sufficiently to accommodate subsequent runoff events within a reasonable time frame. To achieve this purpose, drawdown of facilities is to be possible at rates to satisfy the following relationship of available volume to the time from commencing drawdown with the facility at the design high level.

Time After Commencing Drawdown From Full Level	Available Volume Required Below Design Full Level
24 hours	Volume equivalent of 1 in 10 year run-off
72 hours	100% of total storage volume

Submergence of Inlets and Outlets

Inlets and outlets are to be fully submerged, with the crown of the pipe at least 0.5 m below normal water level. Inlet and outlet pipe inverts are to be a minimum 0.1 m above the lake bottom.

Provision for Free Outfall from Inlets to Lakes

The invert elevation at the first manhole upstream from the lake in a minor system shall be at or above the normal water level of the lake to avoid deposition of sediments in the inlet pipe. To avoid backwater effects on the upstream sewers leading to the lake, the obvert of the inlet sewer at the first manhole upstream from the lake shall be at or above the lake level for the 1 in 5 year storm. A drop structure upstream from the lake will generally be required to achieve this. "Inlet" and "outlet" control calculations are required to verify the mode of operation of the lake inlets.

Provisions for Lowering the Lake Level

The provision of the means to drain the lake completely by gravity drainage is desirable. The incorporation of this provision with the outlet control bypass should be considered. Where a gravity drain is not feasible, provisions are to be made in association with the outlet works or otherwise, so that mobile pumping equipment may be installed and used to drain the lake.

Lake Edge Treatment

Edge treatment or shore protection is required and shall be compatible with the adjacent land use. The treatment used shall meet criteria for low maintenance, safety, and ease of access to the waters edge.

The edge treatment is to cover ground surfaces exposed or covered by water during a lake level fluctuation to 0.3 m below or above the normal water elevation, and shall be adequate to prevent erosion of the lake edge due to wave action. The typical acceptable edge treatment shall be, but is not limited to, a 250 mm deep layer of well graded washed rock with a 75 mm minimum size or vegetated strip consisting of hardy materials suitable for this application.

The proposal of variations to the edge treatment minimum is encouraged. The final selection of edge treatment being subject to the approval of the City.

DESIGN STANDARDS FOR DRY PONDS

Outflow Control Works

The outlet from a stormwater management storage system must incorporate appropriate means for control of outflow. In addition, the outlet works must include provisions for operational flexibility, and to address unintentional blockage of the outlet and the possible need to either stop outflow or increase the rate of outflow.

Drawdown Provisions

The means should be provided to permit discharge from storage facilities at the maximum rate of flow which the downstream system can accommodate after storm runoff peak flows have passed and the flows from other contributing areas have decreased or ended. The rate of discharge to be provided for drawdown purposes is to be sufficient to restore availability of storage capacity of facilities sufficiently to accommodate subsequent runoff events within a reasonable time frame. To achieve this purpose, drawdown of facilities is to be possible at rates to satisfy the following relationship of available volume to the time from commencing drawdown with the facility at the design high level.

Time After Commencing Drawdown From Full Level	Available Volume Required Below Design Full Level
24 hours	Volume equivalent of 1 in 10 year run-off
72 hours	100% of total storage volume

Frequency of Operation

All dry ponds shall be designed to temporarily detain excess runoff and thereby reduce the peak outflow rates to the connected downstream system. They shall not detain runoff for storms with post-development return periods of less than 2 years except where special provisions are made to facilitate clean up (i.e. paved bottom areas, etc.).

Depth of Ponding

The maximum live storage limit in a dry pond is 3.0 m, as measured from the invert elevation of the outlet pipe.

Dry Pond Bottom Grading and Drainage

The dry pond shall be graded to properly drain all areas after its operation. The dry pond bottom shall have a slope of 1.0% or greater. Sub-surface drains or similar means may be required where it is anticipated that these slopes will not properly drain the dry pond bottom, or where dictated by multiple use or other special considerations.

Side Slopes

25% of the side slopes subject to inundation upon filling of the dry pond shall have a maximum slope of 5 (horizontal) to 1 (vertical). An alternate method of egress (eg stairs) may be required in steep areas.

Safety Provisions at Inlets and Outlets

All inlet and outlet structures associated with dry ponds shall have grates provided over their openings to restrict access and prevent entry into sewers by children or other persons. A maximum clear bar spacing of 0.15 m shall be used for gratings.

Grated outlet structures are to be designed with a hydraulic capacity of at least twice the required capacity to allow for possible plugging. Further, the arrangement of the structures and the location of the grating shall be such that the velocity of the flow passing through the grating will not exceed 1.0 m/s. Appropriate fencing and guard-rails are to be provided to restrict access and reduce the hazard presented by the structure headwalls and wingwalls.

Other Considerations

An on-stream dry pond may be constructed upstream of a road crossing as long as geotechnical evaluations conclude that construction is appropriate. Facilities must be constructed to allow overtopping without causing undue erosion or damage. All facilities on fish bearing streams shall be designed to pass fish.

DESIGN STANDARDS FOR INFILTRATION BASINS

Outlet Design

Infiltration basins do not have a formal outlet structure. As such, the storage volume must be based upon the complete runoff generated by the 1:100 year storm with no provision for outlet during the event, plus a 50% safety factor.

Depth of Ponding

The maximum live storage limit in a basin is 3.0 m.

Side Slopes

Side slopes subject to inundation upon filling of the basin shall have a maximum slope of 5 (horizontal) to 1 (vertical).

Safety Provisions at Inlets

All inlet structures associated with infiltration basins shall have grates provided over their openings to restrict access and prevent entry into sewers by children or other persons. A maximum clear bar spacing of 0.15 m shall be used for gratings.

Appropriate fencing and guard-rails are to be provided to restrict access and reduce the hazard presented by the structure headwalls and wingwalls.

Other Considerations

(a) A detailed hydrogeological investigation must be conducted to support the proposed infiltration basin. The investigation must assess impacts to upstream and downstream properties and identify measures to alleviate impacts, if necessary.

(b) To address the issue of sediment plugging during development in the catchment area, the basin is to be constructed to 90% of its ultimate depth and volume. When development in the catchment reaches 90%, the infiltration basin is to be completed.

3.5 EROSION AND SEDIMENTATION CONTROL

All proposed projects must provide erosion and sedimentation controls to prevent the displacement of soil and the transport of sediment from the project site resulting from land-disturbing activities. To prevent the displacement of soil and the sediment transport during land-disturbing activities, Erosion and Sedimentation Control (ESC) measures are required and shall be performed as described below. Both temporary and permanent erosion and sedimentation controls shall be implemented.

The objective of erosion and sedimentation control is to prevent the displacement of soil and the transport of sediment to streams, wetlands, lakes, drainage systems, and adjacent properties. Erosion on construction sites can result in excessive sediment transport to adjacent properties and to surface waters. Sediment transport can result in adverse impacts such as flooding due to obstructed drainage systems, smothering of aquatic habitat and the creation of algal blooms in lakes, among others.

ESC

The following ESC documents detail methods of control:

- Best Management Practices for Erosion & Sediment Control – Upland Works, City of Kelowna (1998)
- Land Development Guidelines for the Protection of Aquatic Habitat, Department of Fisheries and Oceans and the BC Ministry of Environment (1992)

In general, erosion and sedimentation controls shall address the following:

Clearing Limits: Prior to any site clearing or grading, areas to remain undisturbed during project construction shall be delineated and marked on-site by flagging or other method. At a minimum, clearing limit delineation shall be installed at the edges of all sensitive area buffers.

Retain existing vegetation, as much as possible.

Cover Measures: Temporary and permanent cover measures shall be provided when necessary to protect disturbed areas as detailed in the ESC Documents. Temporary cover shall be installed if an area is to remain unworked for more than seven days, unless otherwise determined by the City. Any area to remain unworked for more than 30 days shall be seeded or sodded, unless the City determines that winter weather makes vegetation establishment infeasible. Slopes and stockpiles 3H:1V or steeper and with more than 3 metres of vertical relief shall be covered if they are to remain unworked for more than 12 hours. The intent of these measures is to have as much area as possible covered during any period of precipitation.

Perimeter Protection: Perimeter protection to contain sediment from sheet flow shall be provided downslope of all disturbed areas when necessary as detailed in the ESC Documents. Such protection shall be installed prior to upslope grading. Perimeter protection includes the use of vegetated strips, as well as more conventional constructed measures such as silt fences.

Traffic Area Stabilization: Unsurfaced entrances, roads, and parking areas used by construction traffic shall be stabilized to minimize erosion and tracking of sediment offsite as detailed in the ESC Documents.

Sediment Retention: Surface water collected from disturbed areas of the site shall be routed through a sediment pond or trap prior to release from the site as detailed in the ESC Documents, except areas at the perimeter of the site small enough to be treated solely with perimeter protection. Sediment retention facilities shall be installed prior to grading of any contributing area.

Surface Water Controls: Surface water controls shall be installed to intercept and convey all surface water from disturbed areas to a sediment pond or trap and discharge it downslope of any disturbed areas as detailed in the ESC Documents, except areas at the perimeter of the site small enough to be treated solely with perimeter protection. Significant sources of upslope surface water that drain onto disturbed areas shall be intercepted and conveyed to a stabilized discharge point downslope of the disturbed areas.

Implementation requirements

ESC Plan

All proposed projects must submit a plan for providing ESC measures as specified in City Policy 265. All ESC measures shall conform to the details and specifications in the ESC documents unless an alternative is approved by the City.

Construction within Sensitive Areas and Buffers

Any construction that will result in disturbed areas on or within a stream or associated buffer, within a wetland or associated buffer, or within 15 metres of a lake shall be subject to the Best Management Practices for Erosion & Sediment Control – In-stream Works (1998). These provisions include phasing the project whenever possible so that construction in these areas is limited to the dry season.

Maintenance

All ESC measures shall be maintained as per the Erosion and Sedimentation Control Plans. The consulting engineer shall be responsible for maintenance and review of ESC and for compliance with all conditions relating to ESC.

Final Stabilization

Prior to obtaining total performance, the site shall be stabilized and the structural ESC measures (such as silt fences and sediment traps) shall be removed and drainage facilities cleaned as specified.

TABLE 1

Rational Method "C" Coefficients for Design

Description of Area		Minor Storm	Major Storm
Commercial		0.85	0.90
Residential	Single-Family areas	0.40	0.50
	Multi-units, detached	0.50	0.60
	Multi-units, attached	0.60	0.70
Apartments		0.75	0.80
Industrial		0.75	0.80
Parks		0.20	0.25
Natural Areas		*	*
Streets	Asphaltic	0.85	0.95
	Concrete	0.85	0.95
Drives and walks		0.80	0.90
Roofs		0.80	0.90

* - to be determined by site specific conditions

BL10640 replaced Table 2:

TABLE 2

IDF CURVE VALUES for 1 HOUR STORM

Kelowna Airport						
	2 yr	**5 yr**	**10 yr**	**25 yr**	**50 yr**	**100 yr**
a=	8.8	12.2	14.4	17.2	19.3	21.3
b=	0.685	0.723	0.738	0.753	0.761	0.767

STORM INTENSITY (mm/hr)

	STORM					
T (min)	2	5	10	25	50	100
5						143
6						125
7					99	111
8				78	89	100
9			58	72	82	91
10	30	45	54	66	75	84
11	28	42	50	62	70	78
12	27	39	47	58	66	73
13	25	37	45	54	62	69
14	24	35	42	51	58	65
15	23	33	40	49	55	62
16	22	32	38	47	53	59
17	21	30	37	44	50	56
18	20	29	35	43	48	54
19	19	28	34	41	46	51
20	19	27	32	39	45	49
21	18	26	31	38	43	48
22	17	25	30	37	41	46
23	17	24	29	35	40	44
24	16	24	28	34	39	43
25	16	23	27	33	38	42
26	16	22	27	32	36	40
27	15	22	26	31	35	39
28	15	21	25	31	34	38
29	14	21	25	30	34	37
30	14	20	24	29	33	36
35	13	18	21	26	29	32
40	12	16	19	23	26	29
45	11	15	18	21	24	27
50	10	14	16	20	22	24
55	9	13	15	18	21	23
60	9	12	14	17	19	21

Based on 2004 Airport IDF values

SCHEDULE 4 DRAINAGE, TABLE 3 – HYETOGRAPHS

	Rainfall Depths						
Duration	Duration	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
1.00	60	8.8	12.2	14.4	17.2	19.3	21.3
3.00	180	12.4	16.5	19.2	22.6	25.1	27.5
6.00	360	15.5	20.0	23.0	26.8	29.6	32.3
12.00	720	19.2	24.3	27.6	31.8	35.0	38.0
24.00	1440	23.9	29.4	33.1	37.7	41.3	44.7

Kelowna Airport						
	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
a=	8.8	12.2	14.4	17.2	19.3	21.3
b=	0.685	0.723	0.738	0.753	0.761	0.767

	t<= 6 hr	t> 6 hr	2 year					5 year					10 year				
Time	Dist	Dist	1 hr	3 hr	6 hr	12 hr	24 hr	1 hr	3 hr	6 hr	12 hr	24 hr	1 hr	3 hr	6 hr	12 hr	24 hr
0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.08	0.08	0.08	0.7	1.0	1.2	1.5	1.9	1.0	1.3	1.6	1.9	2.4	1.2	1.5	1.8	2.2	2.6
0.17	0.10	0.09	0.9	1.2	1.5	1.7	2.2	1.2	1.7	2.0	2.2	2.6	1.4	1.9	2.3	2.5	3.0
0.25	0.19	0.10	1.7	2.4	2.9	1.9	2.4	2.3	3.1	3.8	2.4	2.9	2.7	3.6	4.4	2.8	3.3
0.33	0.20	0.10	1.8	2.5	3.1	1.9	2.4	2.4	3.3	4.0	2.4	2.9	2.9	3.8	4.6	2.8	3.3
0.42	0.09	0.10	0.8	1.1	1.4	1.9	2.4	1.1	1.5	1.8	2.4	2.9	1.3	1.7	2.1	2.8	3.3
0.50	0.08	0.11	0.7	1.0	1.2	2.1	2.6	1.0	1.3	1.6	2.7	3.2	1.2	1.5	1.8	3.0	3.6
0.58	0.07	0.11	0.6	0.9	1.1	2.1	2.6	0.9	1.2	1.4	2.7	3.2	1.0	1.3	1.6	3.0	3.6
0.67	0.06	0.11	0.5	0.7	0.9	2.1	2.6	0.7	1.0	1.2	2.7	3.2	0.9	1.2	1.4	3.0	3.6
0.75	0.05	0.08	0.4	0.6	0.8	1.5	1.9	0.6	0.8	1.0	1.9	2.4	0.7	1.0	1.2	2.2	2.6
0.83	0.04	0.07	0.4	0.5	0.6	1.3	1.7	0.5	0.7	0.8	1.7	2.1	0.6	0.8	0.9	1.9	2.3
0.92	0.03	0.03	0.3	0.4	0.5	0.6	0.7	0.4	0.5	0.6	0.7	0.9	0.4	0.6	0.7	0.8	1.0
1.00	0.01	0.02	0.1	0.1	0.2	0.4	0.5	0.1	0.2	0.2	0.5	0.6	0.1	0.2	0.2	0.6	0.7

	t<= 6 hr	t> 6 hr	25 year					50 year					100 year				
Time	Dist	Dist	1 hr	3 hr	6 hr	12 hr	24 hr	1 hr	3 hr	6 hr	12 hr	24 hr	1 hr	3 hr	6 hr	12 hr	24 hr
0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.08	0.08	0.08	1.4	1.8	2.1	2.5	3.0	1.5	2.0	2.4	2.8	3.3	1.7	2.2	2.6	3.0	3.6
0.17	0.10	0.09	1.7	2.3	2.7	2.9	3.4	1.9	2.5	3.0	3.1	3.7	2.1	2.8	3.2	3.4	4.0
0.25	0.19	0.10	3.3	4.3	5.1	3.2	3.8	3.7	4.8	5.6	3.5	4.1	4.0	5.2	6.1	3.8	4.5
0.33	0.20	0.10	3.4	4.5	5.4	3.2	3.8	3.9	5.0	5.9	3.5	4.1	4.3	5.5	6.5	3.8	4.5
0.42	0.09	0.10	1.5	2.0	2.4	3.2	3.8	1.7	2.3	2.7	3.5	4.1	1.9	2.5	2.9	3.8	4.5
0.50	0.08	0.11	1.4	1.8	2.1	3.5	4.1	1.5	2.0	2.4	3.8	4.5	1.7	2.2	2.6	4.2	4.9
0.58	0.07	0.11	1.2	1.6	1.9	3.5	4.1	1.4	1.8	2.1	3.8	4.5	1.5	1.9	2.3	4.2	4.9
0.67	0.06	0.11	1.0	1.4	1.6	3.5	4.1	1.2	1.5	1.8	3.8	4.5	1.3	1.7	1.9	4.2	4.9
0.75	0.05	0.08	0.9	1.1	1.3	2.5	3.0	1.0	1.3	1.5	2.8	3.3	1.1	1.4	1.6	3.0	3.6
0.83	0.04	0.07	0.7	0.9	1.1	2.2	2.6	0.8	1.0	1.2	2.4	2.9	0.9	1.1	1.3	2.7	3.1
0.92	0.03	0.03	0.5	0.7	0.8	1.0	1.1	0.6	0.8	0.9	1.0	1.2	0.6	0.8	1.0	1.1	1.3
1.00	0.01	0.02	0.2	0.2	0.3	0.6	0.8	0.2	0.3	0.3	0.7	0.8	0.2	0.3	0.3	0.8	0.9

BL8847 replaced Part 4 Highways
DESIGN STANDARDS

4. HIGHWAY

BL10696 amended the following:

LIST OF TABLES

4. Highway

4.1 General

Developments may require Frontage Roads, double Frontage lots, deep lots with rear service Lanes, or such other treatment as may be necessary in the public interest for the adequate protection of residential properties and to afford separation of through and local traffic.

In reviewing engineering plans, the Approving Officer or Building Inspector must consider the sufficiency and suitability of the proposed Road system, the arrangement, width, grade and location of all Roads in relation to existing and planned Roads, to topographical features, to public convenience and safety, and to the proposed uses of the land to be served by such Roads.

The arrangement of Highways in a Subdivision must either:

(a) provide for the continuation or appropriate projection of existing Roads in surrounding areas; or

(b) where topographic or other conditions make continuation or projection of existing Roads impractical, provide an adequate and suitable Highway system having regard to the uses of the land to be served.

The dimensions, locations and standard of all Roads in a proposed Subdivision must conform substantially to any applicable community plan.

Local residential Roads must be aligned so that their use by through traffic will be discouraged.

Cul-de-sac Roads, designed to be permanent, must be provided at the closed end with an area designed to permit safe and adequate space for the turning of motor vehicles.

Walkways must be provided where they are deemed desirable to provide access through the Subdivision to schools, playgrounds, shopping centres, transit, beaches and other community facilities or for proper circulation of pedestrian traffic.

Jogs in Highway alignment at intersections may be allowed provided that the distance between centre lines is sufficient to maintain traffic safety.

Intersections are to be designed and located within a range of angles between 70° and 110°.

In the design of all street intersections, including those with lanes and walkways, the Consulting Engineer must give consideration to providing adequate sight and stopping distances for conflicting traffic streams involving pedestrians, bicycles and/or vehicles. The City of Kelowna Traffic Regulation Bylaw No. 8120 prohibits sight obstruction greater than 1 m in height within 8 m of intersections.

If reversed curves are required in a Highway alignment, the City Engineer may require that they be separated by means of tangents of sufficient length.

Where angular deflections occur in a Highway alignment, the City Engineer may require that the angle be replaced by a curve of suitable radius.

Road name signs and traffic signs required as a result of constructing or improving Roads must be provided by the City of Kelowna at the expense of the Owner.

Transit bays must be provided where required by the City Engineer.

4.2 Road Classification

The roadway classification applicable to the Road under consideration will be determined from Table 1. Where topographical or other conditions make continuation or projection of an existing street impractical, the City Engineer will review the Developer's proposal and may approve the alternative.

NOTE: All vertical and horizontal alignment elements will be designed utilizing information from Tables 1 and 2 and in accordance with:

1. Transportation Association of Canada - Geometric Design Guide for Canadian Roads, 1999 Edition

TABLE 1 – ROADWAY CLASSIFICATION

Road Class/R.O.W. Improvements	Road Allowance Width (min.)	Surface Width (min.)	Curb Type	Standard (Dwg. No.)
LANES				
Residential and Emergency and Private Access Roads	6.0	6.0	N/A	SS-R2
Commercial	7.6	7.6	N/A	SS-R2
LOCAL STREET				
Class -1, 2 Lane - ULU	18	10.3	Rollover	SS-R3
- RLU	18	7.0	N/A	SS-R3
Class -2, 2 Lane - ULU	15	9.1	Rollover	SS-R4
- RLU	15	7.0	N/A	SS-R4
COLLECTOR STREETS				
Class -1, 2 Lane - UCU -	20	13.1	Barrier	SS-R5
- RCU -	20	10.0	N/A	
Class -1, 2 Lane - UCU - with Bike Lanes	22	14.5	Barrier	SS-R6
- RCU - with Bike Lanes	22	10.0	N/A	
Class -2, 2 Lane - UCU -	18	11.3	Rollover	SS-R7
- RCU -	18	10.0	N/A	
ARTERIAL STREETS				
Class -1, 4 (6) Lane - UAD - Parkway	35	21.5	Barrier	SS-R8
Class -1, 4 Lane (Ult.) - UAD - Parkway	30	21.5	Barrier	SS-R9
Class -1, 2 Lane (Stage I) -UAD - Parkway	30	21.5	Barrier	
Class -1, 2(4) Lane - RAD -	30	20.6	N/A	SS-R10
Class -2, 4 Lane - UAD- Residential	30	20.9	Barrier	SS-R11
Class -2, 3 Lane (one way) -UAU - Residential	20	12.3	Barrier	SS-R12
Class -2, 2 Lane - RAU - Residential	20	10.3	N/A	SS-R13
Class -3, 4 Lane - UAU - TwnCntre	28	20.9	Barrier	SS-R14
Class -3, 3 Lane (one way) - UAU - TwnCntre	25	17.7	Barrier	SS-R15

Note the following definitions:

ULU - Urban/Local/Undivided
RLU - Rural/Local/Undivided
UCU - Urban/Collector/Undivided
RAU - Rural/Arterial/Undivided
RCU- Rural/Collector/Undivided
UAU - Urban/Arterial/Undivided
UAD - Urban/Arterial/Divided
RAD- Rural/Arterial/Divided

Surface Width - on urban section, this measures from back of curb to back of curb
- on rural section, it measures from the edge of asphalt to edge of asphalt.

4.3 Vertical Alignment

The vertical alignment of roads must be set so the grades of driveway to adjacent properties will conform to MMCD Drawing C7. Where it is impractical to meet this criteria, the City Engineer may approve the use of private access roads.

The minimum and maximum road centreline grades allowed on various classes of roads must be as per Table 2.

TABLE 2

GEOMETRIC STANDARDS

Facility Classification	Design Speed (km/h) (min.)	% Super. Elevation (max.)	Radius (metres) (min.)	% Grade		K-Value (min.)			Sight Distance (min.)	
				Min.	Max.	Crest	Sag		Stopping (metres)	Decision (metres)
							No Illum.	Illum.		
Walkway				1.0	15					
Emergency Access	30			1.0	15					
Driveway Single Fam.				1.0	15					
Driveway Multi-Fam.	30			1.0	12					
Rear Laneway See Notes Below	40	*I.C.	18	1.0	12 (10)	4	7	4	45	110 - 160
Local Roadway See Notes Below	50	*N.C.	100	0.5	12 (10)	7	11	6	65	140 - 190
Collector Roadway See Notes Below	50	6 (4)	115 (500)	0.5	10 (8)	7	11	6	65	140 - 190
Arterial Roadway See Notes Below	70	6 (4)	190 (1,000)	0.5	8 (6)	22	25	15	110	200 - 270

Notes: 6% super-elevation only permitted on collector roads in segments without intersecting roads or private access.

Notes: Through roads at an intersection are governed by the numbers shown in brackets, with the reduced grades on each side of the intersection for a distance equivalent to the "stopping sight distance".

*Inverted Crowns (I.C.) and Normal Crowns (N.C.) shall be built with 2% crossfall.

At road intersections, the minor road and/or cul-de-sac must be constructed with an approach grade of not greater than 3% for a distance of not less than 15 m from the adjacent edge of asphalt of the major road.

The draining grade around the outside curb of a cul-de-sac must be not less than 0.50% and not greater than 5.00%. Longitudinal gradients of cul-de-sac bulbs shall not exceed 5.00%.

When a cul-de-sac is at the bottom of a hill, the longitudinal gradient of the first 50m of roadway uphill from the cul-de-sac bulb shall not exceed 5.00%. The maximum longitudinal gradient for the rest of the hill shall not exceed 8.00%.

When a cul-de-sac is at the top of a hill, the longitudinal gradient for the roadway downhill from the cul-de-sac must not exceed 12.00%.

All changes in gradient over 1.00% on arterial and collector Roads and over 2.00% on all other road classifications must be connected by vertical curves. Vertical curves must be designed in accordance with the latest edition of the Geometric Design Guide for Canadian Roads as published by the Transportation Association of Canada.

Standard cross slopes (normal crown) must be 2.00% on all road classifications unless specified otherwise by the City Engineer. Design road elevations must give due consideration to flood-proofing requirements of adjacent properties. Full road crossfall (reverse crown) may be considered in special circumstances, as a means of more closely matching property grade adversity on either side of the highway.

The length of a transition from a normal cross-sectioned road to a section of road where there is super-elevation or crossfall must, in no case, be less than 70 m for a 50 kmh designed road or 110 m for a 70 kmh designed road. In selecting the length of the transition, care and consideration must be given to draining all of the pavement. Typically, if no horizontal spiral curve is used, 60% of the super-elevation is introduced prior to the beginning of the curve, and the balance is developed in the curve.

Gutter elevations on curb returns and cul-de-sacs must be shown on the drawings at the beginning, one-quarter points and end of curb returns and at 7.50 m intervals around cul-de-sacs.

4.4 Horizontal Alignment

The horizontal centreline alignment of the road will be located on the centreline of the right-of-way, unless approved otherwise by the City Engineer. Typical locations of works and utilities in Roads are shown on Standard Drawings.

Centreline chainage stations must be fully referenced and dimensioned from property lines.

Minimum radius of curve and maximum super-elevation normally allowed are shown in Table 2 (Geometric Standards). The Minimum radius of curb return at intersections must be 7.50 m. Transitions in road widths, tapers, etc., must be formed with smooth curves and tangents, including no less than 30:1 for 50 km/h design speeds and preferably 40:1 tapers.

A horizontal curve must be fully described showing internal angle, radius, tangent length and arc.

Curb returns located on roads within industrial and commercial districts may require a larger radius to facilitate truck traffic and bus traffic, and will be as specified by the City Engineer.

When a new road with curbs intersects an existing road without curbs, only half the curb returns must be constructed unless the road design for the uncurbed road is available and will allow construction of the full curb returns. Full curb returns must be constructed at the intersection of two curbed roads.

A turn-around or a second point of access is required on roads longer than 100 m. The maximum length of a permanent cul-de-sac shall be 200 m. Where it is part of a temporary and/or staged development, this maximum length may be 400 m. Cul-de-sac lengths greater than 200 m may be considered by the Approving Officer.

4.5 Road Cross-Section

The standard Road cross-section shall be as detailed in Table 1.

Note that the objectives of the standard road cross-sections as detailed in Table 1 and the Standard Drawings are the clear and intended goals on all roadways within the City of Kelowna. It is recognized, however, that ambient conditions may require variance from these standards in existing and substantially "built-up" areas, where provisions to accommodate the required roadway modification may not have been anticipated. A variance to these standards may be considered by the City Engineer.

4.6 Curb and Gutter, Sidewalks and Bike Lanes

The standards for curbs, gutters, sidewalks and bike lanes shall be as detailed in Table 1 and in the MMCD standard drawings and City of Kelowna supplemental drawings to the MMCD.

Each property shall only have one (1) driveway access per road frontage. Upon demonstrated need and approval from the City Engineer, more than one (1) driveway access may be granted to service stations, major commercial and other developments. Where a lot abuts a lane or road of different classification, the driveway shall be located to access the lane or road of the lower classification.

Residential driveway access onto an arterial or Class 1 collector road, is not permitted unless alternate access is impossible. Wherever physically possible, alternate local road or lane access shall be dedicated to preclude residential driveways accessing directly onto major roads.

Residential driveway accesses serving corner lots shall be a minimum of 7 m from the lot corner nearest the intersection. All residential driveway accesses shall have a minimum width of 4 m and a maximum width of 6 m.

Driveway accesses to commercial and industrial corner lots shall be a minimum of 15 m from the property line of the adjoining road. The maximum width of a driveway to a commercial or industrial property having only one access shall be 11 m. The maximum width of each driveway to a commercial or industrial property having more than one access shall be 9 m.

At the discretion of the City Engineer, access to large parking areas shall be by curb returns rather than a driveway letdown. The City Engineer may require deceleration and acceleration lanes for access off major roads for safety reasons and to minimize disruption to traffic flows. Design of such access shall follow the recommendations in the Ministry of Transportation & Highways, Highway Engineering Branch "Design Manual".

Wheelchair ramps must be provided at all intersections as an integral part of the sidewalk.

4.7 Appurtenances

All proposed traffic islands, retaining walls, guard-rails, and permanent barricades must be designed in keeping with good engineering practices.

Traffic control devices shall be designed and installed in accordance with applicable and current City of Kelowna requirements.

For all utility poles and tie-downs which require re-locating prior to road construction, the utility must confirm the feasibility of their re-location prior to design completion.

4.8 Pavement Structure

4.8.1 Subgrade Preparation

Subgrade preparation shall be considered integral for construction of new roads.

Frost Susceptible Soils (ML): The susceptibility of soils to frost heave is commonly classified using the US Corp of Army Engineers four categories, as shown in Table 15.2 of the "Canadian Foundation Engineering Manual", 3rd edition, 1992. All geotechnical reports shall address the frost susceptibility of the subgrade soil.

Swelling Soils (CH): Pockets of soils known to change volume with variation of moisture content are known to exist in several locations within the limits of the City of Kelowna. These soils are typically identified as high plastic clays (CH) using the Unified Soil Classification System and Atterberg Limits index test (ASTM D4318). Where these soils are encountered as subgrade, special subgrade preparation considerations are required, as outlined below.

Scarification should render the subgrade to cohesive pieces of a maximum size of 20 mm to allow adequate moisture conditioning of the soil. The soil should be moisture conditioned to achieve a homogeneous moisture content between 0 and 3% over optimum. Following moisture conditioning, the subgrade soil should be compacted to a minimum of 95% of Modified Proctor density, as determined by ASTM D1557. The subgrade should be covered with granular sub-base as soon as practical to minimize the variation of the moisture content in the subgrade. The contractor should be aware that additional moisture condition and compaction may be required, at the contractor's expense, should the moisture content be allowed to vary significantly from optimum prior to placing the sub-base.

4.8.2 New Pavement Design

Designers of pavement structures shall consider four primary factors in undertaking a specific design. These are:

Subgrade support quality (geotechnical report)

Design life (20 years)
Traffic loading (expressed in ESALs)
Climate

New pavement structures shall be designed in accordance with the methodologies presented in "AASHTO Guide for Design of Pavement Structures", 1993. The pavement structure shall be designed for a twenty (20) year design life.

The AASHTO design method is based on a Structural Number (SN) for the entire pavement structure (i.e. hot mix asphalt, granular base and granular sub-base). The method incorporates the subgrade strength expressed as the Subgrade Resilient Modulus (Mr), and design loading (ESALs). Each component of the pavement structure is assigned a layer coefficient.

Subgrade strength is frequently characterized utilizing the California Bearing Ratio (CBR) test procedure (ASTM D1883). This test should be performed on soaked subgrade soil specimens compacted to 95% of Modified Proctor density as determined by ASTM D1557. The Resilient Modulus may be approximated from the soaked CBR test values using the following relationships:

Mr (MPa) = 10.3 CBR, or
Mr (psi) = 1500 CBR

The soaked CBR properties of subgrade soil should be determined at a frequency of at least one test per every 150 lineal metres, or a portion there of, and for each major soil type encountered. Where more than one test is required, the tests should be evenly spaced.

The required SN for the pavement structure is the sum of the product of the layer coefficient, the component thickness, and a drainage coefficient for each component:

eq'n (1) $SN = a_{ac}D_{ac} + a_bD_bM_b + a_{sb}D_{sb}M_{sb}$

where:

SN	=	Structural Number for pavement structure
a_{ac}	=	layer coefficient for hot mix asphalt (0.4)
a_b	=	layer coefficient for granular base (0.14)
a_{sb}	=	layer coefficient for granular sub-base (0.10)
D_{ac}	=	Thickness of hot mix asphalt (mm)
D_b	=	Thickness of granular base (mm)
D_{sb}	=	Thickness of granular sub-base (mm)
M_b & M_{sb}	=	layer drainage coefficient (1.0 for Kelowna)

Road classifications, design traffic values and minimum depths of hot mix asphalt and granular base components of the total pavement structure are defined in Table 3.

Table 3
Minimum Asphalt & Granular Base Depth vs Design Traffic

Road Classification	Design Traffic (ESALs) (1)	Minimum Depth of Hot Mix Asphalt	Minimum Depth of Granular Base

Walkways	n/a	50	75
Local, Lanes & Access Roads	2.8×10^4 (28,000)	50	75
Collector	2.8×10^5 (280,000)	100	75
Arterial (2)	1.0×10^6 (1,000,000)	100	75

Notes:

(1) See Part 1 – Chapter 1 of AASHTO for definition of an Equivalent Single Axle Load (ESAL).
(2) Special design reviews may be requested by the City Engineer.

Standard pavement structures, including required SN values, are provided on Table 4 for three strengths of subgrade. The standard pavement structures incorporate the minimum depths of hot mix asphalt and granular base shown in Table 3.

Table 4
Standard Pavement Structures

Street Classification	Structure Component	Thickness in mm for Soaked CBR (1) of		
		3.0(4)<CBR≤5	5.0<CBR≤10	CBR>10
Walkways	Asphalt - Surface Course	50	50	50
	Granular Base	75	75	75
	Granular Sub-base (3)	150	150	150
	Required SN Value	n/a	n/a	n/a
Local, Lanes & Access Roads	Asphalt - Surface Course	50	50	50
	Granular Base	75	75	110 (2)
	Granular Sub-base (3)	275	165	0
	Required SN Value	58	47	35
Collector	Asphalt - Surface Course	40	40	40
	Asphalt - Base Course	60	60	60
	Granular Base	75	75	100 (2)
	Granular Sub-base	335	185 (3)	0
	Required SN Value	84	69	53
Arterial	Asphalt - Surface Course	40	40	40
	Asphalt - Base Course	60	60	60
	Granular Base	75	75	75
	Granular Sub-base	535	355	155 (3)
	Required SN Value	104	86	66

Notes:

(1) Soaked CBR value shall be at 95% of Modified Proctor maximum dry density and optimum moisture content, as determined by ASTM D1557.

(2) Placement of equivalent sub-base layer is not practical and shall be replaced with additional granular base.

(3) Maximum aggregate size of sub-base material to be no more than 50% of total depth of sub-base.

(4) Where the top 1 m of subgrade has a soaked CBR value of less than 3, then the subgrade strength should be supplemented with an additional thickness of granular sub-base material in order to achieve a soaked CBR value of 3 or greater. The thickness of the supplemental sub-base and the corresponding composite CBR value for the top 1 m of composite subgrade can be determined by the following formula:

$$\text{CBR Composite} = ((t_{ssb} \times CBR_{ssb}^{0.33} + (100-t_{ssb}) \times CBR_{sg}^{0.33})/100)^3$$

Where CBR Composite is 3 or greater.
t_{ssb} = thickness of supplemental sub-base (cm).
CBR_{ssb} = CBR value of supplemental sub-base.
CBR_{sg} = CBR value of subgrade soil.

Design pavement structure to be placed on a prepared subgrade or adequately compacted fill embankment. Refer to Section 4.8.1 and 02226 of the MMCD.

Granular base and granular sub-base to have a minimum soaked CBR value of 80 and 20, respectively (refer to City Supplemental S02226).

For design purposes, the maximum subgrade soaked CBR value shall not exceed 10.

Required physical properties for granular base and granular sub-base are given in Schedule 5, Section S02226.

Staged construction may be considered by the City Engineer when a road is to be constructed and to be widened at a later date.

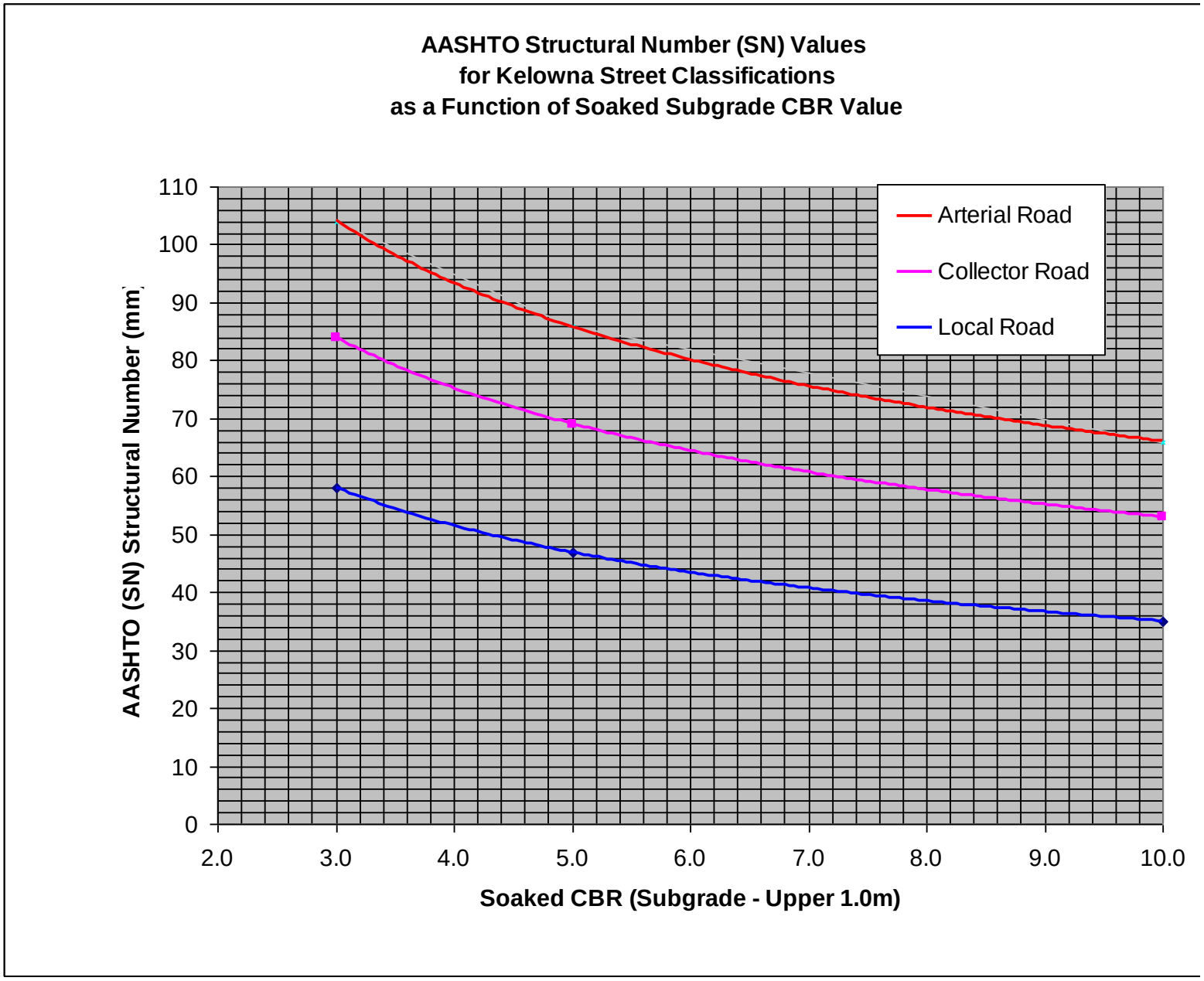
Table 4 provides standard pavement structures for roads constructed on only three strengths of subgrade. Alternate pavement structures may be designed based on the SN determined using Figure 1. For example, for a Collector Road with soaked subgrade CBR value of 4, then the corresponding pavement structure requires a SN of 75. Using eq'n (1), and the specified layer coefficients, a suitable pavement structure alternative may be determined as shown on Table 5:

Table 5
Example Pavement Structure

Pavement Structure Component	Thickness, D (mm)	Layer Coefficient, a	SN
Hot Mix Asphalt	100	0.40	40
Granular Base	100	0.14	14
Granular Sub-base	210	0.10	21
Total SN			75

Note that the minimum depths of hot mix asphalt and granular base shown on Table 3, and the required SN have been met.

The curves shown on Figure 1 are derived from the methodologies presented in AASHTO. A description of all variables used to derive the curves is presented in the MoT Technical Circular T - 9/95, "Pavement Design Standards".


AASHTO Structural Number (SN) Values
for Kelowna Street Classifications
as a Function of Soaked Subgrade CBR Value
AASHTO (SN) Structural Number (mm)
110
100
90
80
70
60
50
40
30
20
10
0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Soaked CBR (Subgrade - Upper 1.0m)
Arterial Road
Collector Road
Local Road

4.8.3 Design of Overlays for Existing Pavements

Overlay designs for existing pavements are to be performed in accordance with "Technical Publication No. 12" published by the Roads & Transportation Association of Canada. The design criteria for overlays are based on limiting Benkelman Beam deflections as follows in Table 6:

Table 6
Benkelman Beam Criteria for Overlays

Road Classification	Maximum Deflection (mm)
Arterial Roads	1.00
Collector Roads	1.25
All Other Road Classifications	1.50

Notes: (1) The design Benkelman Beam rebound ($x + 2\sigma$) should be determined on the basis of at least 10 uniformly spaced readings per two-lane kilometre (one half in each lane).

(2) The summary rebound statistic for a pavement section should be seasonally adjusted to the spring peak rebound value.

BL8847 amended Part 5 Electrical
DESIGN STANDARDS

5. ELECTRICAL, STREET LIGHTING AND COMMUNICATION WIRING

BL10696 amended the following:

5.1 General

The electrical systems must be installed at the Owner's expense, in accordance with the requirements of the appropriate utility company.

Where overhead distribution is permitted, pole and anchor locations must be approved by both the City Engineer and the appropriate utility company. Care must be taken to avoid aerial trespass.

Plans and agreements for rights of way for anchors, pad-mounted transformers, etc., must be provided and registered at the expense of the Owner.

5.1.1 Rules and Regulations

Equipment, installation, wiring methods, and materials used must be in accordance with the Rules and Regulations for the Installation and maintenance of Electrical Equipment as issued by the Ministry of Transportation & Highways, Province of British Columbia. Work must also be in accordance with all applicable Municipal codes and regulations, Provincial statutes or regulations in effect at the site.

5.1.2 Conduits

Conduits must be installed, as nearly as possible, at a constant depth and on the alignment shown on the Standard Drawings. Conduits under existing paved roads, driveways, or sidewalks must be installed by tunnelling unless the City Engineer gives his express written consent for open trenching prior to the commencement of the work.

5.2 Electrical

Electrical systems must be provided to serve each lot within the Subdivision. The location of all facilities and structures must be in accordance with the engineering drawings as approved by the City Engineer, and must be clearly indicated on the plans.

5.3 Street Lighting

5.3.1 Design Levels

(a) **Level of Illumination:** The "Maintained illuminance Uniformity Levels" as recommended by the Illumination Engineering Society (IES) shall be as follows:

TABLE 1

Road Classification	Area Classification	Average Maintained Illuminance in Lux	Illuminance Uniformity Ratio
Arterial	Commercial	17	3 to 1
	Intermediate	13	
	Residential	9	
Collector	Commercial	12	4 to 1
	Intermediate	9	
	Residential	6	
Local	Commercial	9	6 to 1
	Intermediate	7	
	Residential	4	

(b) **Roadway Classification:**

Arterial: A Roadway that serves as a continuous route primarily for inter community through traffic.

Collector: A Roadway that performs the dual function for traffic of land access and traffic movement between arterial and local roads.

Local: A Roadway that provides direct land access and is not intended to carry through traffic.

(c) **Area Classification:**

Commercial: All areas that are zoned as Commercial. Examples are Roadways adjacent to shopping centres, central business districts, Village town centres, Motels and Hotels.

Intermediate: Areas that are zoned as High Density Multi-Family, Local Commercial, Industrial, and Public. Transportation area between commercial and residential areas of up to 500 m in length.

Residential: Areas that are zoned as Rural-Residential, and Single Family Residential to Medium Density Multi-Family Residential.

Notes: Lux is defined as illuminance and is expressed in lumens per square metres. Foot Candles has been the previous measurement term. For conversion purposes 1 Lux = .09 Foot Candle.

5.3.2 Pole Locations

In general, the layout for pole installation must be as follows:

(a) Divided Arterial Roadways:

- Four (4) Lane road width< 22 m staggered spacing.
- Six (6) Lane road width > 22 m. Treat each three Lane portion of divided Roadway as two separate roads. One sided or staggered spacing.

(b) Undivided Arterial Roadways two (2) to four (4) Lanes. Staggered spacing.

(c) Collector Roadways - staggered spacing.

(d) Local Roadways - staggered or one sided spacing.

Poles must be located within 0.6 m of the property corners where possible and must not conflict with driveways and underground utilities. Pole layout must be based from the intersections.

5.4 Communication Wiring

The owner must make arrangements with the appropriate communication and cable T.V. company for installation of services in accordance with the requirements of these utilities.

Underground Telephone and Cable TV, where installed, must be sufficiently complete prior to construction of sidewalks, curbs and gutters and Street paving, to avoid damage to these improvements.

5.7 **Overhead/Underground Requirements**

The City's requirements for allowing overhead or underground wires is as follows:

a) In all Town Center and Village Center areas as identified by the Official Community Plan all wires shall be buried and installed in conduits.
b) All streets and highways that are created as a result of new development shall have all wires buried underground.
c) Outside of these areas where existing overhead wires parallel the existing road the developer shall have the option to bury or to leave overhead the wires.
d) On roadways identified in the City's 20 Year Servicing Plan for upgrade and urbanization, all service wires crossing the roadway must be buried.

BL10640 added a new sub-secion 5.6:

5.6 Kiosks/Laminate Wrapping Requirements

All kiosks to be wrapped with anti graffiti vinyl wrapping. Wrap material shall be a cast vinyl then laminated with a high gloss laminate. The wrap is to be visually pleasing and compliment the area it would be situated in considering the landscape, geography, or general theme of the specific area. Artwork to have a high degree of contrast so as to be more impervious to graffiti vandalism and not to be for commercial advertising. All artwork to be approved before installation.

BL10481 added 6A: Landscape and Irrigation Water Conservation.

DESIGN STANDARDS
6. LANDSCAPE AND IRRIGATION

6A. LANDSCAPE AND IRRIGATION WATER CONSERVATION

6A.1 General

6A.1.1 Application

For purposes of this bylaw, an automatic irrigation system means any outdoor watering device that includes a timeclock, connected valves opened by the timeclock, and underground distribution pipe to water outlets used for watering plant materials.

These landscape standards and specifications shall apply:

(a) To all landscape areas within highway limits in the City of Kelowna including: medians, soft landscape areas between the curbs and the highway limits, and plantings in urban plaza and sidewalk areas.

(b) To new construction and rehabilitated landscapes for City projects including all utilities and facilities for water, sanitary sewer, drainage, electrical and communication Works and Services infrastructure.

The following exemptions to the requirements of Section 6 apply:

(a) Projects where the sum of all new or renovated landscape areas does not exceed 100 square metres in area are exempt from the requirement for landscape and irrigation plan and detail submittals set out in these requirements.

(b) Projects without an automatic irrigation system are exempt from the irrigation system design guidelines, but the landscape, grading and soil management requirements and related drawing submittals other than irrigation drawings still apply;

Landscape and irrigation shall be designed, installed and operated to meet the requirements of the City of Kelowna Water Regulation Bylaw No. 10480, including the requirement to not exceed the Landscape Water Budget for landscape areas of the project and to calculate the Estimated Landscape Water Use.

(April 4, 2011)

The standards specified herein reflect the City's minimum expectations and are intended for most applications. These standards may be enhanced or revised by the City or the Owner at the discretion of the City Engineer where the Works and Services are intended for large, complex, unusual and innovative applications and provided they meet the intent and objectives of the requirements herein.

6A.1.2 Qualifications

The Owner, at their expense, shall retain as a Qualified Professional a Landscape Architect registered with the British Columbia Society of Landscape Architects (BCSLA) to design, inspect and certify all landscape Works and Services covered by this section.

The Owner, at their expense, shall retain as a Qualified Professional a Certified Irrigation Designer registered with the Irrigation Industry Association of British Columbia (IIABC) to design, inspect and certify all irrigation Works and Services covered by this section.

With proper qualifications from both BCSLA and IIABC, one individual may serve as both the Landscape Architect and Certified Irrigation Designer.

For the Works and Services covered by this section the Landscape Architect(s) and/or Certified Irrigation Designer(s) shall have the powers and responsibilities prescribed elsewhere in this bylaw to the Contract Administrator.

6A.2 Water Conservation Requirements and Report

All subject applications shall include a Landscape Water Conservation Report – either as a set of drawings or a bound report - that defines how the development will meet the design requirements for water conservation. The report shall meet the requirements of the City prior to "Issued for Construction" Documents or Building Permits under this bylaw. The Landscape Water Conservation Report shall:

(a) Include the calculations for the proposed landscape area of Landscape Water Budget and Estimated Landscape Water Use in the format as required by the City of Kelowna (equivalent to Schedule C in the City of Kelowna Water Use Bylaw No. 10480).

(b) Indicate by drawings, notes, specifications and if necessary other written materials how the application complies with or varies from the Design Criteria 6A.2.1and 6A.2.2 below.

(c) The City may, at its discretion, accept the information in two stages: Stage One requires the report and a conceptual landscape drawing with corresponding hydrozone and Landscape Water Conservation Report – and may be submitted at the Preliminary Layout Review or Application for Subdivision Approval stage for Subdivision Projects, or Building Permit application stage for Works and Services in Development Projects. Stage Two requires detailed landscape and irrigation drawings and specifications, and update to the report and calculations, to be generally consistent with and substituting for the earlier design concept submission – Stage Two must be submitted and approved prior to City Engineer's "Issued for Construction' documents in both Subdivision and Building Permit processes.

6A.2.1 Landscape Design

The Applicant shall appoint a Qualified Professional to create and submit a Landscape Plan and supervise installation to produce a landscape installation that:

- (a) Groups planting areas into 'hydrozones' of high, medium and low or unirrigated/unwatered areas. Submit a plan diagram and table showing the extent and area of hydrozones in the project.
- (b) Shows appropriate use of plant material with similar water demand within hydrozones.
- (c) Maximizes the percentage of landscape area that is unirrigated/unwatered area, commensurate with landscape aesthetics and plant survival e.g. using pervious paving, unplanted stone or organic mulch, pervious deck (strive for a minimum of 25% of the total landscape area).
- (d) Maximizes retention or replanting of vegetation with low water-use requirements after the establishment period e.g. existing native vegetation to remain, wildflower meadow, rough grass, xeriscape plant species (strive for a minimum of 25% of the total landscape area).
- (e) Designs to minimize mown turf areas that are high water use areas (strive for 25% of total landscape area, and consider a maximum of 50% of the total landscape area) – substitute with areas of lower water use treatments.
- (f) Provides mulch cover to shrub and groundcover areas, to reduce evaporation from soil
- (g) Uses recirculated water systems for any water features such as pools and fountains.
- (h) Ensures landscape installation standards including growing medium depth and quality to meet the requirements of this bylaw. A submitted soils report or notes on the plans shall indicate proposed growing medium depth, amendments, and shall refer to appropriate sections of the reference or supplementary specifications, or the qualified professional shall supply a custom specification of similar detail.
- (i) Includes the following written declarations signed by a licensed Landscape Architect qualified by the British Columbia Society of Landscape Architects (BCSLA):
    - At the time of application:"This landscape plan is subject to and complies with the Landscape Water Conservation Design requirements of the City of Kelowna for the efficient use of water".
    - At the time of substantial performance of the construction: "This landscape installation complies substantially with the submitted water conservation and landscape plans, specifications and reports."

6A.2.2 Irrigation Design

If irrigation is to be installed, the Applicant shall appoint a Qualified Professional to create and submit an Irrigation Plan and supervise installation to produce an irrigation system that:

(a) Groups irrigation circuits/ zones into 'hydrozones' of high, medium and low or unirrigated areas consistent with the landscape planting plan.

(b) Uses reclaimed or recycled water or rainwater capture from roofs or rain barrels for outdoor water use when such is available, as a substitute for use of potable water.

(c) Minimizes use of high-volume spray heads, and employs drip or low volume irrigation where practical to meet the watering needs of hydrozones.

(d) Uses surface or subsurface drip irrigation or low volume irrigation technology to water long, narrow or irregularly shaped areas including turf areas less than 2.4m in width.

(e) Keeps drip, spray and rotor heads (different precipitation rates) on different irrigation circuits.

(f) Designs with irrigation head-to-head coverage in accordance with manufacturer's specifications.

(g) Ensures matched precipitation rates on each irrigation circuit.

(h) Minimizes the elevation change in each irrigation circuit – and where required provides pressure compensating devices to minimize pressure variations or check valves to stop low head drainage.

(i) Ensures irrigation mainlines are proved leak-free with hydrostatic tests, as a part of the construction quality assurance review. Re-test irrigation mainlines after major repair or nearby excavation work.

(j) Provides pressure regulating devices to ensure irrigation outlets are operating at the manufacturer's optimum pressure range.

(k) Designs head placement and type, and adjusts head radius, arc and alignment to avoid overspray of paved surfaces or buildings.

(l) If irrigating slopes greater than 25%, designs an irrigation system with a precipitation rate not greater than 20mm/hour.

(m) Provides automatic shut off devices that shut off the system in cases of pipe leak or breakage, and that shut off the system when rain is present.

(n) Installs - and programs to minimize water use – one or more 'Smart Controllers' with water-conserving functions. Acceptable Smart Controllers are identified in the City of Kelowna Water Regulation Bylaw 10480. Includes a written Irrigation Schedule or equivalent instructions for operation of the Smart Controller, with a copy stored with the controller cabinet, that adjusts the amount of applied water scheduled to be applied on a daily basis – schedule different run-times as weather changes, by using the weather-sensitive features of a Smart Controller. In cases where manual irrigation

(o) program adjustment is temporarily required, adjust water programming at least once per month to recognize that highest water need is in July and lower water needs exist in other months of the growing season.

(p) Ensures irrigation design and installation standards including adjustments and scheduling meet the requirements of the Supplementary Specifications in , Schedule 5

Construction Standards, or a custom or alternate irrigation specification at a similar level of detail provided by the Qualified Professional.

(q) Includes the following written declarations signed by a Certified Irrigation Designer qualified by the Irrigation Industry Association of BC (IIABC):

-
- At the time of application:"This irrigation plan is subject to and complies with the Irrigation Water Conservation Design requirements of the City of Kelowna for the efficient use of water."
- At the time of substantial performance of the construction: "This irrigation installation complies substantially with the submitted water conservation and irrigation plans, specifications and reports".

BL10481 added 6B. Landscape

DESIGN STANDARDS
6. LANDSCAPE AND IRRIGATION

6B. Landscape

6B.1 General

6B.1.1 General Landscape Requirements

The general design and construction of the landscape shall be in accordance with the standards set out in this section.

Street Tree plantings shall be required on streets and highways in all subdivisions where new roads (including cul-de-sacs) or road extensions are required.

All soft Boulevard and Median Areas within the highway limits shall be landscaped to the standards of *Section 6B.2 Boulevard* and *Section 6B.3 Medians*.

Rough grass or wildflower mixture may be used on all or part of boulevards visually backed by areas of woodland or rural appearance - subject to the approval of the City Engineer.

The Landscape Maintenance Period for landscape establishment shall be one year from the date of Substantial Performance of the landscape components of the work. All landscape areas shall be provided establishment maintenance which shall include irrigation maintenance and watering, mowing, weeding, pruning and supplemental fertilization until the end of the Landscape Maintenance Period. The Landscape Maintenance Period shall continue until a Certificate of Acceptance of all

Landscape Works and Services is issued by the City upon the expiration of the Landscape Maintenance Period.
Plants or other materials that fail in the Landscape Maintenance Period shall be replaced at no cost to the City. Replacement trees shall be guaranteed for a further year after planting, with maintenance and replacements repeated until trees are provided that are acceptable to the City at the end of the Landscape Maintenance Period.

The use of Naturescape or similar wildlife habitat principles in landscape development is encouraged. Refer to Naturescape Kit Southern Interior, available from Naturescape British Columbia.

Site and planting design shall co-ordinate with watering 'hydrozones' and irrigation plans in accordance with *Sub-Section 6C – Irrigation*.

All landscape and irrigation products, installation and operations shall be completed in accordance with the requirements of Schedule 5 of this Bylaw.

6B.1.2 Landscape Plan Requirements for Works and Services

For landscape Works and Services that will be owned by the City of Kelowna, the Owner's Qualified Professional is required to submit the following plans, gain City 'Issued for Construction" documents, and certify construction quality assurance. Landscape plan and design submittals required are:

(a) Landscape Plan

(b) Landscape Grading Plan

(c) Landscape Water Conservation Report as required by the Water Regulation Bylaw.

The following information shall be shown on the Landscape Plan:

(a) property lines and easements.

(b) buildings, edge of pavement, curb lines and curbs, sidewalks, lighting fixture locations, surface utilities and related service boxes or other elements that would affect the landscape and street tree location.

(c) Location of all existing vegetation to remain.

(d) Location of retaining walls and existing or proposed slopes that exceed 3:1 vertical.

(e) Location of all proposed trees, shrubs, ground cover and lawn areas.

(f) Indication of which areas will be seeded grass vs sodded lawn.

(g) Plant list showing botanical name, common name, size at planting, quantity, typical spacing, and root zone volume of supplied growing medium for trees.

(h) Location of all proposed trees, shrubs, ground cover and lawn areas.

(i) Hydrozone information table for the project.

(j) Planting hydrozones – delineate and label each hydrozone by number, letter or other method and identify each area of similar water requirement e.g. high, medium, low, or no supplemental water after establishment. Hydrozones may be shown on a separate drawing if required for clarity.

(k) Water features, if applicable.

(l) Type of mulch and application depth.

(m) Growing medium depths for each planting type.

The following information shall be shown on the Landscape Grading Plan:

(a) Spot elevations of top and bottom of retaining walls and at top and bottom of any slopes exceeding 3:1

(b) Drainage patterns by slope arrow and percent slope. Drain inlets or culvert inlet elevations.

(c) Finished floor elevations if applicable.

(d) General shaping of finished grades by a combination of proposed contour, spot elevations and slope arrows for landscape areas that are bermed, dished, or that have noteworthy grading constraints or design intents.

(e) Stormwater retention or infiltration facilities if applicable.

(f) Rain harvesting or catchment technologies if applicable.

The general requirements used by the City for review of the Landscape and Grading Plan is specific to the site and use thereof. The landscape design shall:

(a) respond functionally and aesthetically to existing and proposed land uses, utilities, terrain and flood patterns, drainage facilities, roads, driveways, cycle, transit and pedestrian facilities;

(b) promote accessibility as it relates to pedestrians, cyclists and people with limited physical or visual abilities

(c) consider appearance of the proposed plant material and site landscape, including appropriateness, aesthetics, visual screening, sight lines and functionality

(d) provide access for maintenance equipment and personnel;

(e) allow for cost effective maintenance methods and practices;

(f) provide access to park, recreation or environmental opportunities;

(g) incorporate protection of existing trees where feasible;

(h) consider protection of the natural environment and restoration or enhancement of natural habitat;

(i) coordinate with engineering site drainage, water levels, ponding and overland flow;

(j) consider design features that minimize the opportunity for crime and undesirable behavior;

(k) provide for weed control;

(l) coordinate with sediment and erosion control practices;

(m) follow fire hazard reduction principles.

The completed Landscape and Grading Plan(s) shall be considered part of the package that forms the "issued for Construction" documents.

6B.1.3 Landscape Construction

Prior to the start of construction the Owner shall provide the City with a schedule of construction of the landscape and irrigation Works and Services and Related Work. In addition, the Owner shall provide the City with the name and contact information for the Consulting Landscape Architect and Engineer, Certified Irrigation Designer, the general Contractor and the Landscape Contractor of the site, as well as the designated Contract Administrator for each of the Landscape and Irrigation works.

Proposed changes to the landscaping from that shown on the "Issued for Construction" Landscape Drawings or related documents shall be submitted to the City for review and approval at least five (5) working days prior to anticipated construction of the change. Submission of a proposed change in no way implies or suggests approval of the proposed change by the City.

Changes to the landscaping performed without approval from the City will not be accepted at the time of Substantial Performance or Total Performance. Changes to the landscaping performed without approval from the City will be corrected by the Owner at the Owner's expense or the cost of making the corrections will be held back by the City upon release of the Performance Bond.

6B.2 Boulevard Landscape

Unless specified otherwise herein boulevards shall be vegetated with sodded lawn or densely planted groundcover. Rough grass and/or wildflower seeding may be used on boulevards and side slopes that are visually backing onto natural or rural areas, or for temporary boulevard treatments, subject to the approval of the City Engineer.

For the boulevards of arterial and collector roads within Urban and Village Centre DP areas, the treatment shall be as per the streetscape improvement plan for that area.

For boulevards adjacent to commercial property and locations outside Urban/Village Centre DP areas, or where no plan is in place, the boulevard treatment shall generally be turf or hard-surfaced, and

shall include street trees and irrigation. Acceptable hard surface materials for the boulevard may include:

(a) unit pavers
(b) exposed aggregate concrete;
(c) stamped and coloured concrete;
(d) irrigated turf; or
(e) xeriscape or dryland landscaping

For boulevards where the land use of the adjacent property is industrial, institutional or multi-family the boulevard treatment shall generally be street trees and turf or dryland landscaping, serviced and maintained by the Owner of the parcel with the boulevard frontage.

For boulevards where the land use of the adjacent property is one, two or four-family residential or park, and where the boulevard is accessible for maintenance mowing and watering from the adjacent property, the boulevard treatment shall generally be street trees and turf,

For boulevards where it is unlikely that the adjacent property owner will be able to adequately maintain the boulevard, the boulevard treatment shall generally be hard surfaced and may include street trees. Acceptable boulevard materials in these cases may include:

(a) unit pavers; or
(b) exposed aggregate concrete

6B.3 Median Landscape

The landscaping of medians shall be designed and constructed generally as follows:

(a) for Highway 97 and Highway 33 - with sloped aprons of concrete unit pavers with irrigated street trees and irrigated landscaping;

(b) in Urban Centre and Village Centre DP Areas - except as described above or per the approved streetscape improvement plan for that area, with sloped aprons of concrete unit pavers and irrigated street trees; or

(c) elsewhere - with sloped aprons of exposed aggregate concrete, concrete unit pavers or stamped and coloured concrete and irrigated street trees..

The landscaping of roundabouts and cul-de-sac islands shall have a hard surface material or landscaping with low shrubs or groundcovers, and should feature:

(a) a single specimen tree;

(b) a group of like trees; or

(c) public art if the roundabout or cul-de-sac is in an Urban or Village Centre. The selection, design and placement of public art shall be made in cooperation with the Public Art Committee.

Lighting of trees or public art in a median shall be provided as required by the Parks Division or the Public Art Committee.

(April 4, 2011)

6B.4 Utilities Coordination with Planning

Underground utilities shall be aligned and buried to provide a continuous 1.0m deep utility-free trench beneath tree planting locations.

Planting and paving design shall be co-coordinated with the design and construction of surface utility boxes, such that boxes fall entirely within either a paved surface or entirely within a planted surface but not partly in paving and partly in planting and that grades and alignment of boxes match the final design and construction of all elements to create a co-coordinated and orderly appearance, free of trips and hazards.

6B.5 Plant Material

6B.5.1 Urban Trees in Pavement

Select urban trees in pavement in accordance with Section 6B.5.6.

Select and site urban trees in pavement to eliminate long term above-ground and below ground conflicts with utilities, buildings and structures, and pedestrian and vehicular traffic.

6B.5.2 Planting Details and Procedures

Landscape Drawings shall specify the appropriate planting detail standard from the City of Kelowna Standard Details.

All planting shall meet the City of Kelowna Specifications in Schedule 5.

6B.5.3 Planting Provisions in Single Family Subdivisions

Street trees and landscape finish of the public highway fronting occupied homes shall be completed no later than the date that 85% of the homes in a single family development are completed and occupied. Earlier completion dates are encouraged provided that landscape maintenance and repair is provided at no cost to the City until such time as units are occupied.

Planting of street trees in the hot dry summer period of June, July and August is discouraged, due to the risk of failure of the planting caused by heat and drought.

Minimum number of boulevard trees shall be calculated as follows:

(a) Medium Trees (± 10 - 20m ht. at maturity) Greater of 1 per lot or 15m.

(b) Small Trees (Under 10m ht. at maturity) Greater of 1 per lot or 10m.

(c) Plantings of trees closer than 6m on centre shall require the written concurrence of the City Engineer.

(d) Locate trees fronting on single family lots in locations that avoid all utility service alignments and driveways. Generally this will lead to tree placement in the half of the lot frontage away from the driveway side, and not at either the lot centerline or at a lot line.

6B.5.4 Plant Material Selection

6B.5.4.1 Plant Materials:

(a) Plants shall have the ability to withstand adverse conditions such as airborne pollutants, maximum sun exposure and reflected heat from pavements, high winds and abrasive forces, occasional snow loading and exposure to salt from road clearing operations, and limited root zone soil volumes.

(b) Plant hardiness requirements vary by elevation. Plants shall be hardy to Canadian Plant Hardiness Zone 5A to 1A as site conditions dictate.

(c) Plants shall be capable of reduced water demand following a one year establishment period.

(d) Plants shall have relatively low maintenance attributes including: fine to medium leaf size and canopy density; non-fruit bearing or having only berry-sized non-staining and non-toxic fruits; low susceptibility to disfiguring or fatal diseases and infestations; infrequent demands for pruning, fertilizing and other cultural requirements.

(e) Plants shall be of appropriate size and form at maturity to meet criteria in Section 6B.5.6 *Street Tree Selections and Soil volumes*.

6B.5.4.2 Lawns/Fine Grass, Rough Grass and Wildflowers:

(a) Sod shall be used on all lawn/fine grass areas. Seeding, as an alternate, shall require approval of the City Engineer.

(b) Rough grass and wildflower areas shall be seeded. Seeding method shall be noted on drawings.

(c) Areas to be seeded with grades greater than 3:1 and/or highly erodible soils shall be hydroseeded with a nurse crop seed mix, a hydraulically applied erosion control mulch, or erosion control blanket. Erosion control method to be noted on drawings.

6B.5.4.3 Trees:

(a) Boulevard or 'street' trees shall be of a single species/cultivar on either side of the street within a given block. Median tree species may vary.

(b) Street tree species shall vary between intersecting streets. Street tree selection will be made with consideration of maintaining a diverse and varied street tree distribution across a neighbourhood to minimize disease risks.

(c) All street trees shall have:

i. A compact or upward branching structure.

ii. Ability to withstand pruning for pedestrian, vehicle and/or building clearance without compromise to tree health or form.

iii. Absence of species/varietal characteristics of structural weakness, susceptibility to wind damage, or thin, easily damaged bark.

6B.5.5 Street Tree Size, Spacing and Location

Trees shall be minimum 5 cm caliper measured at 300mm above the rootball at the time of planting, and of uniform size if planted in a boulevard row.

Tree branch clearance requirements are 5m over the traveled portion of road and 2.25m over the sidewalk.

6B.5.6 Street Tree Selections and Soil Volumes

Refer to City of Kelowna website for requirements for tree species selections: http://www.kelowna.ca/CM/Page292.aspx

Trees for directly under Hydro lines

(a) Minimum allowable soil volume per tree is 4 cu.m. with 1m depth pit.

(b) Mature height not greater than 7.62m.

Trees for beside hydro lines

(a) Minimum lateral distance from nearest line 2.75m.

(b) Minimum allowable soil volume per tree is 4 cu.m. with 1m depth pit.

(c) Mature spread not greater than 5m.

Trees for limited available soil volume

(a) Minimum allowable soil volume per tree is 4 cu.m. with 1m depth pit.

(b) Mature height not greater than 10m.

Trees for available soil volumes of 9 cu. m. or greater

(a) 1m pit depth

(b) Mature height not greater than 20m.

Trees for a wide boulevard or wide median use only

(a) Minimum available root zone of 20 cu. m. per tree

(b) Minimum boulevard or median width of 3.5m

6B.5.7 -Setbacks for Trees

Minimum setbacks for trees to objects in new developments shall be as follows:

Underground street light conduit or irrigation main	0.6m
Other underground utilities	3.0m
Lamp standards	6.0m
Steel and wooden utility poles	3.0m
Driveways	1.5m
Catch basins	1.5m
Manholes, valve boxes, services	3.0m
Sewer service boxes	3.0m
Fire hydrants	2.0m
Road intersection	7.0m
Curb face (see SS-L3 for Root Barriers required)	0.5m
Sidewalk	0.85m
Curb face and sidewalk with root barrier	0.60m
Buildings - fastigiate (columnar) tree	2.0m
Buildings - regular crown tree	3.0-5.0m

The City Engineer may consider custom setbacks where trees are being installed in existing streets with established utilities.

6B.6 Landscape Maintenance Schedule

The Owner's qualified professional shall submit a maintenance schedule with the Certificate of Substantial Performance. It shall include timing and arrangements for:

(a) Routine inspection
(b) Aerating and dethatching turf areas
(c) Replenishing mulch
(d) Fertilizing
(e) Pruning
(f) Weeding

The project applicant is encouraged to implement sustainable or environmentally-friendly practices for overall landscape maintenance.

BL10481 added 6C. Irrigation

DESIGN STANDARDS
6. LANDSCAPE AND IRRIGATION

6C. Irrigation

6C.1 General Irrigation Requirements

(a) A complete and working automatic irrigation system shall be provided for all landscaped areas within a high, medium or low hydrozone of a Highway, utility parcel or utility facility. Temporary watering provisions shall also be made for planted areas of a 'non-irrigated' hydrozone – to allow for watering through a maximum 1 year establishment period or in severe drought.

(b) Boulevard trees, shrubs and ground covers shall be watered from an automatic irrigation system.

(c) Urban trees in pavement shall be irrigated with an automatic irrigation system that may include bubblers or drip elements.

(d) Sleeves shall be provided under sidewalks and driveways, and to medians / islands, as required for installation and maintenance of the irrigation system without removing surface paving.

(e) Provide a flow sensor and master valve, both connected to the controller, that will stop flow to the system or irrigation circuit in cases of an irrigation water leak. Provide an isolation gate valve upstream of all automatic sprinkler valves.

(f) Design to water plant materials with different watering requirements (e.g. grass vs. shrub areas and high vs medium vs low water use shrub areas) on different valve circuits.

(g) Where surface sprinklers are used, ensure unobstructed sprinkler coverage to tree bases from at least two sides.

(h) Every drip system shall be designed with a filter, pressure regulator, flush valve and air relief valve. The drip component manufacturer's instructions for installation and maintenance shall be included in the project specifications.

(i) The Irrigation System shall perform to within 15% of the targeted application efficiency standards for irrigation systems, as determined by the Irrigation Association and the Irrigation Industry Association of British Columia, as follows:

i. Spray Zones: 75% or higher;
ii. Rotor Zones: 80% or higher;
iii. Microjet Irrigation Zones: 85% or higher.
iv. Drip Irrigation Zones: 90% or higher.

(j) Sprays and rotors shall be designed with head to head coverage to meet the application efficiency standards.

(k) It is the responsibility of the Certified Irrigation Designer to identify to the Owner and to the City of Kelowna any landscape impediments, existing or planned, that will impede reaching the targeted efficiencies. At the discretion of the City of Kelowna, irrigation system design audits may be performed to ensure design efficiency has been met.

(l) The Irrigation System shall be designed with minimal pressure losses where possible. Pressure losses between any two sprinklers on the same zone shall be less than 10%.

(m) Pipes shall be sized to allow for a maximum flow of 1.5m/sec.

(n) The Irrigation System shall be sized and designed to 80% of Point of Connection available flow and pressure; allowing for 20% growth of system or 20% reduction in operating pressure while retaining targeted operational efficiencies.

(o) Locate Point of Connection or Pedestal to meet the following requirements:

i. No Pedestal or Point of Connection locations will be permitted with medians without the explicit written consent of the City of Kelowna.
ii. No Pedestal location shall be subject to application of irrigation watering.
iii. No Point of Connections shall be placed within a sidewalk without the explicit written consent of the City of Kelowna.

(p) The irrigation design shall include voltage loss calculations to the electrical control valve furthest from the controller. The drawings are to include:

i. A chart comparing the actual voltage drop to the allowable voltage drop on common and zone signal wires;
ii. Voltage loss shall not exceed the maximum voltage loss as specified by the manufacturer of the irrigation controller;
iii. Indicate wire locations, wire gauge required, spare wires and necessary splice box locations on the Contract Drawing.

(q) Install one spare control wire for every five (5) electric control valves connected to the controller;

(r) Install one spare common wire for every ten (10) electric control valves connected to the controller.

(s) Irrigation sleeves shall be installed to route irrigation lines under hard surfaces and features. Non-metallic CSA approved electrical conduit shall be installed adjacent to irrigation sleeves.

(t) Electric control valves used in the design of the Irrigation System are to remain consistent in size and manufacturer, where possible. Renovations or additions to the Irrigation System shall use the same manufacturer, model and size that exist on site. It is permissible to use an electric control valve from a different manufacturer for specialized applications. In general:
   i. Electric control valves must be sized to the design flow;
   ii. Drip and Micro irrigation zones must include filtration and pressure regulation to manufacturers' specifications. Drip and Micro zones must have an isolation valve prior to zone valve for maintenance of filtration.
   iii. Unless it has deemed not possible, valves are to be located on the periphery of green spaces and where available, within planting beds.
   iv. Design approval will be required to insert valve locations within hardscape surfaces.

(u) Sprinklers used in the design of the Irrigation System are to remain consistent in size, nozzling and manufacturer. Renovations or additions to the existing Irrigation System shall use the same manufacturer, model and size that exist on site. Sprinkler choice is based upon:
   i. Available operating pressure at the base of the sprinkler;
   ii. Desired radius;
   iii. Type of landscape/plant material to be irrigated.
   iv. Preference will be given to sprinklers incorporating pressure compensating devices.
   v. Preference will be given to sprinklers incorporating check valves to reduce low head drainage.

(v) Sprinkler arcs, radius and alignment are to be designed and capable of adjustment to minimize overspray onto adjacent surfaces outside of landscape areas.

(w) Drip line and emitters must incorporate technology to limit root intrusion.

(x) Specify all irrigation components from a coordinated manufacturer's line listed in the Subdivision, Development & Servicing Approved Products List Policy 266.

(y) All irrigation products, installation and operations shall be completed in accordance with the requirements of Schedule 5.

(z) The Landscape Maintenance Period for landscape establishment shall be one year from the date of Substantial Performance of the landscape components of the work. All landscape areas shall be provided establishment maintenance which shall include irrigation maintenance and watering.

6C.2 Irrigation Plan and Irrigation Design Report Requirements for Works and Servies

For irrigation Works and Services that will be owned by the City of Kelowna, the Owner's Qualified Professional is required to submit the following plans and reports, gain City "Issued for Construction" status, and certify construction quality assurance:

a) Irrigation Plan
b) Landscape Water Conservation Report (in accordance with Water Use Regulation Bylaw 10480)
c) Irrigation Design Report
d) Maintenance Schedule

The following information shall be shown on the Irrigation Plans and Landscape Water Conservation Report

(a) Name and contact information for the IIABC Certified Designer.

(b) Name and contact information for the water utility provider and the electrical utility provider.

(c) property lines

(d) buildings, edge of pavement, curb lines and curbs, sidewalks, lighting fixture locations, surface utilities and related service boxes or other elements that would affect the irrigation system – but with an objective of minimizing drawing clutter.

(e) Location of all existing vegetation to remain.

(f) Location of retaining walls and slopes that exceed 3:1 vertical.

(g) Landscape Water Budget, and Estimated Landscape Water Use and calculations (in accordance with Schedule C of the Water Regulation Bylaw No. 10480 - may be a separate Landscape Water Conservation Report).

(h) Hydrozones shall be designated by number, letter or other designation.

(i) Designate the areas irrigated by each valve (irrigation zones) and assign a number to each valve.

(j) Indication of which irrigation zones will be automatic vs manual watering systems. Clearly identify any 'temporary zones': those zones which are intended to operate for less than a two (2) year grow in period.

(k) Schematic layout showing all points of connection, backflow prevention, water meters, electrical supply and meters, winterization facilities, timeclocks, heads, valves, piping, sleeves, sensors and other elements critical to construction and maintenance of the irrigation system.

(l) Irrigation legend describing brand, model and size of timeclocks, heads, valves, piping, sleeves, sensors and all other elements shown on the irrigation plan.

(m) Any details specific to the project that are not included in Schedule 5.

The Irrigation Design Report shall be submitted with the Irrigation Plans, in booklet form on 8.5 x 11 paper and shall include:

(a) Static water pressure obtained either by pressure gauge reading from the site; or from the City of Kelowna.

(b) Design flow calculations indicating maximum water flows required to irrigate the proposed site in the desired water window;

(c) Water utility jurisdiction; inclusive of any regulations or restrictions imposed by the said water utility that will affect the operation of the Irrigation System.

(d) The electrical requirements necessary to operate the proposed Irrigation System. Verification from the applicable electrical utility that the service is available and what is required to route it to the necessary location(s);

(e) Identification of the micro-climates throughout the proposed site;

(f) A chart illustrating a zone by zone breakdown of the following items;
   i. Type of plant material
   ii. Product Type (micro, spray, rotor); and area based calculated precipitation rates.
   iii. Required operating pressure
   iv. Required zone flow
   v. Zone valve size

(g) Scheduling data utilizing a maximum ET value of 7”/month (Kelowna July ET); taking into consideration soil type, slope and micro-climate. Show the cumulative watering time required to water all circuits in the project. Except where otherwise required or approved, the irrigation water window shall not be greater than 6 hours per day on an odd or even scheduling format.

6C.3 Establishment Watering Provisions in Single Family Subdivisions

Watering provisions are required for establishment of all street tree planting. Automatic irrigation systems to be provided to the boulevard area as an extension of privately held irrigation systems on the fronting lot. Provide irrigation sleeves across the sidewalk at the lot centerline and across the driveway as necessary to accommodate the irrigation pipe connecting all landscape areas and the fronting boulevard and medians.

In cases where boulevard landscape and related irrigation is being installed in advance of single family lots being occupied, the developer is to install a temporary irrigation system to water the boulevard. When private homes are constructed and occupied, within 6 months of occupancy the developer must arrange to have the boulevard irrigation fronting each lotremoved from the temporary irrigation system and attached permanently to the irrigation system of the fronting lot. Design of the temporary irrigation system may follow one of two general arrangements:

FULL LANDSCAPED BOULEVARD: generally in accordance with Schedule 5 Standard Drawing "Temporary Boulevard Irrigation", based on a spray or drip irrigation system to serve grass, groundcover, shrubs and trees in the boulevard, OR

TREES ONLY BOULEVARD: if trees only are being planted, with dryland or paved landscape in between, a Root Watering System (Double) on public property shall be provided that meets the requirements Schedule 5 Standard Drawings.

(a) For temporary boulevard irrigation systems, and/or for permanent median irrigation systems, water supply, backflow prevention and irrigation smart controller shall be provided in central location(s) in the subdivision, with valves and distribution piping designed in accordance with Section *6C – Irrigation*. Water supply may be obtained from the services of the new lots. A water billing account must be established prior to use.

(b) Irrigation sleeves for the temporary or permanent boulevard and median systems shall be provided under all driveways or other paved areas to provide pipe access to all landscape areas within the highway for installation and maintenance of the irrigation system without removing surface paving.

(c) The City will withhold part of the maintenance bond at a value of 140% of the cost of connecting temporary irrigation in boulevards to permanent irrigation systems on fronting private lots, and abandonment of any temporary irrigation system. If this conversion is not completed by the Developer within 6 months of home occupancy, the City may if necessary at the Developer's expense undertake the connection of the boulevard irrigation system to the adjacent private lot system and decommission the temporary irrigation with its own forces.

6C.4 Irrigation Service Connections

Except as required otherwise all landscaped areas of a Highway or Utility Facility shall be serviced with a metered water service (50mm diameter, and a metered electrical service (120/240 volts, 60 amps minimum). Provision of water and electrical services by the Owner shall include the establishment of service accounts with the utility providers, all necessary permits, testing and certification, and all materials, labour, fees and utility costs necessary to provide the service until the end of the Landscape Maintenance Period.

BL10640 amended Hillside Street Standards to Hillside Development Street Standards"
DESIGN STANDARDS

7. HILLSIDE DEVELOPMENT STREET STANDARDS

BL10696 amended the following section:

LIST OF TABLES (located at back of section)

Bylaw 9051 added the following drawings:

LIST OF DRAWINGS (located at back of section)

HILLSIDE DEVELOPMENT STREET STANDARDS

7.1 General

BL10640 amended the following:

Where development lands receive hillside zoning (Residential Hillside (RH) zone or "h" designation to parent RU1 zone), these standards may be utilized in place of the specific sections in the HIGHWAY DESIGN STANDARDS (Section 4 of this Schedule). The Hillside Street Standard drawings are included in Schedule 5, Section 2 (Drawings) of this Bylaw.

The hillside standards have been designed for environmental sensitivity with reduced physical impacts in mind. Generally, the street standards proposed herein have been drawn from the following principles:

- The public interest requires safe, liveable and attractive streets that contribute to the urban fabric;
- Streets should be designed to suit their function. Many streets, especially local ones, have purposes other than vehicular traffic;
- A hierarchical street network should have a rich variety of types, including bicycle, pedestrian and transit routes; and
- Standards should be developed to enhance local streets' contributions to urban design. Issues such as sense of enclosure, landscaping, parking, building setbacks, surface materials, street furniture, signs and street lighting are vital determinants of liveability in neighbourhoods.

These street standards have largely been designed for application under specific traffic volumes and development densities. Traffic volume determines which general street type (Arterial, Collector, Minor Collector, Local, etc.) is required to service an area and, in most cases, density of fronting development determines which specific street condition ("Condition A", "Condition B", "Condition C", etc.) will be applied. In the case of Collector Streets, whether or not the street acts as a village centre "main street" is also a factor. For Arterial Streets, proximity to a village centre and local environmental conditions are the determinants of "condition" application.

Development that has direct public street access is defined as "fronting" the street. In other words, only those units that are oriented to the street are considered to "front" on it. This will most often occur in areas of fee-simple single family, mixed-use, or apartment development. Circumstances where strata units "front" onto a public street may also arise; however, strata and bareland strata developments will primarily be serviced by Private Streets. Standards for Public Lanes, Cul-de-sac Streets and Hillside Emergency Accesses are also included.

7.2 Street Trees

Street trees contribute to the liveability of a street. Trees modify the microclimate and foster a sense of comfort and safety for drivers and pedestrians by creating an edge between the sidewalk and the moving traffic. In hillside areas it is desired that the natural landscape be more prominent. While in some instances, such as along Arterials and Collectors and in a village centre, street trees are thought to be appropriate, even necessary, in other areas a more natural approach is desired, and the retention of natural vegetation is encouraged.

BL10640 amended the following:

Therefore, those hillside street standards that will be applied to areas that will have a tighter "fit" to the natural landscape will not be required to incorporate street trees. For Minor Collector Streets and Local Streets street trees are considered optional. The planting of stands of native trees and vegetation is encouraged in these areas to contribute some of the elements of liveability that would otherwise be missed with the elimination of formal street tree plantings. Street trees and landscaping are to be to the satisfaction of the City's Development Services Department/Subdivision Approval Branch and a landscape plan showing proposed

planting on private property are required. The City's Development Services Department/Subdivision Approval Branch will require a performance bond for landscaping on private property.

A discussion of each class of street follows.

7.3 Hillside Street Classification – See Table 1

An overall plan is required allocating the location of each street type and its relationship to adjacent land uses proposed.

A discussion of each class of street follows.

7.3.1 Arterial Streets

Arterial streets provide a continuos drive path for inter-community through traffic. The Arterial corridors of hillside areas will be different in that, while they will continue to provide a throughway for automobiles, the experience will take on qualities of a scenic drive.

7.3.2 Village Collector Streets ("Main Street")

Collector streets perform the dual function of land access and traffic movement between arterial and local roads. In the village centre the unique and very social function of this more localized type of street will be reflected in a more urban feel than will be found on collectors elsewhere throughout the site.

7.3.3 Collector Streets

Collector streets perform the dual function of land access and traffic movement between arterial and local roads; however, this more localized type of street plays a social as well as a functional role in the neighbourhood. Street design, therefore, must balance all objectives including, but not limited to, the need to provide a driving path for automobiles to access the neighbourhood.

7.3.4 Minor Collector Streets

There is the potential for some portions of Collector streets to experience lower traffic volumes. In these instances, Minor Collector streets will be utilized. Toward reducing the street section, a sidewalk will be provided on only one side of the street for all Minor Collectors.

7.3.5 Village Local Streets

The residential areas of the village centre will be more urban than those that will be found elsewhere within the Hillside areas. Narrow local streets with on-street parking and framed by street trees and sidewalks on both sides will provide a comfortable environment for all users in

the neighbourhood. This condition is for use where development fronts at least one side of the street.

7.3.6 Local Streets

Local streets serve a multitude of functions that are important in the day-to-day lives of residents: residents walk their dogs on the street, they wash their cars on the street and they meet and talk to their neighbours on the street. Children play on the street, they learn to ride their bicycles on the street; they treat the street as an extension of the local neighbourhood park system. At this level, the street plays a very social role. Local street design, therefore, should continue to be sensitive to the needs of non-vehicle street users as well as seeking the best fit between street and landscape.

7.3.7 Public Lanes

Public Lanes are also used by the residents of a community as a venue for social interaction and play and they can contribute greatly to the fabric of a liveable community. One opportunity for their use, however, is in areas such as the village centre. Such higher density development is generally located in more gently sloping areas where steeply sloping terrain is not an issue. The inclusion of Public Lanes in these neighbourhoods will contribute to the more urban feel envisioned as well as provide an alternate route for bikes and pedestrians.

BL10696 amended title:

7.3.8 Cul-de-Sac Streets Hillside Emergency Accesses and Hillside Private Lanes

Some of the Local streets within complex topographic areas will take the form of a cul-de-sac. Generally, cul-de-sac streets are used where street connectivity is not possible (i.e. steep terrain) or not warranted (i.e. serves very few homes). Although the appropriate Local street standard will also apply to cul-de-sac streets, there are two additional street specifications unique to this street form that must be addressed in relation to liveability: permitted length and the design of the street turnaround.

In complex topographic areas long streets may be required to access developable pockets within areas of steep terrain. Due to the complex topography it will often not be advisable, or even possible, for connectivity to be achieved at both ends of a street.

Longer cul-de-sac streets will result and systems of branching cul-de-sacs will be established to access some areas of extremely difficult terrain. In response to public safety issues, it is desirable that emergency access routes to such areas are available – Hillside Emergency Access standards are included below. This is considered more acceptable from a liveability stance than requiring street connectivity in all situations as the lower standards required for an emergency access will result in a lesser impact to the hillside. Maintaining street connectivity wherever possible will remain a priority.

The radius of a cul-de-sac also plays a role in the liveability of a street. Laying a cul-de-sac requires a relatively large flat area. The larger this area is, the greater the impact to the landscape, particularly in complex topographic areas. Large cul-de-sacs can also decrease the social quality of a street by terminating the public corridor with a large, barren paved surface. A reduction of the cul-de-sac radius is feasible if parking is restricted in the cul-de-sac, which will ensure a large enough circumference for car turning. It is noted that provision must be made on a case by case basis for emergency vehicle turning.

Cul-de-sac

- ROW: min 13.0m radius;
- Radius to edge of paved surface: min 12.0m radius;
- Alternative types of street turnarounds will be considered for use based on site specific topographic conditions. In certain circumstances reduced cul-de-sac radii or hammer head type turnarounds will be permitted.
- Cul-de-sac streets may exceed the maximum length as specified by the City of Kelowna - mid-block turnarounds should be considered in this situation;

BL10640 amended the following:

- A secondary emergency access must be provided for any public cul-de-sac streets that are in excess of the maximum length as specified by the City of Kelowna. This requirement may be modified with the written approval of the City's Development Engineering Manager or Subdivision Approving Officer.

Hillside Emergency Access

- Maximum grade: 15%;
- 4.5m ROW; 4.5m roadway;
- Restrict non-emergency vehicles access through the use of removable bollards or gates;
- Shared use with pedestrian trails.

BL10640 added the following:

Hillside Private Lanes/Emergency Access Lanes/Maintenance Roads

Maximum grade: 15%;

Private Lanes must have a turn-around at or near their terminus. Acceptable turn-around types include cul-de-sac, eyebrow or hammerhead.

6.0m ROW; 6.0m roadway.

BL10640 added the following:

7.3.9 Lighting Standards

Allow for reduced light pollution where street lighting may be visually prominent.

BL10640 added the following:

7.3.10 Sanitary Sewer Location and Corridors

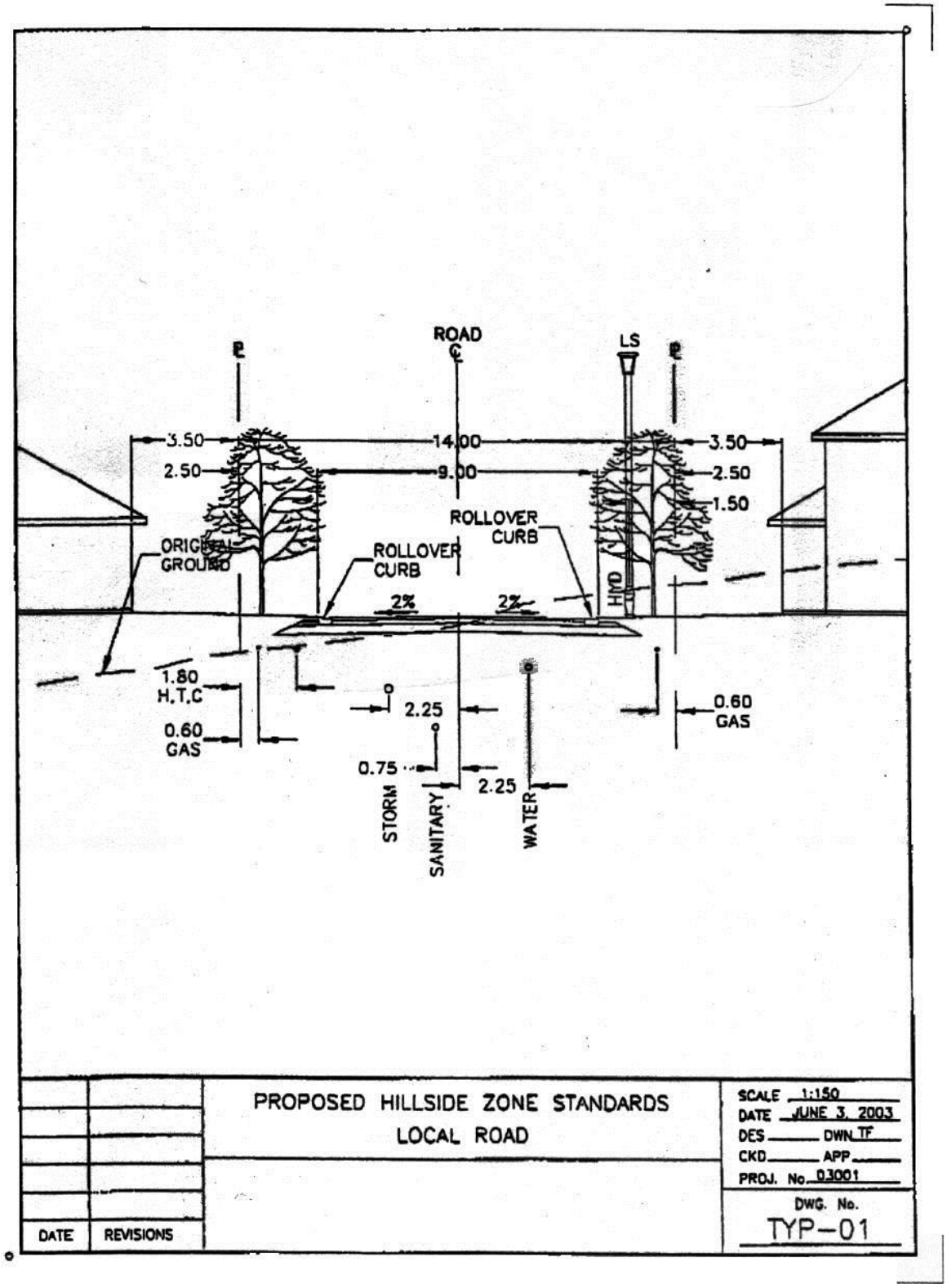
Where rear yard sewers are necessary, ROW of for rear yard serviced lots must be constructed in a manner which allows for practical and unencumbered access by maintenance equipment with a minimum width of 4.5m with a grade of less than 15%.

Vehicle access to manholes is required and these accesses are to be protected by a right-of-way which would be perpendicular to the road.

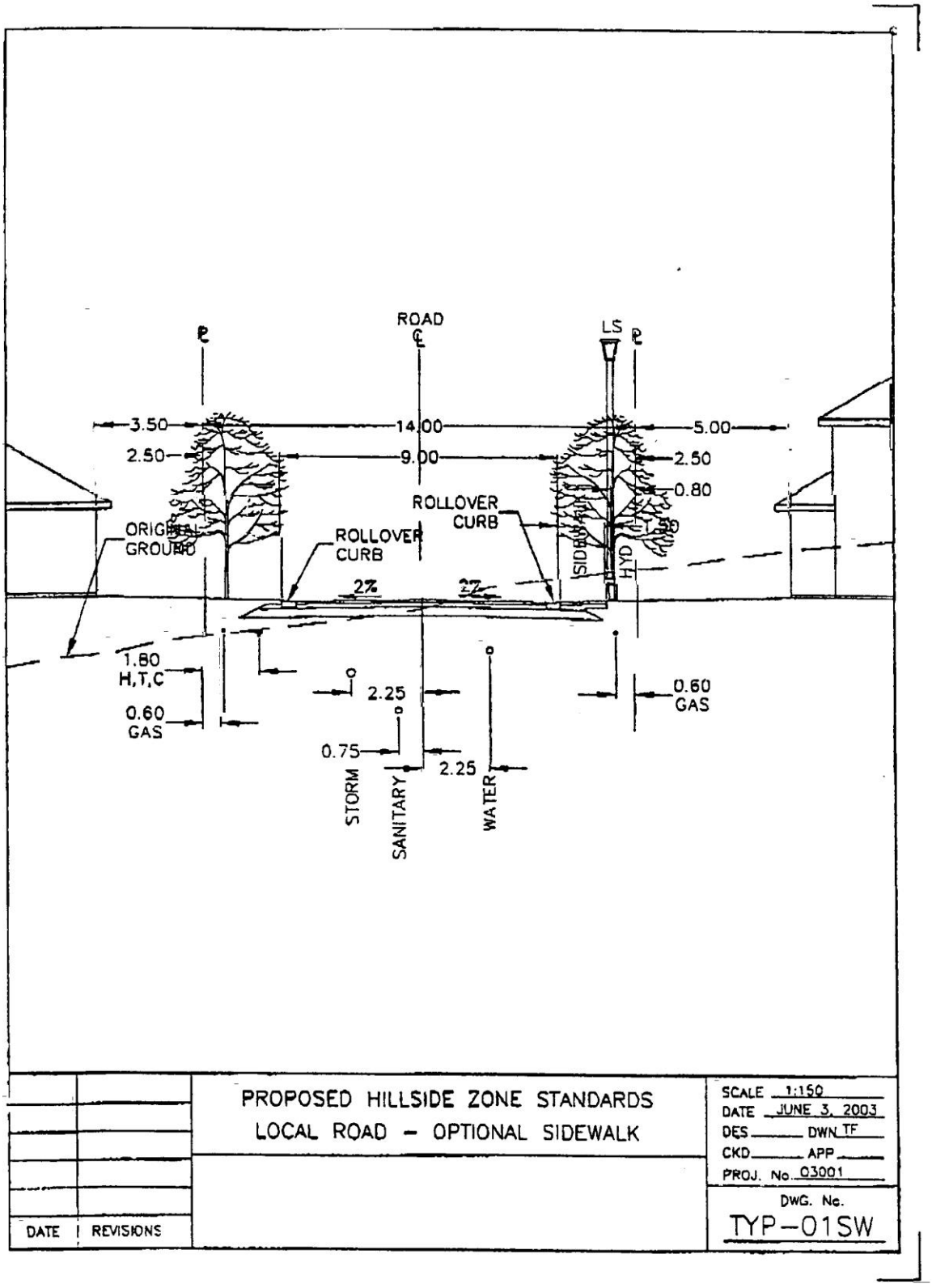
In order to help reduce the number of required manholes around a curve, manufactured long radius bends may be used to achieve curves, if approved by the City Engineer. The following standards should apply:

1. Maximum of 3 bends between manholes.
2. Minimum of 1 full pipe length (4m) between each bend.
3. All bends shall be supplied by an approved pipe manufacturer as listed in the City's approved products list.
4. All bends shall be a 'long radius bend'.
5. Maximum bend angle of 11.25 degrees.
6. Minimum pipe diameter of 200mm.
7. The resulting pipe alignment shall have a constant radius (i.e. no compound or reverse curves) which shall be noted on the design & as-built drawings. If bends are to be installed within a roadway, the radius for the pipe alignment shall have a constant offset from the road centreline or edge of curb.
8. Manholes must be installed within 10m of each end of the resulting equivalent radius.
9. The minimum pipe grade shall be governed by a minimum design velocity of 0.9 m/s. If flows of 0.9m/s are not expected, than the minimum grade shall be calculated based on the pipe flowing 35% full at 0.9m/s. However, in any case, the minimum grade shall not be less than 1%.
10. The as-built drawings shall detail the co-ordinates of each bend location.

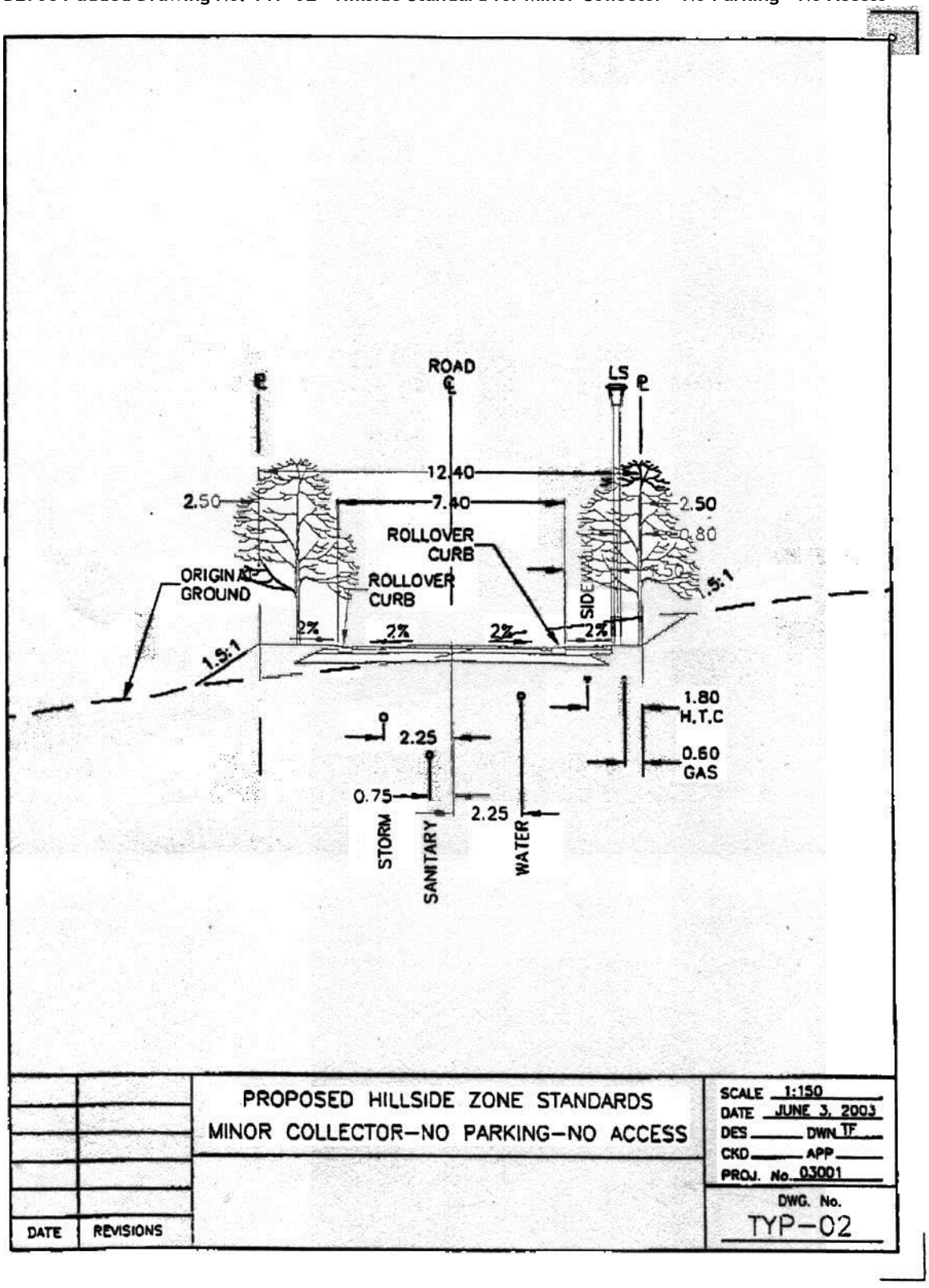
BL9051 added Drawing No. TYP-01 Hillside Standard for a Local Road



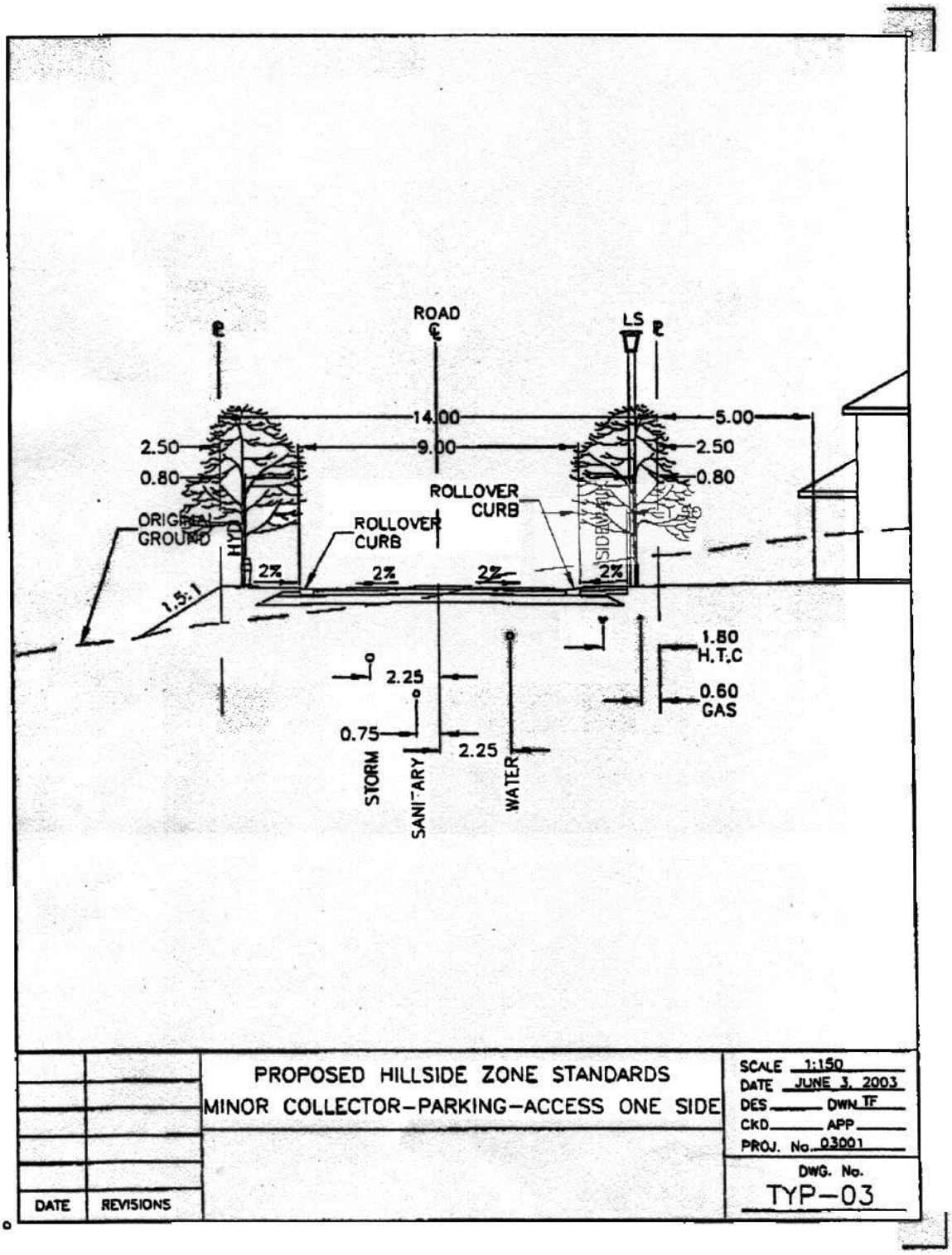
BL9051 added Drawing No. TYP-01SW – Hillside Standard for Local Road – Optional Sidewalk



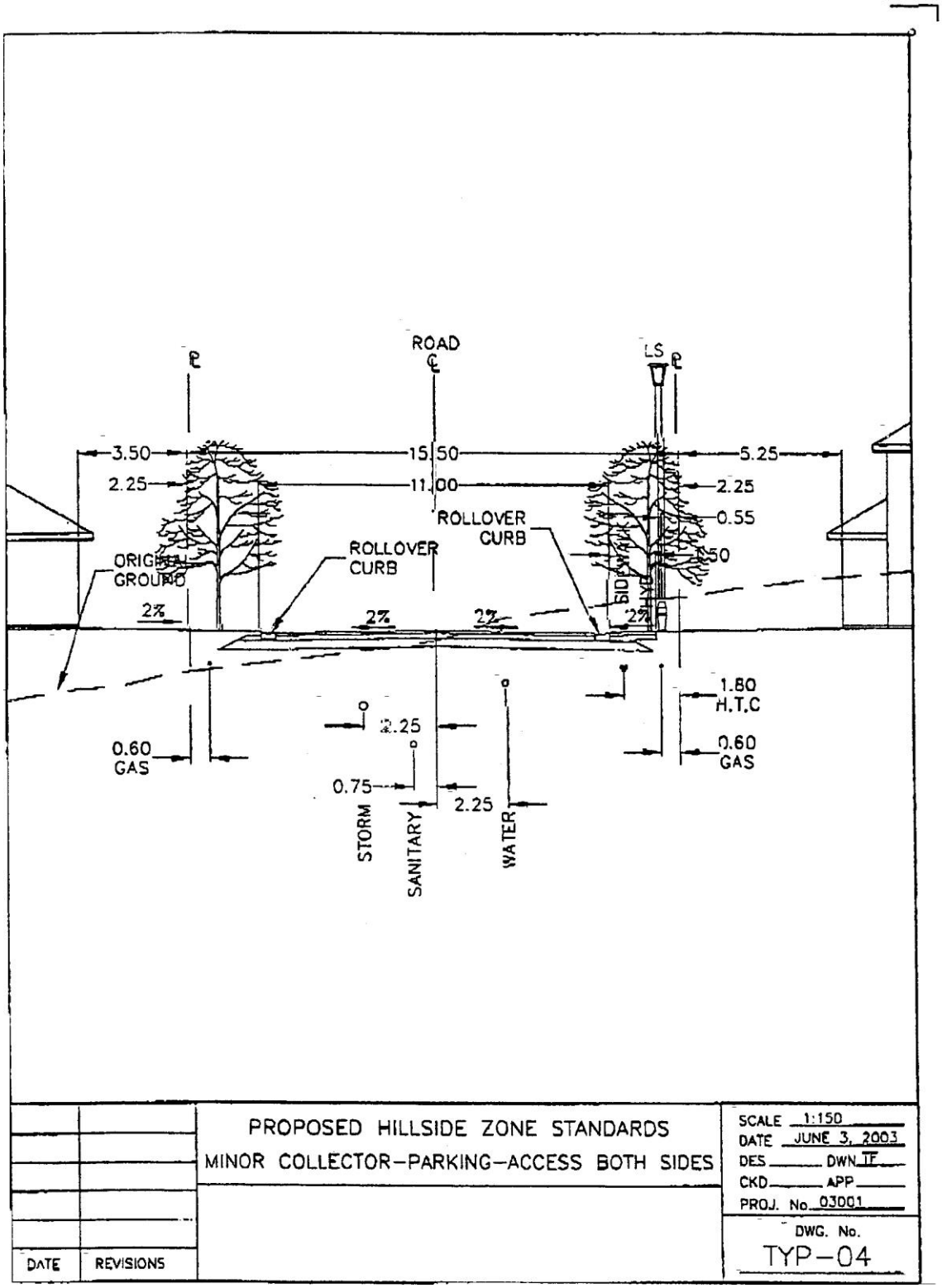
BL9051 added Drawing No. TYP-02 – Hillside Standard for Minor Collector – No Parking – No Access



BL9051 added Drawing No. TYP-03 – Hillside Standard for Minor Collector – Parking – Access One Side



BL9051 added Drawing No. TYP-04 – Hillside Standard for Minor Collector – Parking – Access Both Sides



BL10696 Amended Table 1:

TABLE 1

Hillside Street Standards

Street Conditions			Street Section Specifications							
Street Type and Condition (Std Drawing number)		**Max. Units Served**	**Design Speed[1] (km/h)**	**Max. Grade (%)**	• *ROW* **(m)**	**Street Width[2] (m)**	• ***Parking***	**Curb & Gutter**	**Sidewalk[3]**	**Street Trees**
Arterial Streets		**>600**								
Condition A (median) (SS-H1)	within village centre where environmental conditions permit		60 (50)[4]	8 (10)[11]	23.0	16.0[5]	none permitted	barrier curb required	required both sides[6]	required both sides and in median
Condition B (SS-H2)	within 10-minute walking distance[7] of village centre; or, within village centre where environmental conditions do not permit the use of Condition A		60 (50)[4]	8 (10)[11]	17.0[8]	10.0[8]	none permitted	barrier curb required	Required both sides[6]	required both sides
Condition C (SS-H3)	greater than a 10-minute walking distance[7] from village centre.		60 (50)[4]	8 (10)[11]	15.0[8]	10.0[8]	none permitted	barrier curb required	Required one side[6]	required both sides
Village Collector Streets (main street)		**600**								
Condition A (SS-H4)	• where commercial development fronts street		50	10	20.0	12.8	required on-street both sides	barrier curb required	required both sides	required both sides
Condition B (SS-H5)	• where no commercial development fronts street		50	10	20.0	12.8	required on-street both sides	barrier curb required	required both sides	required both sides
Collector Streets		**600**								
Condition A (SS-H6)	• development[9] fronts both sides		50 (40)[4]	10 (12)[11]	18.2[8]	8.6[8]	required above curb both sides	rollover curb required	required both sides[6]	required both sides
Condition B (SS-H7)	• development[9] fronts one side only		50 (40)[4]	10 (12)[11]	14.9[8]	8.6[8]	required above curb one side	rollover curb required[12]	required one side[6]	required both sides

Condition C (SS-H8)	• no development[9] fronts street		50 (40)[4]	10 (12)[11]	14.0[8]	8.6[8]	none permitted[10]	rollover curb required[12]	required one side[6]	required both sides
Minor Collector Streets		**500**								
Condition A (SS-H9)	• development[9] fronts both sides; or, • development[9] fronts one side only		50 (40)[4]	10 (12)[11]	13.3[8]	7.0[8]	required above curb one side	rollover curb required	required one side[6]	required on one side
Condition B (SS-H10)	• no development[9] fronts street		50 (40)[4]	10 (12)[11]	12.4[8]	7.0[8]	none permitted[10]	rollover curb required	required one side[6]	required on one side

TABLE 1 (continued)

Hillside Street Standards

Street Conditions			Street Section Specifications							
Street Type and Condition (Std Drawing number)		**Max. Units Served**	**Design Speed[1] (km/h)**	**Max. Grade (%)**	• *ROW* **(m)**	**Street Width[2] (m)**	• *Parking*	**Curb & Gutter**	**Sidewalk[3]**	**Street Trees**
Village Local Streets		**200**								
Village Local (SS-H11)	• development[9] fronts at least on side		40 (30)[4]	12	17.4	8.7	required on-street both sides	barrier curb required	required minimum one side[6]	required both sides
Local Streets		**200**								
Condition A (SS-H12)	• development[9] fronts both sides		30	15	14.1	6.0	required above curb both sides	rollover curb required	optional one side[6]	required on one side
Condition B (SS-H13)	• development[9] fronts one side only		30	15	12.3	6.0	required above curb one side	rollover curb required	optional one side[6]	required on one side
Condition C (SS-H14)	• no development[9] fronts street		30	15	10.5	6.0	none permitted[10]	rollover curb required	optional one side[6]	required on one side
Public Lane		10								
(SS-H15)	• all cases		20	12 (15)[11]	6.0	5.7	on edge of paved surface	rollover curb required	none	--
Hillside Emergency and Utility Vehicle Access		--								
• provide a secondary access route, if possible, where a cul-de-sac exceeds maximum street length as specified by the City of Kelowna			--	15	4.5	4.5	--	--	--	--

Footnotes:

1. See Table 2 for alignment design criteria for each design speed.
2. Street width measured from curb face (gutterline).
3. For all conditions, sidewalks should terminate at a destination or connect with another sidewalk or trailhead.
4. Minimum permitted design speed reduction, where necessary due to topographic constraints, and approved by the City.
5. Separate left turn lanes to be provided in the medians.
6. Where issues of livability warrant, (eg. extreme topographic conditions) sidewalk(s) may be located in a separate dedicated corridor and street ROW width reduced accordingly. Unless necessary for pedestrian connectivity to schools, parks, commercial areas or land beyond, a sidewalk is not required for local streets accessing 30 lots or less. Street right of way may be reduced accordingly if a sidewalk is not required. (see Standard Drawings)
7. For this purpose, the 10-minute walking distance is considered to be ½ mile (0.8 km).
8. Where required, ROW and street widths will be increased at major intersections to provide for separate turning lanes.
9. "Development" includes all residential, mixed-use, commercial, institutional and park uses.
10. All parking shall be managed on-site or within small parking pullouts, as required.
11. Maximum grade permitted where necessary due to topographic constraints and as approved by the City.
12. Where no fronting development (driveway access not required), barrier curbs to be considered to restrict illegal parking on sidewalks.

Table 2
Alignment Design Criteria

BL10640 amended the following:

1. Horizontal Curve Radii

Criteria	60 km/h	50 km/h	40 km/h	30 km/h
Roadway Crossfall				
normal crown (-2%)	260m	165m	90m	25m
2% superelevation	205m	120m	65m	25m
4% superelevation	150m	80m	45m	22m
6% superelevation	120m	-	-	-
Through Intersections	200m	120m	70m	40m

2. Superelevation

Criteria	60 km/h	50 km/h	40 km/h	30 km/h
Maximum Superelevation	6%	4%	4%	4%
Maximum Superelevation at Intersections	4%	4%	4%	4%

3. Superelevation Transition Lengths

Criteria	60 km/h	50 km/h	40 km/h	30 km/h
Transition Lengths (2 / 4-lane roadways)				
normal crown to +2%	24m / 36m	22m / 34m	20m	20m
normal crown to +4%	38m / 54m	33m / 50m	30m	30m
normal crown to +6%	48m / 72m	-	-	-
Min Tangent Length between reversing				
2% superelevation (2 / 4-lane roadways)	15m / 22m	13m / 20m	12m	12m
4% superelevation	28m / 42m	26m / 40m	24m	22m
6% superelevation	42m / 64m	-	-	-

1 Values for transition lengths include tangent runout applied at the same rate as superelevation runoff.
2 60% of superelevation runoff occurs on the tangent approach and 40% on the curve, resulting in a minimum length of tangent between reversing curves of 120% of the superelevation runoff length.

Table 2 (continued)
Alignment Design Criteria

4. Gradients

Criteria	60 km/h	50 km/h	40 km/h	30 km/h
Minimum Grade	0.5%	0.5%	0.5%	0.5%

Table 2 (continued)
Alignment Design Criteria

4. Gradients

Criteria	60 km/h	50 km/h	40 km/h	30 km/h
Maximum Grades				
on horizontal tangents	8%[1]	10% [2]	12%	12%
on minimum radius horizontal curves [3]	8%	9%	10%	10%
Grades Through Intersections				
with design speed on major road	8%	8%	8%	-
approach distance for major road [4]	15 / 5m [5]	5m	0m	-
with design speed on minor road	5% [6]	5%	6%	6%
approach distance for minor road [7]	20m	15m	5m	5m

1 Under special circumstances, grades up to 10% may be permitted.
2 Under special circumstances, grades up to 12% may be permitted.
3 Applies where radius is less than 1.5 times minimum allowable radius.
4 Minimum distance back from the gutter line of the minor road that the specified grade may not be exceeded.
5 Distances for design road approach to intersection with collector road / local road.
6. 4% desirable.
7 Minimum distance back from the gutter line of the major road that the specified grade may not be exceeded.

5. Vertical Curve K Values

Criteria	60 km/h	50 km/h	40 km/h	30 km/h
Minimum Crest	15	8	4	2
Minimum Sag	10	7	4	2
Crest / Sag on approach to stop condition	4	3	2	2

K values listed assume that new roadways will be illuminated

6. Stopping Sight Distances

Criteria		60 km/h	50 km/h	40 km/h	30 km/h
Down grades:	12%	109	78	52	34
	9%	101	73	50	32
	6%	94	69	48	31
	3%	89	66	46	30
	0%	85	63	45	30
Up grades:	3%	81	61	44	29
	6%	78	59	42	29
	9%	76	57	41	28
	12%	73	56	40	28

7. Decision Sight Distance

Minimum decision sight distance for 60 km/h: 175m – 235m.

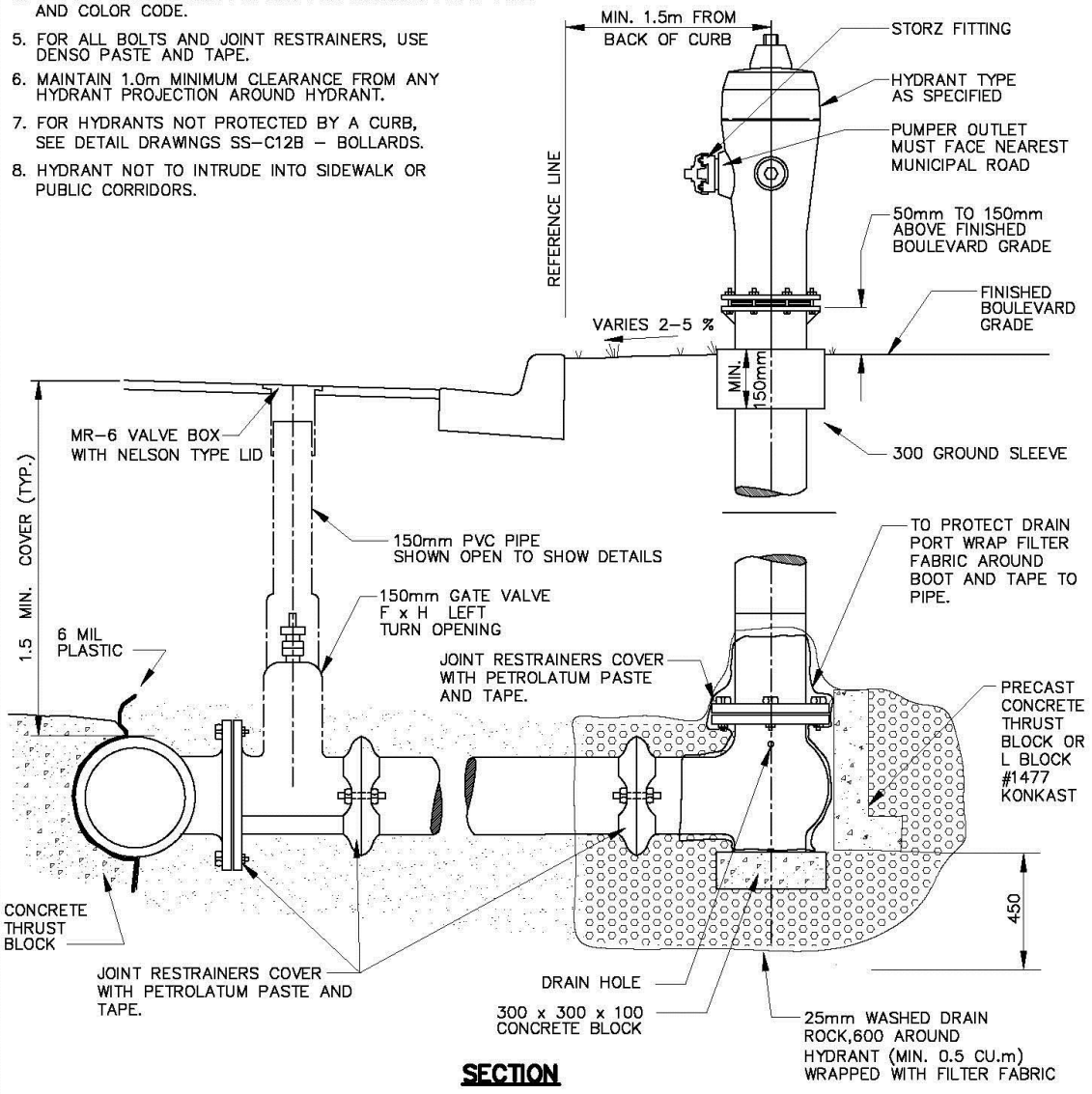
1. Note that decision sight distance applies only to multi-lane roads at intersections.
2. The range of values recognizes the variation in complexity that occurs at various sites. For less complex situations, values towards the lower end of the range are appropriate and for more complexity, values at the upper end are used.

Attachment "B"

STANDARD DETAIL DRAWINGS

NOTES:

1. HYDRANTS – IN ACCORDANCE WITH APPROVED PRODUCTS LIST.
2. HYDRANTS SHALL HAVE 2 – 63.5mm OUTLETS B.C. STANDARD
   1 – 100mm PUMPER OUTLET WITH STORZ FITTING
3. ALL HYDRANTS TO HAVE 300DIA. GROUND SLEEVE (SDR 35 PVC)
4. SEE APPROVED PRODUCTS LIST FOR HYDRANT PAINT TYPE AND COLOR CODE.
5. FOR ALL BOLTS AND JOINT RESTRAINERS, USE DENSO PASTE AND TAPE.
6. MAINTAIN 1.0m MINIMUM CLEARANCE FROM ANY HYDRANT PROJECTION AROUND HYDRANT.
7. FOR HYDRANTS NOT PROTECTED BY A CURB, SEE DETAIL DRAWINGS SS–C12B – BOLLARDS.
8. HYDRANT NOT TO INTRUDE INTO SIDEWALK OR PUBLIC CORRIDORS.



SECTION

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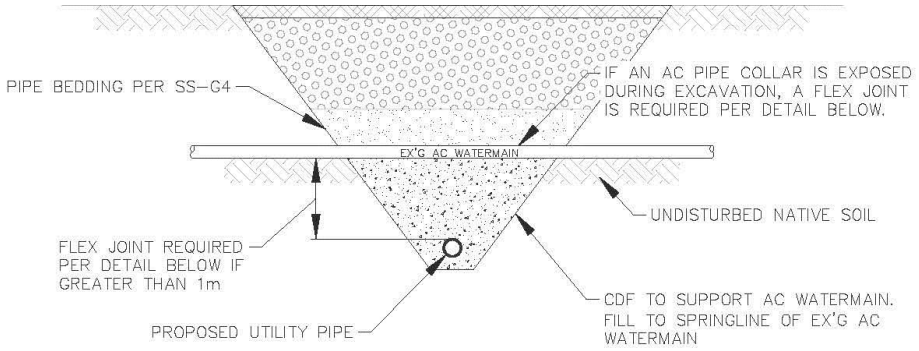
HYDRANT

JUNE 29/18

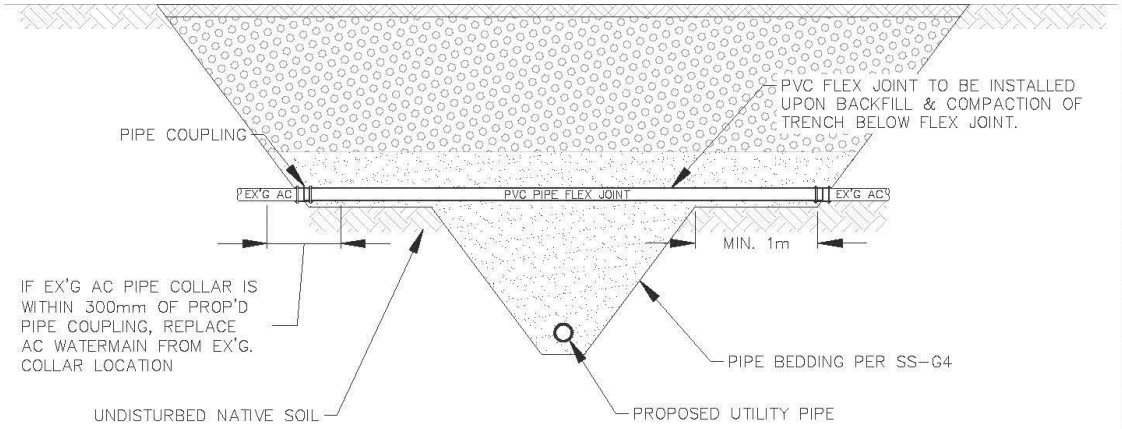
SS–W4

Attachment "C"

STANDARD DETAIL DRAWINGS



CDF SUPPORTED CROSSING



FLEX JOINT CROSSING

NOTES:

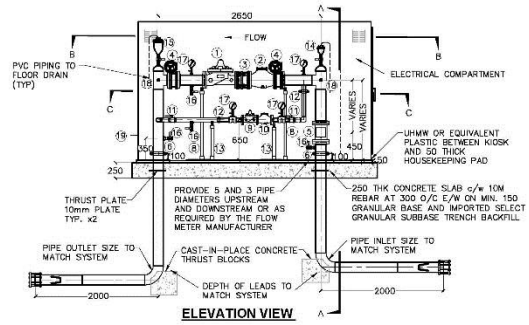
1. TRENCHING TO COMPLY WITH WORKSAFE REGULATIONS.
2. PIPE BEDDING & TRENCH BACKFILL TO BE PER SS-G4.
3. SURFACE RESTORATION TO BE AS REQUIRED PER SS-G5.
4. FLEX JOINT REQUIRED IF EXISTING WATERMAIN IS CLASS 100 AC.
5. PROPOSED AND EXISTING MAINS WITHIN CDF TO BE WRAPPED WITH POLY.
6. BASE OF CDF AREA TO BE TWICE THE DIAMETER OF THE SUPPORTED MAIN.
7. PIPE & COUPLINGS TO BE PER APPROVED PRODUCTS LIST.

AC WATERMAIN CROSSINGS

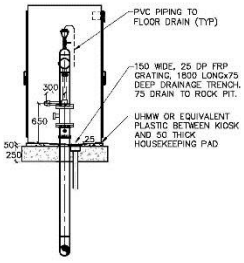
SS-W52

SCALE: NTS

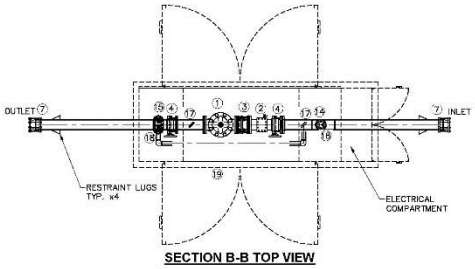
2018-02-19



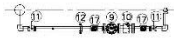
ELEVATION VIEW



SECTION A-A SIDE VIEW



SECTION B-B TOP VIEW



SECTION C-C TOP VIEW (LOWER RUN)

NOTES:
1. ALL PIPE & FITTINGS TO BE PER APPROVED PRODUCTS LIST.
2. ALL PIPING 316 STAINLESS STEEL.
3. COORDINATE WITH FORTIS TO PROVIDE A 120/240 VAC, 100A SERVICE C/W CABLE PULL BOX IN KIOSK.
4. KIOSK TO BE SUPPLIED WITH:
   - 500W BASEBOARD HEATER AND TWO VENTILATION FANS C/W HEATING AND COOLING THERMOSTATS
   - TEMPERATURE AND HUMIDITY TRANSMITTER
   - FLOW TRANSDUCER AND FLOW INDICATING TRANSMITTER
   - 2-15A GFCI RECEPTACLES
   - DATA RADIO AND YAGI ANTENNA
   - 1000VA UPS
   - O&M MANUALS

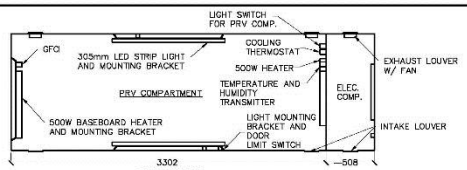
MATERIALS LIST		
ITEM	QTY	DESCRIPTION
1	1	PRESSURE REDUCING VALVE W/ POSITION INDICATOR, AWWA EPOXY COATING AND S.S. TRIM – APPROVED SUPPLIERS: CLA–VAL OR SINGER
2	1	"H" STRAINER W/ EPOXY COATING, S.S. HARDWARE AND S.S. BLOWDOWN VALVES – APPROVED SUPPLIERS: CLA–VAL OR SINGER
3	1	DISMANTLING JOINT W/ S.S. FASTENERS – APPROVED SUPPLIERS: ROBAR OR OTHER APPROVED SUPPLIER
4	2	BUTTERFLY VALVE W/ S.S. DISC AND HANDWHEEL – APPROVED SUPPLIERS: MUELLER, DEZURIK OR VICTAULIC
5	1	MAG METER W/ REMOTE DISPLAY IN ELECTRICAL CABINET–APPROVED SUPPLIERS: SIEMENS OR ROSEMOUNT
6	2	RIGID COUPLING FOR S.S. – APPROVED SUPPLIERS: VICTAULIC OR SHURJOINT
7	2	EXTERNAL TRANSITION COUPLING – APPROVED SUPPLIERS: ROBAR OR OTHER APPROVED SUPPLIER
8	2	CWS ADJ. GALV. STEEL PIPE SUPPORT
9	1	PRESSURE REDUCING VALVE W/ POSITION INDICATOR, AWWA EPOXY COATING AND S.S. TRIM – APPROVED SUPPLIERS: CLA–VAL OR SINGER (BYPASS)
10	1	"H" STRAINER W/ EPOXY COATING, S.S. HARDWARE AND S.S. BLOWDOWN VALVES – APPROVED SUPPLIERS: CLA–VAL OR SINGER (BYPASS)
11	2	S.S. BALL VALVE (BYPASS)
12	2	RIGID COUPLING FOR S.S. – APPROVED SUPPLIERS: VICTAULIC OR SHURJOINT (BYPASS)
13	2	CWS ADJ. GALV. STEEL PIPE SUPPORT (BYPASS)
14	1	AIR RELEASE VALVE W/ S.S. ISOLATION VALVE AND VENT PIPE – APPROVED SUPPLIERS: VALMATIC OR VENT–O–MAT
15	1	COMBINATION AIR RELEASE VALVE W/ S.S. ISOLATION VALVE AND VENT PIPE – APPROVED SUPPLIERS: VAL–MATIC OR VENT–O–MAT
16	4	THREADOLET W/ S.S. BALL VALVE AND PLUG
17	4	(100mm) LIQUID FILLED PRESSURE GAUGE (6MM NPT) W/ S.S. ISOLATION BALL VALVES AND TEE OR WELDOLET AS REQUIRED – APPROVED SUPPLIERS: SIEMENS OR ABB
18	2	(19mm) THREADOLET FOR WALL MOUNTED PRESSURE TRANSMITTER W/ S.S. BALL VALVE – APPROVED SUPPLIERS: SIEMENS OR ABB
19	1	ALUMINUM QUAD DOOR KIOSK WITH END CABINET PER APPROVED PRODUCTS LIST

PRESSURE REDUCING STATION

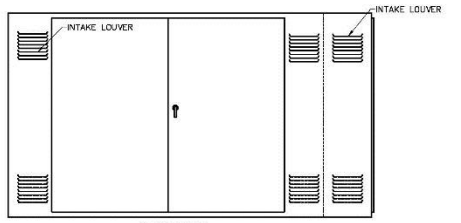
SCALE NTS

2018-06-12

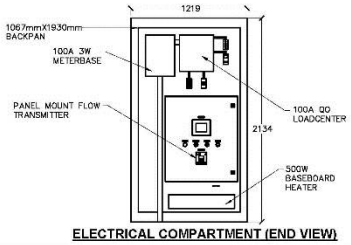
SS–W53a



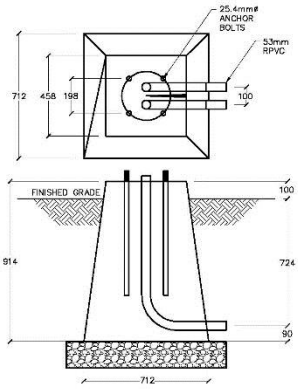
TOP VIEW

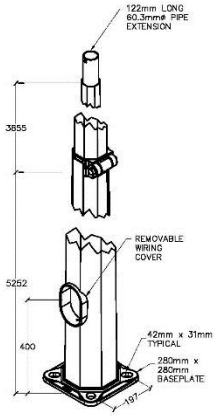


SIDE VIEW



ELECTRICAL COMPARTMENT (END VIEW)





RADIO ANTENNA POLE AND BASE DETAILS

ANTENNA MAST: WEST COAST ENGINEERING 19430 9107mm OVERALL HEIGHT HINGED POLE, HOT DIPPED GALVANIZED, MOUNT ANTENNA MAST ASSEMBLY ON KON KAST (KELOWNA, B.C.) NUMBER 1045 STANDARD BASE

PRESSURE REDUCING STATION

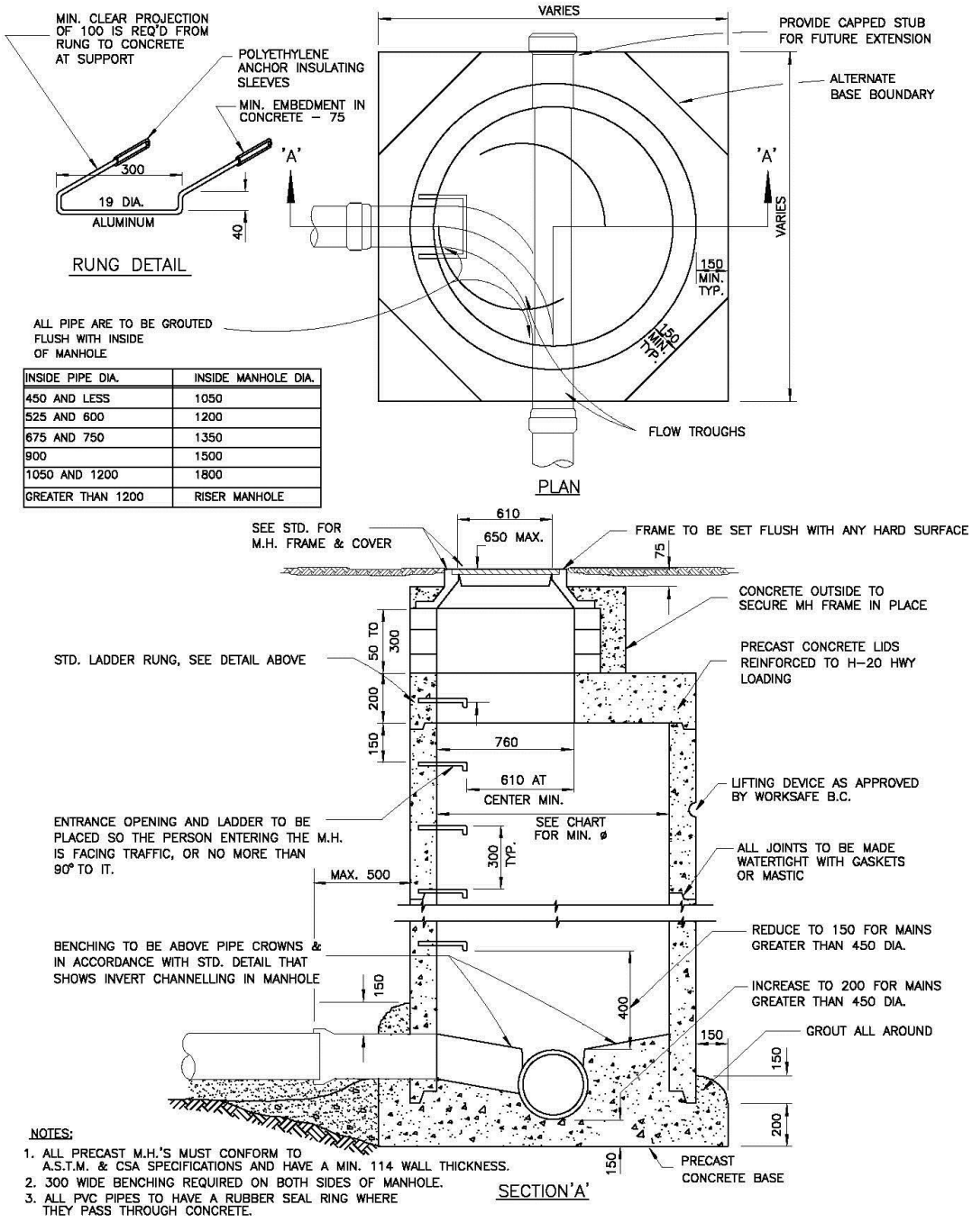
SCALE NTS

2018-08-12

SS-W53b

Attachment "D"

STANDARD DETAIL DRAWINGS



INSIDE PIPE DIA.	INSIDE MANHOLE DIA.
450 AND LESS	1050
525 AND 600	1200
675 AND 750	1350
900	1500
1050 AND 1200	1800
GREATER THAN 1200	RISER MANHOLE

NOTES:

1. ALL PRECAST M.H.'S MUST CONFORM TO A.S.T.M. & CSA SPECIFICATIONS AND HAVE A MIN. 114 WALL THICKNESS.
2. 300 WIDE BENCHING REQUIRED ON BOTH SIDES OF MANHOLE.
3. ALL PVC PIPES TO HAVE A RUBBER SEAL RING WHERE THEY PASS THROUGH CONCRETE.

MANHOLES

JULY 25/18

SS–S1a

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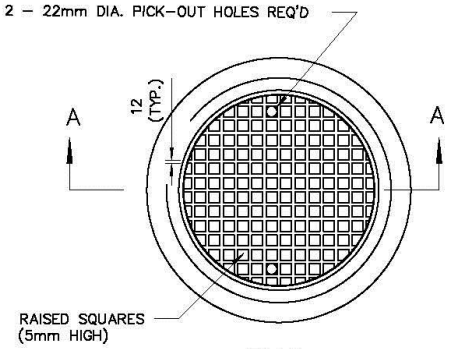
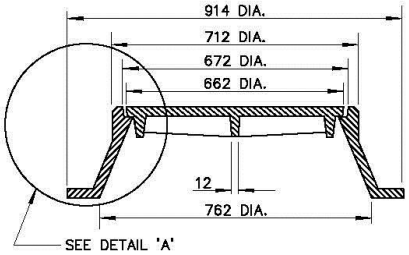
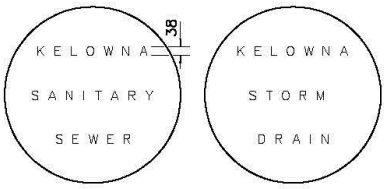
STANDARD DETAIL DRAWINGS



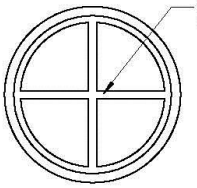
PLAN



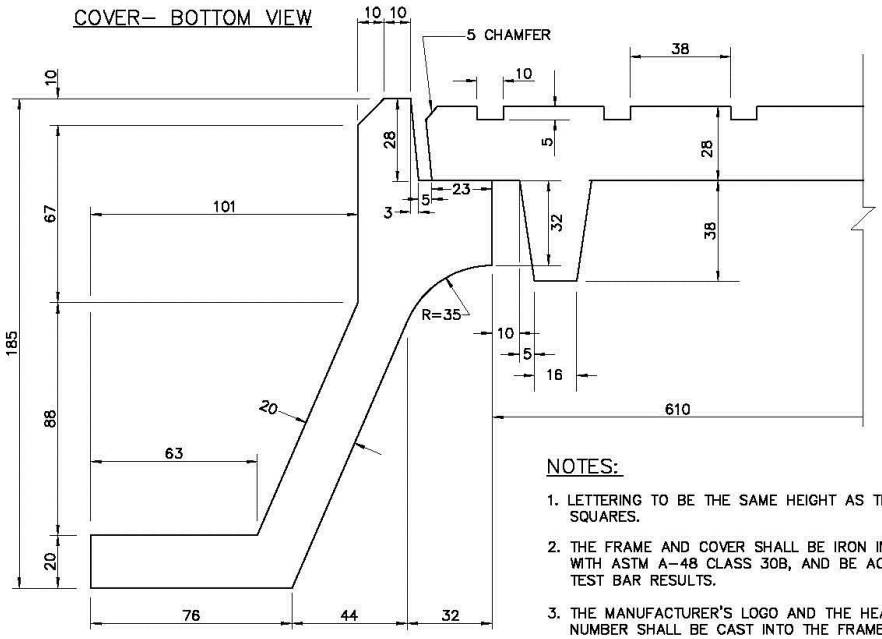
SECTION 'A–A'



STANDARD LETTERING ON COVER



COVER– BOTTOM VIEW



DETAIL 'A'

NOTES:

1. LETTERING TO BE THE SAME HEIGHT AS THE RAISED SQUARES.
2. THE FRAME AND COVER SHALL BE IRON IN ACCORDANCE WITH ASTM A–48 CLASS 30B, AND BE ACCOMPANIED BY TEST BAR RESULTS.
3. THE MANUFACTURER'S LOGO AND THE HEAT SERIES NUMBER SHALL BE CAST INTO THE FRAME AND COVER.
4. COVER AND FRAME TO BE ABLE TO WITHSTAND 175 kN (40 000LBS) LOAD APPLIED AT THE CENTER OF THE COVER ON A 50mm THICK 250 x 250 RUBBER PAD.
5. THE CONTACT SURFACES BETWEEN THE FRAME AND THE COVER ARE TO BE MACHINED SMOOTH.

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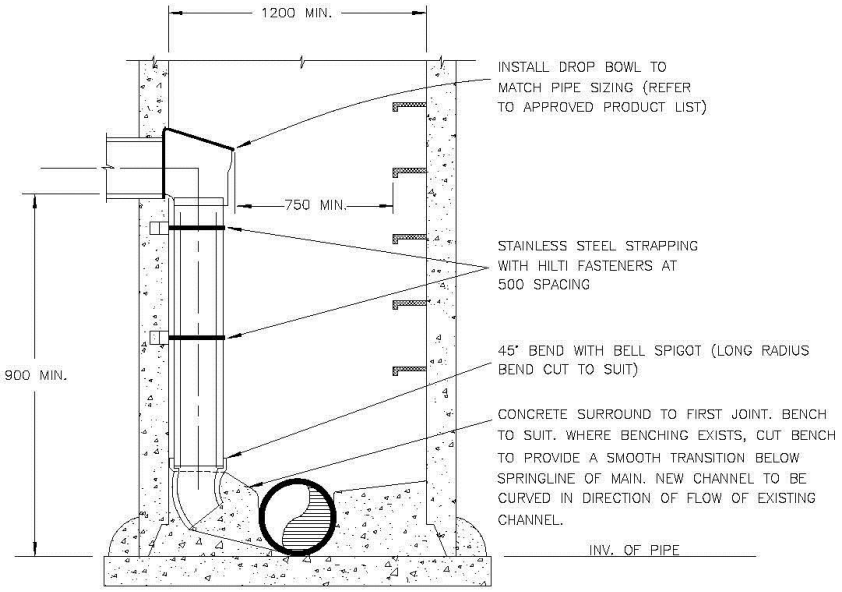
MANHOLE FRAME AND COVER

JUNE 28/18

SS–S1b



INSIDE DROP TYPE

NOTE:

1. INSIDE DROP TO BE USED WHERE SPECIFIED BY ENGINEER.
2. ALL INSIDE PIPE AND FITTINGS PVC DR 28/35.
3. THIS DRAWING SHOWS INSIDE DROP ONLY. SEE DRAWING SS-S1A FOR ALL OTHER DETAILS PERTAINING TO MANHOLE REQUIREMENTS.
4. REFER TO CONTRACT DRAWINGS. SECTION 33 44 01 FOR DETAILED SPECIFICATIONS.

NOT TO SCALE

INSIDE DROP MANHOLE

SS-S4

JULY 4/18

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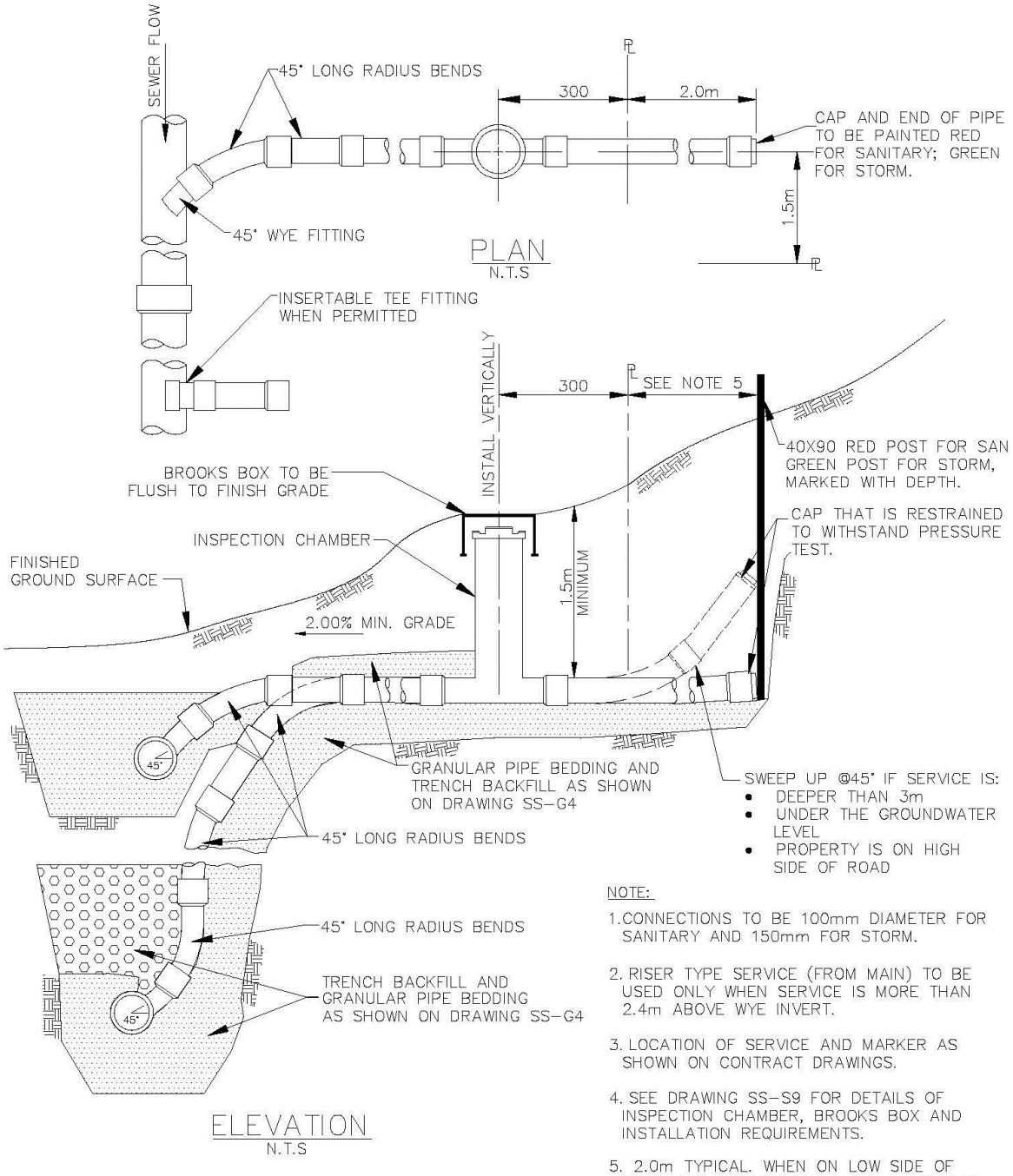


NOTE:

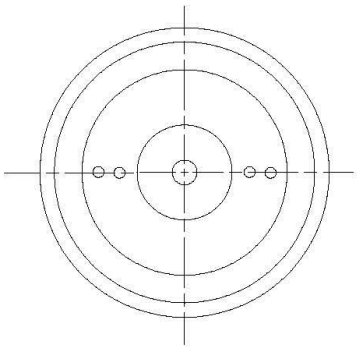
1. CONNECTIONS TO BE 100mm DIAMETER FOR SANITARY AND 150mm FOR STORM.
2. RISER TYPE SERVICE (FROM MAIN) TO BE USED ONLY WHEN SERVICE IS MORE THAN 2.4m ABOVE WYE INVERT.
3. LOCATION OF SERVICE AND MARKER AS SHOWN ON CONTRACT DRAWINGS.
4. SEE DRAWING SS-S9 FOR DETAILS OF INSPECTION CHAMBER, BROOKS BOX AND INSTALLATION REQUIREMENTS.
5. 2.0m TYPICAL. WHEN ON LOW SIDE OF ROAD AND PIPE DEPTHS > 2.0m, USE 4.0m
6. HORIZONTAL SEPARATION BETWEEN SANITARY SEWER SERVICE AND ADJUST WATER AND STORM SERVICES TO BE MINIMUM OF 0.5m

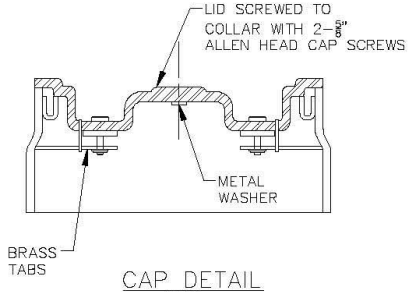
P:\DRAFTING\STANDARD_DRAWINGS\CITY_OF_KELOWNA\UTILITIES\DRAINAGE_AND_SANITARY\PROPOSED_FOR_COUNCIL\SS-S7

SANITARY AND STORM SEWER SERVICE CONNECTION

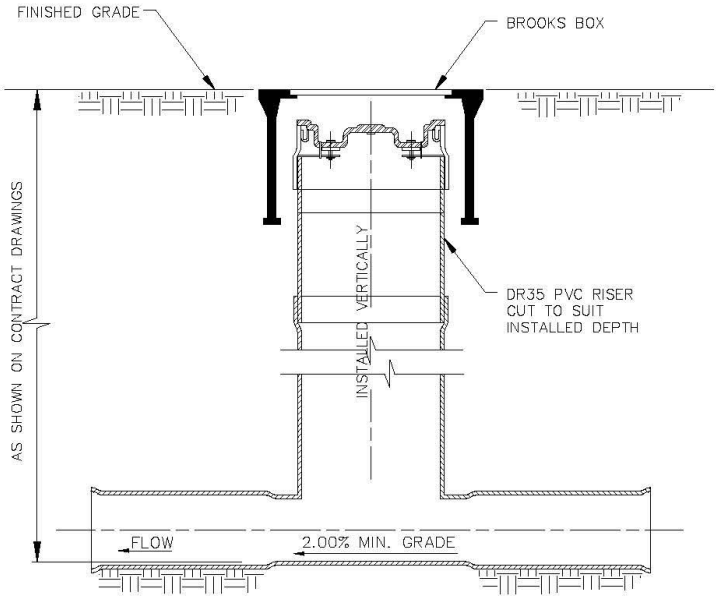
DRAWING NUMBER
SS-S7

REV. SEPT. 7/2018

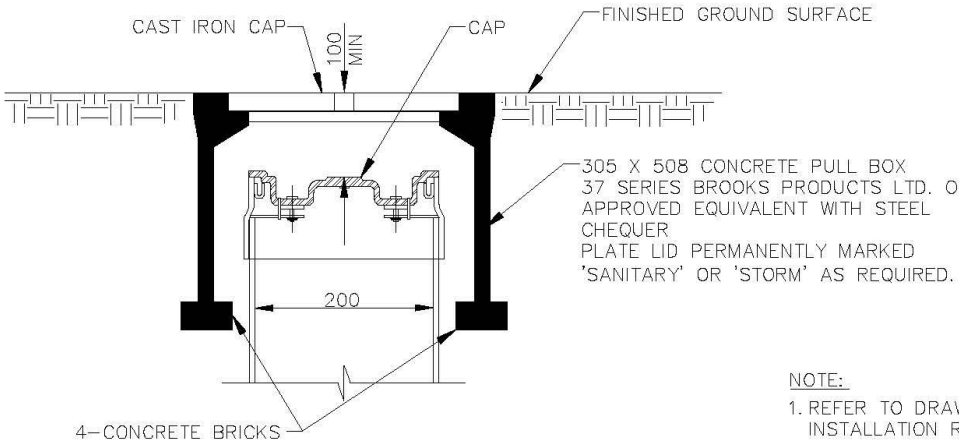




CAP DETAIL
N.T.S



PROFILE VIEW
N.T.S



BROOKS BOX DETAIL
N.T.S

NOTE:

1. REFER TO DRAWING SS–S7 FOR INSTALLATION REQUIREMENTS.
2. INSPECTION TO BE APPROVED MANUFACTURED FITTING.
3. REFER TO CONTRACT DRAWINGS FOR SITE SPECIFIC DIMENSIONS AND SECTION 02731 FOR DETAILED SPECIFICATIONS.
4. RED CAP FOR SANITARY AND GREEN CAP FOR STORM CONNECTIONS.

INSPECTION CHAMBER FOR 100 TO 200 SANITARY SEWER OR STORM DRAIN CONNECTION

DRAWING NUMBER
SS-S9

REV. JUNE. 28/18

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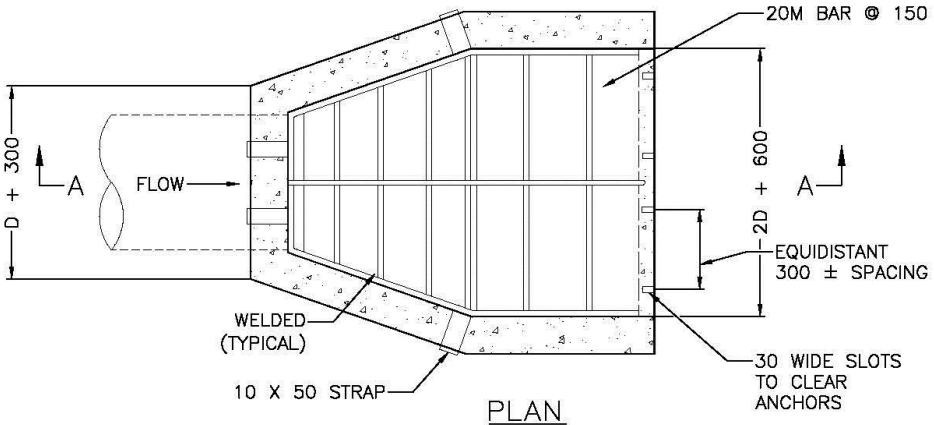
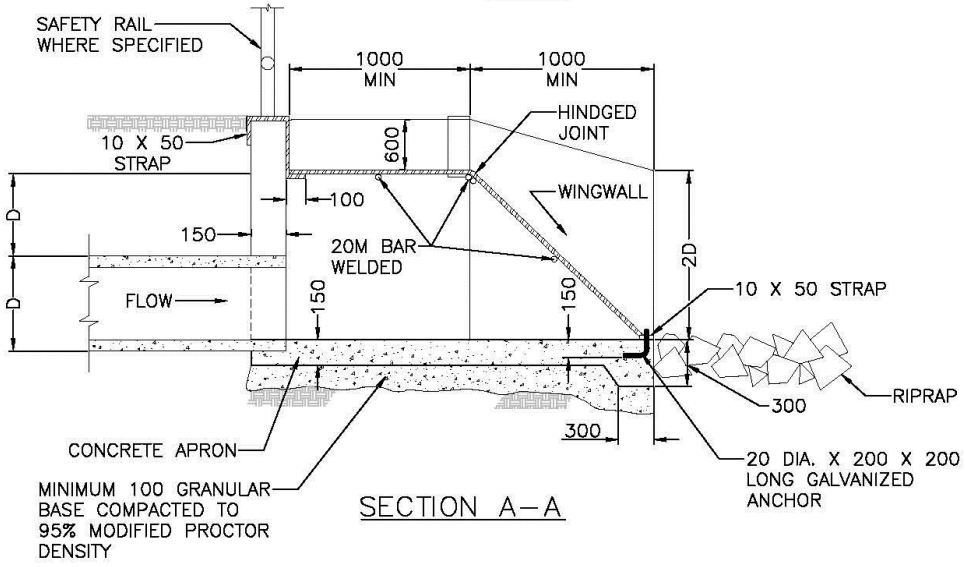
STANDARD DETAIL DRAWINGS



PLAN



SECTION A–A

NOTES

1. INSTALL SAFETY HANDRAIL IF SPECIFIED ON CONTRACT DRAWINGS
2. PRECAST UNIT MAY BE PROVIDED AS ALTERNATIVE WITH CONTRACT ADMINISTRATOR'S APPROVAL.
3. ALL STEEL COMPONENTS TO BE HOT DIPPED GALVANIZED AFTER FABRICATION.
4. SAFETY GRILLAGE TO BE WELDED AT ALL JOINTS AND CONNECTIONS EXCEPT AT ANCHOR BOLTS
5. REFER TO CONTRACT DRAWINGS FOR LOCATIONS AND SITE SPECIFIC DIMENSIONS. REFER TO SECTIONS 03200 AND FOR DETAILED SPECIFICATIONS.

STORM DRAIN OUTLET WITH SAFETY GRILLAGE

JUNE 28/18

DRAWING NUMBER:

SS–S13B

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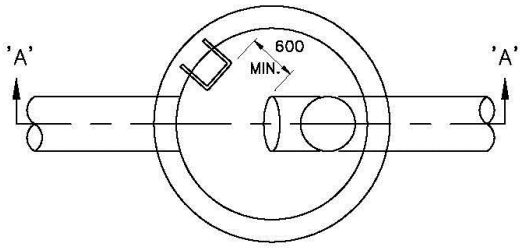
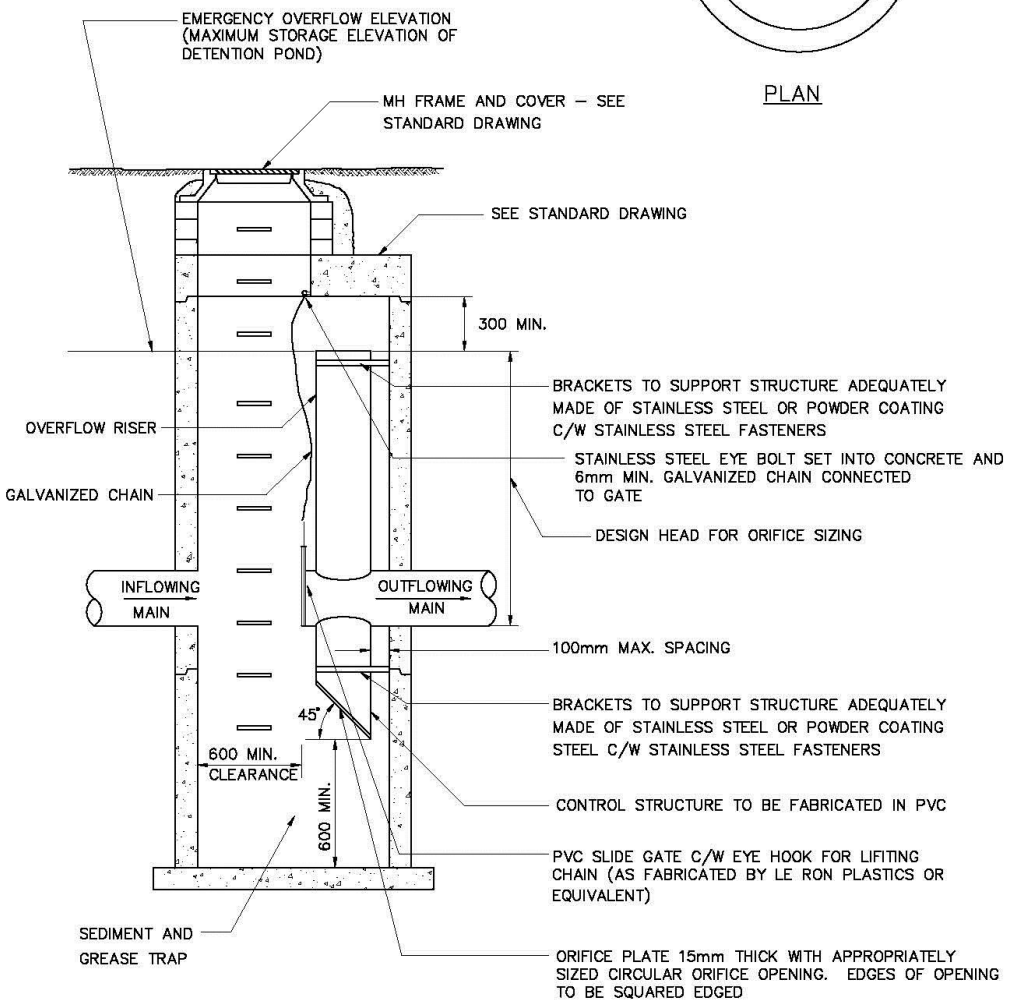
STANDARD DETAIL DRAWINGS



PLAN



SECTION 'A – A'

NOTES:
1. ALL DIMENSIONS IN MILLIMETRES.

FLOW CONTROL CHAMBER (WITH SEDIMENT & GREASE TRAP)

JULY 25/18

SS-S55

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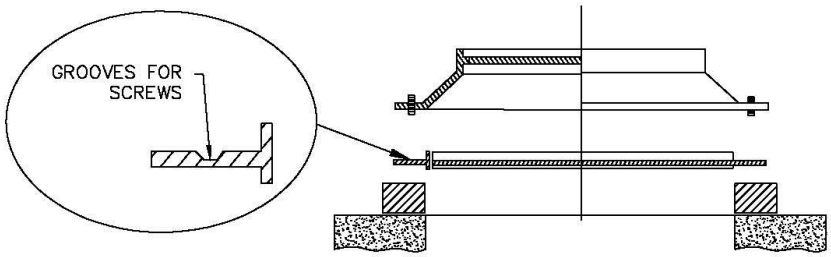
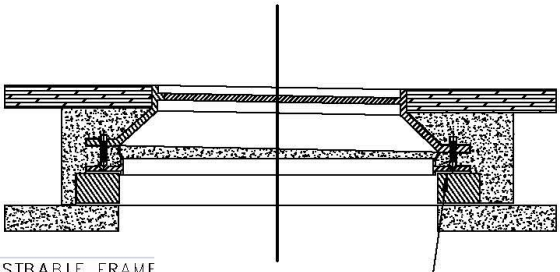
Attachment "E"

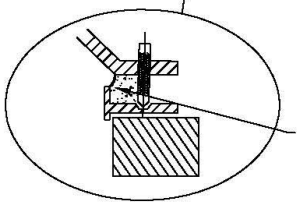
STANDARD DETAIL DRAWINGS



NOTES:
FOR GRADES >4% USE
LONGER SET SCREWS OR
USE SLOPE GRADE RINGS
AS RECOMMENDED BELOW.



ROAD GRADE	GRADE RING	ADJUSTBABLE FRAME
8-12%	8%	AFSR
4-8%	4%	AFSR
0-4%		AFSR ONLY



15mm MINIMUM GAP BETWEEN
TOP OF SUPPORT RING FORM
TO BOTTOM OF CASTING

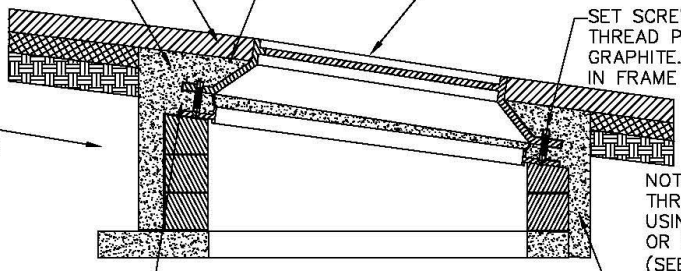
RAKE FINISH SURFACE OF CONCRETE
MAINTAIN MINIMUM 50mm ASPHALT
THICKNESS OVER CONCRETE

MIN. ASPHALT THICKNESS TO BE
50mm AROUND FRAME

FILL VOID
WITH CONCRETE

MATCH CONTOUR OF ROAD
SURFACE.

SET SCREW TO HAVE BONDED
THREAD PROTECTION AND
GRAPHITE. THREADED HOLES
IN FRAME



DO NOT EXCAVATE
BEYOND GRADE RINGS
100mm, RECOMMEND
HYDRO EXCAVATION

NOTE: PROTECT SET SCREW
THREADS FROM CONCRETE
USING PLASTIC THREAD CAPS
OR OTHER APPROVED EQUAL.
(SEE MANUFACTURERS
RECOMMENDATIONS.)

PLACE CONCRETE BETWEEN FRAME
AND SUPPORTING RING, IN A SINGLE
HOMOGENEOUS MANNER.
EXPOSED CONCRETE INSIDE CHIMNEY
TO BE HAND FINISHED SMOOTH

THICKNESS OF CONCRETE TO
BE 100mm
-CONCRETE 30 MPA
-10mm AGREGATE REDUCE
SHRINKAGE BY USE OF
PLASTISIZER

ADJUSTABLE MANHOLE FRAME AND COVER

SS-S1c

JUNE 28/2014

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