

REGIONAL DISTRICT OF NANAIMO

COMMUNITY SEWER SYSTEM STANDARDS

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1. GENERAL

1.1. Requirement

The RDN will require a “Subdivision Servicing Agreement” to be completed for any new sewer system or existing system extension, unless otherwise agreed to in writing by the RDN.

Sewage collection and conveyance systems shall be designed, installed, extended, tested and maintained in accordance with the following regulations and standards.

1.2. Design

The engineering design of the sewage collection and conveyance systems shall be carried out by, and the preparation of drawings and specifications shall be sealed by a Professional Civil Engineer registered in the Province of British Columbia, and shall conform to these Standards.

1.3. Definitions

ADWF: Average Dry Weather Flow

AWWF: Average Wet Weather Flow

B.O.D :Quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory procedure in 5 days at 20°C expressed in mg/l.

Collection facility: A facility used for the collection and conveyance of sanitary sewage.

Comminuted Garbage:The wastes from the preparation, cooking and dispensing of food that have been shredded to such a degree that all particles will be carried freely under the flow conditions normally prevailing in public sewers, with no particle greater than 6mm in any dimension

Design Flow: Peak sewage flow plus peak storm water infiltration.

Direct Service Area: Land and improvements directly served by the proposed facility.

Engineer: The Manager of Engineering Services for the Regional District of Nanaimo, or the person designated by the General Manager of Regional and Community Utilities.

Engineer of Record: A Professional Engineer registered with the Association of Professional Engineers and Geoscientists of BC who is responsible for the construction drawings and documents. The Engineer of Record will be the engineer that signs and seals the record drawings and the certification of installed works.

Facilities: Sewers, sewage treatment and disposal plants, pumping stations and other works necessary thereto, and outlets for carrying off, treating and disposing of sewage, and includes any and all works, structures, lands, conveniences, incidental to and necessary for a sewerage system.

Garbage: Solid wastes from domestic and commercial preparation cooking and dispensing of food, and from the handling, storage and sale of produce.

Industrial Waste: Liquid waste from industrial manufacturing processes trade or business, as distinct from sanitary sewage.

Lateral Sewer: Sewer serving more than a single subdivided parcel

LPCPD: Litres per capita per day

l/s: Litres per second

mg/l: milligrams per litre

MPa: megapascals (1000 kPa)

Member Municipality or Member: A municipality or improvement district within the Regional District of Nanaimo.

M³/ha: cubic metres per hectare

M³pd: cubic metres per day

PDWF: Peak Dry Weather Flow

pH: The logarithm of the reciprocal of the weight of hydrogen ions in grams per litre of solution

ppm: parts per million

Peaking Factor (PF) : The Ratio of peak dry weather flow to the average dry weather flow.

Regional District: In this document the Regional District shall refer to the Regional District of Nanaimo.

Sanitary Sewage: Sewage having a quality substantially equal to that of normal domestic sewage

Sanitary Sewer: A sewer which carries sewage and to which storm, surface and ground water are not intentionally admitted

Service Connection: A sewer connection a subdivided lot to the lateral sewer

Sewage Treatment Plant: An arrangement of structures and devices used for treating sewage

Stormwater Infiltration: The infiltration of groundwater or inflow of stormwater through leaks and connections into the system

Suspended Solids: Solids that either float on the surface of, or are in suspension in water, sewage or other liquids, and which are removable by laboratory filtering

Tributary Area: All land in the service area tributary to the proposed facility

1.4. Application

All applications shall be made in the following steps:

.1 Feasibility Review

All proposed construction of sewage collection and conveyance facilities shall be submitted to the Regional District for a feasibility review prior to commencement of any detailed design or construction. Such requests shall include a plan of the proposed construction and the area it will serve. The applicable feasibility review fee, in accordance with RDN Bylaw No. 1259.03 or most recent amendment, and the **Letter of Assurance** shall also be submitted at this time.

The Regional District will review the proposal, and reply in writing indicating the District's decision regarding acceptance or rejection, and/or the necessary amendments required.

.2 Detailed Design

The detailed design and specifications shall be submitted in duplicate to the Regional District for Design Stage Approval (DSA) prior to construction. Attached to the submission shall be a **Certification of Design**. The applicable engineering review fee, in accordance with RDN Bylaw No. 1259.03 or most

recent amendment, shall also be submitted at this time, along with the Design Professional Engineer's certified cost estimate for the works upon which the fee amount is based. *The final determination of the DSA fee shall be determined upon completion of the project and final certification of the construction costs by the **Design Professional**.*

The detailed plans will be returned either approved or with a request for re-submission. Re-submission will be carried out until the Regional District approves the detailed plans and specifications, and issues Design Stage Approval (DSA).

The designer shall submit the RDN approved plans to the Provincial Ministry of Transportation & Infrastructure and Vancouver Island Health Authority for approval permits. Receipt and submission of these permits to the RDN shall also be a prerequisite to the start of construction. Approval permits from other applicable agencies as required shall also be obtained.

1.5. Drawings and Specifications

All design drawings shall be ISO A1 size, 594 mm in depth and 841 mm in width the following information shall be supplied

1. **Location Plan** - showing the location of the proposed work. This may appear on the same sheet as the Key Plan.
2. **Key Plan** - showing a plan of the proposed work at a suitable scale such that the whole works are shown on one drawing, usually 1:5000, 1:2000 or 1:1000. The Key Plan shall show a general outline of the works, area covered and sheet numbers of the plan/profile drawings, and a legend showing existing and proposed works.
3. **Plans/Profiles** - showing detailed design of the proposed works.

Plans shall be drawn at a scale of 1:500 or 1:250, showing the location of the pipe centre line, pipe size and type and off-set from property line, manholes, services, trench details, trench dam details and all related appurtenances in relation to road, easement and adjacent property and lot lines. Existing or proposed underground utilities are to be indicated on the plan in addition to the extent of work required in making connection to existing sewer main. Location of service connections are to be shown. Connections not conforming to the standard offset require a distance from an iron pin or lot line.

Profiles shall be drawn at a horizontal scale of 1:500 and a vertical scale of 1:50 if more suited to specific conditions. The profile shall show the line of the existing and finished road grade on centreline, the invert of the pipe, location of manholes, and location of storm and water utilities. Where vertical curves are used, the invert elevation shall be shown at the beginning and end of the curves.

4. **Specifications** - shall be prepared to further define materials of construction and shall specify methods of construction and workmanship.
5. **Record Drawings** - shall be prepared by correcting drawings on completion of construction in order to reflect "record drawing" conditions for permanent records. The location of all individual lot sewer service connections shall be clearly shown with distance from the nearest manhole to the service wye. The drawings shall be signed and sealed by the Professional Civil Engineer, and shall be accompanied by a Certification of Installed Works. Final record drawings shall consist of:
 - (a) Two (2) full-size paper sets;
 - (b) One (1) full size 3 mil Mylar set;
 - (c) 2 – 11" X 17" paper sets or 2 A3 half-size paper sets, as agreed by the RDN; and
 - (d) Digital copies: one (1) as AutoCAD or Civil 3D file as applicable to the current software, and one (1) as TIFF files.

1.6. Variations from Standards

Where the applicant wishes to vary from these standards he shall submit a written request with adequate supporting data to the Regional District for review.

The Regional District shall make the final decision in writing as to the standard requirements which shall apply.

1.7. Permits

The applicant shall be responsible for obtaining all necessary approvals and permits required prior to commencing construction of the sewer system.

1.8. New Service Areas

Where a sewer system is to be constructed by an applicant within an area previously unserved by a community sewer system, the design and construction for the system shall comply with the requirements of these standards, unless otherwise agreed to in writing by the Regional District.

1.9. Existing Service Areas

Where a sewer system is to be constructed by an applicant within the existing or extended boundaries of an area already being served by a community sewer system, the design and construction of the system shall comply with the requirements of these standards.

1.10. Inspection

The Manager of Engineering Services of the Regional District or his appointed deputies shall be allowed access and provided adequate facilities for access to any part of the works at all times for the purpose of inspection.

Any connections to or interruption of any existing system will only be permitted be under the direct supervision of the Regional District. Adequate notice to the Regional District of any such interruption to service shall be provided in order that attendance by Regional District personnel can be arranged.

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2. DESIGN

2.1. Sewage Flows

Sanitary sewer systems shall be designed using the following formula to accommodate peak sewage flows and peak inflow & infiltration.

$$AWWF = PDWF + I\&I$$

Storm water connections shall not be made to the sanitary sewer system.

2.2. Design Population

Design contributory populations shall be calculated in accordance with the Regional District of Nanaimo's population predictions or with the ultimate planned development in the tributary area, whichever is greater.

The following densities shall be used for housing types listed below:

Housing Unit	Persons per unit	Notes
Single Family / detached house	2.2	Based on 2011 census for Nanoose: 5674 persons / 2,587 housing units. Nanoose is predominately single family (>90% of dwellings)
Townhouse (attached, semi-detached) unit	1.9	Based on 2011 census for City of Nanaimo, City of Victoria
Apartment / condominium unit	1.4	Based on 2011 census for City of Nanaimo, City of Victoria
Secondary suite (carriage house)	1.1	50% of single family, consistent with draft zoning bylaw
Seniors living unit	1.1	Per CWPC Senior`s Housing Group

Where units are not known the following should be used:

.1 Dwelling unit	30 pph
.2 Multi dwelling unit development	125 pph
.3 Commercial Equivalent of	50 pph
.4 Industrial Equivalent of	50 pph
.5 Institutional	50 pph

pph = persons per hectare

2.3. Sewage Flow Calculation

Average dry weather flow (ADWF) shall be established by multiplying the design population by an average daily sewage flow of 300 Litres per capita per day.

Peak dry weather flow (PDWF) shall be established by multiplying the ADWF by the peaking factor (PF) which obtained from the following formula.

$$PF=6.75*Population^{-0.11}$$

Peak dry weather flow can also be obtained using the graph contained in the standard drawing S-21.

For new developments, where water conservation measures are mandatory (such as low flow toilets), the sewage flow may be reduced by 10% from that obtained from this table.

Design sewage flows may be varied by the Regional District, where suitable metered flow record is available, or for developments utilizing wastewater (grey water) re-use onsite.

Peak inflow and infiltration (I&I) shall be calculated using:

- .1 12 m³/ha for Existing development areas
- .2 10 m³/ha for New development areas
- .3 The peak inflow and infiltration may be varied by the Regional District where suitable metered records for design storm events of maximum infiltration period of the year are available.

Design sewage rates of flow shall be computed by adding peak sewage flow to peak inflow and infiltration design allowances.

Sanitary sewage design calculations shall be prepared and submitted on a drawing showing the sanitary sewer tributary area as part of the detailed design drawings. If the sanitary sewer calculations are completed using modeling software the results of the software shall be displayed on the detailed design drawings. Use of modeling software shall be approved by the Regional District.

2.4. Sewage Characteristics

1. Sewage quality criteria shall be as follows:

Sewage Quantity (ADWF) in the Direct Service Area	Constituent	Average Normal
<50m ³ /day	BOD -5 day 20° C	1000mg/l
	Suspended Solids	800mg/l
	pH	4-10.5
	Temperature	79° C
50m ³ /day to 450 m ³ /day	BOD -5 day 20° C	400mg/l
	Suspended Solids	300mg/l
	pH	5-9.5
	Temperature	66° C
>450 m ³ /day	BOD -5 day 20° C	200mg/l
	Suspended Solids	200mg/l
	pH	5.5-9.0
	Temperature	54° C

2. Regulations governing the quality of wastes acceptable for admission to The Regional District of Nanaimo shall be followed and can be found in Bylaw 1225.

3. Where the existing industrial and/or commercial developments will be connected to the sewer system, the District may require that flow sampling be carried out to determine the design loadings; re-treatment of wastewater prior to discharge to the Regional District's facilities may be required.

2.5. Hydraulics

1. All facilities shall be designed to convey peak sewage flow plus peak I&I calculated as set out in section 2.3 sewage flow calculation.
2. Sewers shall be designed to carry the calculated design flow at a minimum velocity of 0.6 m/s.
3. When carrying design flow the maximum pipe depth of flow shall not exceed the following:

(a)	<250mm	$\frac{3}{4}$ pipe diameter
(b)	300mm to 450mm	$\frac{3}{4}$ pipe diameter
(c)	>500mm	Full pipe diameter
4. Service connections shall be designed with a minimum velocity of 0.9m/s.
5. Forcemains shall be designed with a minimum velocity of 0.6m/s.
6. Manning's Roughness Coefficient of 0.013 shall be used for design sewers and service connections. Manning's Roughness Coefficient of 0.015 shall be used for forcemains and outfalls.
7. Manholes shall be designed to incorporate a minimum elevation differential of 30mm wherever a horizontal deflection exceeding 45 degrees occurs and 5mm where it is straight run. These elevation differentials are in addition to the normal grade of the lateral sewer.
8. Pumping stations and treatment disposal works shall be designed to process peak sewage flow plus peak I&I calculated as set out in section sewage flows section of these standards. Bypassing of works to disposal shall not be allowed except under emergency conditions.

2.6. Piping

1. Lateral Sewers

No lateral sewer shall be less than 200mm in diameter, unless the sewer is the final section of a lateral that cannot be extended, in that case, under the approval of the RDN a pipe 150mm in diameter may be used providing that it meets the hydraulic needs of the sanitary sewer.

2. Service connections

Service connections shall be minimum 100mm in diameter. Service connections serving more than one dwelling unit shall be minimum 150mm in diameter or sized in accordance with design flows and available grades.

No service connection shall exceed 15m in length measured horizontally between the lateral sewer and the property line without the approval of the Regional District. If a service greater than 15m is approved by the Regional District, a cleanout facility must be provided as shown on the standard detail drawing for service connection.

Water service and sewer services in a common trench shall be in accordance with the requirements of the Vancouver Island Health Authority.

3. Depths

Depths of all sewers shall be such that all basements in the area the sewer is intended to serve can be drained by gravity. Lift stations from individual homes may be acceptable. Minimum cover on lateral sewers shall be 1.5m in travelled areas and 1.0 m in untraveled areas.

Minimum cover on services shall be 0.75m.

Where minimum cover cannot be provided, an explanation of the reasons shall be submitted to the RDN with the proposed method of protecting the pipe.

Excessively deep service inspection assemblies should be avoided. Where standpipes are more than 1.8m in depth, the standpipes shall be constructed in two or more sections, each having a length not exceeding 1.8m.

4. Curved Sewers

Wherever possible, curved alignment shall be avoided.

Horizontal curves may be permitted where the configuration of the right of way permits curvature at a constant offset, where the velocity in the pipe exceeds 1m/s and where grades of 1% or greater are available. Tracer wire is required on all sewers with horizontal curves.

Vertical curves may be permitted where excessive depths or rock cuts are to be avoided or energy dissipation is needed.

Radius of curvature for PVC sewers to 250mm diameter shall be uniform throughout the curves by bending pipe barrel plus joint deflection to 2 degrees maximum and shall not be less than 60m or the manufacturer's minimum pipe radius, whichever provides a greater radius of curvature. PVC pipes 300mm diameter shall be deflected only at pipe joints to 2.5 degrees maximum, and 350mm diameter and larger pipes at pipe joints to 1.5 degree maximum. Miter bends are not to be used unless approved by the RDN.

Compound horizontal curves are not permitted between manholes.

Horizontal and vertical may be permitted in the same run.

Concrete pipe shall not be curved horizontally or vertically.

5. Manholes

In general the distance between manholes shall not exceed 150m, unless approved by the RDN. If approved by the RDN the maximum distance between manholes may be increased to 250m.

Manholes shall be located at grade and alignment changes, at lateral size changes, at the upstream end of all lateral sewers, at the junctions of all lateral, at regular spacing not exceeding the maximum allowable, sewers and at service connections larger than 150mm in size.

Cleanouts may be substituted for manholes at the upstream end of lateral sewers where no further extension of the sewer main is anticipated.

Where the difference between the incoming and outgoing invert exceeds 600mm, a drop manhole shall be used. See the standard detail drawings for drop manhole details. Differences between 150mm and 600mm should be avoided. Inside drop manholes with a minimum barrel size of 1200mm as shown in drawing the standard detail drawings, may be permitted for new construction of drops between 900mm and 2000mm and upon the approval of the RDN.

Manholes shall be constructed in a manner that prevents water from infiltrating into the manhole.

Where cast in place manholes are proposed, an explanation of the reasons shall be submitted to the RDN with the proposed design and construction method. Only ready mix concrete, 20 Mpa at 28 days shall be used.

Manholes shall be located so that the manhole covers are not located in the wheel paths of vehicles, in gutter lines, curbs or sidewalks.

Manholes located in untraveled areas shall have a 1m asphalt apron which slopes away from the manhole rims at 2%.

A watertight manhole frame and cover shall be required for all sewer manholes located in areas which flooding can occur.

Precast manhole bases shall be sized according to the following table

Pipe Size (mm) (Nominal)	Depth of Manhole (m) (Top of Cover to Inv.)	Barrel Size (mm) (Inside Diameter)
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150-375	0 - 5.9	1050
150-375	6-9	1200
150-600	9 or deeper	1500
400-600	0-8.9	1200
675 – 1050	All depths	1500

6. Manhole Platforms

Manhole platforms are generally not required. Design of manholes shall consider use of appropriate safety equipment.

A cage, well or ladder safety device shall be provided where the length of climb is greater than 6 metres.

If platforms are necessary, ladders shall meet the following requirements:

- (a) The ladder shall consist of multiple sections.
- (b) Each section shall be horizontally offset from adjacent sections.
- (c) A landing platform shall be provided within the length of climb.
- (d) Refer to the Standard Drawings for manhole platform details.

7. Location of Sewers

Wherever possible, sewers shall be located on the high side of the street where only the high side is served by the lateral and on the low side of the street where both sides are served by the lateral. Wherever possible the sewer shall be located on the opposite side from the watermain and at a constant offset from the property line or paved roadway.

Sanitary lateral sewers shall be located at least 3.0m horizontally and 0.45m vertically from water pipes unless approved by the Vancouver Island Health Authority and all joints are suitably coated and wrapped.

Sanitary sewer mains may be installed in a common trench with storm sewers provided the minimum outside pipe separation is 300mm.

8. Utilities in Private Lands

The design of utilities shall avoid crossing private lands as much as possible.

Utilities crossing private lands shall generally be offset a minimum 1.5 metres from the property boundary unless otherwise approved by the Regional District.

Appurtenances such as manholes, valves ect. shall not be located on property boundaries.

Utilities shall not cross private lands in such a manner that they render the property unusable and generally be located beyond the normal building envelope allowed by zoning. Special considerations must be given to ensure the location of the utility crossing minimizes the limitation on the future use of the property.

The minimum width of the right of way shall be 3m for single pipes and 4.5m for two pipes installed in a common trench.

9. Siphons

Where a siphon (i.e. inverted sewer, depressed sewer) is required to carry flow under an obstruction such as a stream, the following criteria shall be applied to the design:

- (a) All siphons shall be multiple pipe structures.
- (b) A cleansing velocity of 0.6 to 0.9 m/s shall be reached at least once a day in the primary pipe even during the first years of operation.
- (c) The total system shall be sized to accommodate the ultimate design peak flow.
- (d) A 1200mm diameter manhole shall be provided on both ends of the siphon.
- (e) Each manhole on the siphon shall be provided on both ends of the siphon.
- (f) There shall be no high points in the siphon between manholes.
- (g) There shall be no acute bends in the siphon.
- (h) There shall be no change of pipe diameter between manholes.
- (i) The primary pipe shall be minimum 200mm in diameter wherever possible.
- (j) All siphons shall have a separate debris sump manhole upstream of the siphon. The debris sump shall be designed to allow easy access for maintenance and cleaning and shall be suitably vented.

2.7. Pumping Stations

This section applies to all municipal owned and operated sanitary sewer pumping stations. Properties serviced by individual sewer pumps shall be connected to the municipal sewer system by a gravity service connection from the property line to the municipal sewer system.

This section is intended as a guide for general requirements for a pumping station. All pumping station designs shall be developed using good engineering practice with the input of the Regional District of Nanaimo.

Sanitary sewer pump stations shall only be permitted at locations where gravity connections from an existing or proposed trunk sewer cannot be provided.

1. General Design Criteria

Pump station size and configuration shall accommodate ultimate sewage flows.

Pumping stations shall be designed and constructed using materials recognized for quality in the sanitary sewer industry.

Pumping stations shall be fully automatic in normal operation, and fully compatible with the Regional District of Nanaimo's telemetry system. Specifics of SCADA systems shall be coordinated with the Regional District of Nanaimo during the pre-design stage.

All stations shall have a wet well capacity providing not more than 12 hours of storage at minimum design flows and a frequency of pump start –up of not less than 5 minutes at peak flows.

No overflow of sewage shall be permitted. Pumping stations shall have emergency backup systems to prevent sewage overflows during a mechanical or electrical failure.

4 complete sets of operational instructions, maintenance manuals, emergency procedures, parts lists, as-built engineering drawings, shall be submitted to the Regional District of Nanaimo upon completion of the pump station.

Current and future service requirements shall be evaluated with the electrical and phone utility companies.

Buildings shall have gutters on all four sides of the roof.

Pump station buildings shall be BC Hydro green in colour.

2. Pumps and Equipment

As a minimum, pumping stations shall be equipped with alternating duplex pumping units. One pump shall be equipped with a flush valve.

Duplex pump arrangements shall be designed for each pump providing 100 percent standby at peak flow.

Individual pump motors shall be equipped with hour meters and pump run indicator lights.

Only non-clog pumping units capable of handling a 75mm solid.

All pumping units to be grinder or vortex pumps capable of handling a 75mm solid.

All piping and valves shall have a minimum of 100mm diameter.

Minimum pump run time shall not be less than 2.5 minutes or as recommended by pump manufacturer; whichever is greater.

Each sewer pump shall be provided with its own individual pipe connection to the wet well.

A concentric increaser shall be provided on the pump discharge followed by a check and gate valve.

Check valves on discharge lines shall be ball type.

The desirable velocity at the discharge point at maximum pump discharge is from 1.8 to 2.5 metres per second.

3. Controls

Stations shall be equipped with high and low level alarm, security alarm, power fail alarm and general alarm (for motor overload, temperature, and moisture alarms if so equipped.) Also, a level transducer probe and data logger, suitable to the Regional District, shall be installed in the wet well.

Manual operation of all pumps by push-button control shall be possible for checking the operation and for drawing down the wet well. Manual operation shall bypass the low water cutout but not the low water alarm.

Wiring for the control panel shall be underground from the hydro pole to the control panel kiosk.

Alarms shall have audio & visual alerts at the pumpstation.

Stations with submersible pumps shall have the motor starters and controls located in a factory assembled free-standing unit control centre located at ground level on a concrete pad.

Stations with non-submersible pumps, shall have the pump motors and controls located in a ventilated, heated, lighted and dehumidified area.

Name plates, approved by the Regional District, shall be supplied on the pump's control enclosure components and other operating components to indicate to the operator the purpose of the component or the operating routine applying to the component.

An isolation switch for each pump shall be located within sight of a service man working inside. Switches shall function by breaking the pump control circuit, thereby isolating the main power at the control panel.

Relays are to be used in conjunction with level controls.

An electrical panel heater and thermostat shall be installed inside all control panels.

The control panel kiosk shall be aluminum.

The control panel shall include an extra 110 volt, 10 amp, duplex receptacle, complete with cover, for operation of small electric tools. It shall be separately fused within the control panel.

4. Standby Power

The onsite provision of a standby power generator will be decided on a site specific basis by the Regional District . If the Regional District decides that permanent standby power facilities are not needed for the specific pump station, the pump station shall be equipped with a generator receptacle matching the Regional District style.

5. Pumping Station Chamber

The control panel and non-submersible pump motors shall be located in one above-ground enclosure unless otherwise approved by the Regional District.

The below grade chamber shall be reinforced concrete construction or as approved by the Regional District.

Concrete pump chambers shall have a 1 to 1 slope benching around the base perimeter.

Exterior concrete walls shall be tar-coated to prevent leakage.

The chamber above grade shall be designed to harmonize with the surroundings, shall be of fireproof construction and have no windows.

Chamber access shall be in accordance with the latest WorkSafe BC Regulations.

Equipment guards and rails for floor openings shall be provided.

Independent mechanical ventilation shall be provided by explosion proof exhaust fans for the dry and wet chambers where applicable. If the ventilation system is

intermittent rather than continuous, the electrical switches shall be interconnected with the station lighting system. Ventilation interconnected with the station lighting system shall have sufficient capacity to exchange the total volume of air inside the station with fresh air within 3 minutes. All vents lines shall have screened openings to prevent the entrance of rock or other foreign matter. Air flow in fans shall be fresh air to wet well with second vent out for discharge.

Dry well stations shall include a sump and sump pump for the interior of the dry well with discharge above the top water line in the wet well.

The entrance to the station shall be waterproof and supplied with a lockable door complete with security alarm.

Where the entire station is underground, the entrance shall not be more than one metre above the surrounding finished grade.

6. Sitework and Lighting

A water service connection, complete with an approved backflow prevention device, shall be provided in the station designed in accordance with the AWWA Cross-Connection Control Manual.

The pumping station and appurtenances shall be within a porous paved surface or approved gravel which provides for the turning movements. A minimum turning grade of 12.8 metres, shall be used to determine turning movements. A minimum of 3.65 metres in width is required for access to all equipment. Approved landscape screening shall be provided.

Storm drainage from the site shall be self-contained.

Adequate protection shall be provided to prevent vandalism and vehicular damage and to protect public safety. Requirements may include fencing, non-mountable curbs and/or traffic bollards.

High pressure sodium, dark sky compliant, lighting shall be provided unless otherwise approved by the Regional District. Backup lighting connected to the standby power supply shall be provided in case of a power failure.

7. Forcemains

All forcemains shall be designed so that the minimum velocity is 0.6m/s and a detention time not exceeding 12 hours during ADWF.

Forcemains shall be designed without high points unless otherwise approved by the RDN. If approved, an air-relief valve shall be provided at high points in the line, meeting RDN requirements.

Thrust blocks shall be provided at all bends as required.

Cleanouts (blowdowns) shall be supplied at all low points of forcemain.

Flushouts shall be located at the terminus end of all pressure sewer mains leading to manholes or pump stations.

3. CONSTRUCTION

3.1. General

1. Access Roads

Temporary roads shall be constructed as required for access to the working areas. Adequate drainage facilities in the form of ditches, culverts, or other conduits shall be installed as found necessary to maintain these roads. In the construction of access roads, existing drainage facilities, natural or otherwise, shall not be disturbed to the detriment of properties outside the working area and such facilities shall, unless otherwise provided elsewhere in the specifications, be restored to their original condition on completion of the work.

2. Sanitary Facilities

Clean, sanitary latrine accommodations shall be provided and shall be located and maintained in accordance with the regulations of VIHA.

3. Special Tools, Operating Manuals, Shop Drawings

With each piece of mechanical and electrical equipment or machinery having wearing parts and requiring periodical repair and adjustment, all special tools, wrenches, and accessories required for removing worn part, making adjustments, and carrying out maintenance shall be supplied. All gauges, indicators, and lubricating devices necessary for the proper operation of the equipment shall be furnished.

With each piece of equipment, 4 sets of operating manuals and as-constructed shop drawings shall be supplied. The manuals shall provide the manufacturer's recommended maintenance schedules with the grades of lubricants required, and instructions as to how the equipment may be taken apart for periodical inspection and replacement.

4. Blasting

Blasting will be permitted only after securing the approval of the applicable authorities. Blasting will not be carried out without first verifying that insurance covers any loss of life or damage that may result from this work. The Regional District, in granting approval for blasting, does not in any way assume responsibility for injury, loss of life, or damage that result there from, and such approval shall not be construed as approval of the methods employed in blasting, the sole responsibility therefore being that of the applicant.

5. Site Maintenance and Clean Up

The working area shall be maintained in an orderly manner and shall not be encumbered with equipment, materials, or debris.

Clean up shall be a continuing process from the start of the work to final acceptance of the project. Property on which work is in progress shall at all times be kept free from accumulations of waste materials or rubbish. Accumulations of

waste materials, which might constitute a fire hazard, shall not be permitted. Spillage from hauling vehicles on traveled public or private roads shall be promptly cleaned up. On completion of construction, all temporary structures, rubbish, and waste materials resulting from the operations, shall be removed.

6. Erosion and Sediment Control

An Erosion and Sediment Control Plan shall be submitted for review and approval seven days prior to the pre-construction meeting. The Erosion and Sediment Control Plan shall describe the proposed methodology to minimize potential impact on the surrounding environment. The Erosion and Sediment Control Plan shall indicate how the Contractor plans to control sediment discharges from the project and what measures will be put in place to prevent damage to aquatic habitat located downstream.

The work shall be carried in compliance with the submitted and approved Erosion and Sediment Control Plan and all other environmental laws affecting the work and with the recommendations contained in the most recent edition of the “Land and Development guidelines for the Protection of Aquatic Habitat” published jointly by the Ministry of Land, Water, and Air Protection and Fisheries and Oceans Canada.

For the erosion and sediment control plan, ‘environmental laws’ means all statutes, regulations, orders, and bylaws relating in any way to the natural environment or its ecosystems, public or occupational health, transportation, storage or handling of contaminants or hazardous materials.

3.2. Existing Structures and Utility Works

1. Scope

Existing structures shall be interpreted as being all existing pipes, ducts, ditches, or other works forming a part of sewerage, drainage, water, telephone, electrical, gas, or other utility system, as well as sidewalks, curbs, poles, fences, buildings, and other man-made things that may be encountered during construction.

2. Material Supply

Unless otherwise specified, materials supplied for replacement of existing structures shall be at least equal to those being replaced.

3. Location of Structures

Drawings or descriptions, verbal or otherwise, of existing structures or their location that are supplied by the Regional District are intended only as an aid to locating these structures. Measurements and location of the existing underground structures shown on the drawings are not guaranteed to be accurate, and must be verified prior to proceeding with construction.

4. Protection of Structures

Unless authorization from the Regional District is received for their removal, underground and surface structures encountered during construction shall be protected from damage. In the event of damage resulting from the construction operation, structures shall be repaired or replaced to a condition, which is at least the equivalent of that which existed prior to construction.

5. Emergency Situations

In emergency situations resulting from the construction operation, where life or property are endangered, the applicant shall immediately take whatever action is possible to eliminate the danger, and shall also notify the Regional District of the situation.

6. Access Maintained

Existing hydrants, valves or control pit covers, valve boxes, curb stop boxes, fire or police call boxes, and all other utility controls, warning systems, and appurtenances thereof shall not be made inaccessible at any time by the construction work. Bridges, walks, or other temporary facilities shall be provided as may be necessary to ensure that these controls or warning systems are free for use in their normal manner at all times during construction.

7. Curtailment of Utility Service

Where existing utilities such as water, sewer, electricity, telephone, and gas are serving the public, work shall be planned and executed such that there is no curtailment of service provided by these utilities without prior receipt of approval of the authorities responsible for provision and maintenance of these utilities. The applicant shall obtain the above approvals from the recognized authorities

controlling these utilities. If approval for such disruption of utility service is not granted, it may be possible to establish temporary facilities to provide continuous utility service during the course of construction. Such temporary facilities shall only be implemented after receiving the approval of the utility authority.

If approval is received to temporarily shut off an existing utility, individual users of the utility shall be notified at least one hour prior to the time of shut-off.

8. Support of Structures

Existing structures shall be protected against damage from settlement by means of timber support or compaction of backfill as required. Where necessary, timber support shall remain in place following backfill of excavations.

Backfill which is placed under or adjacent to the existing structures, which have been undermined during excavation, shall be compacted in a manner which will prevent damage of the structure from settlement. Such backfill shall be of approved granular material suitable for compaction.

On existing piping, this material shall extend horizontally a minimum distance of 600 mm on both sides of the pipe at a level 300 mm above the pipe, and shall slope down from this point at 1-1/2 horizontal to 1 vertical to meet the bottom of the excavation.

9. Drainage Facilities

Existing culverts, enclosed drains, flumes and ditches, and other drainage structures affected by the work but left in place shall be kept clear of excavated material at all times during construction. When it is necessary to temporarily remove an existing drainage structure, suitable temporary ditches or other approved means of handling the drainage shall be provided during construction.

3.3. Clearing

Prior to clearing, the exact limits of the areas on which clearing may take place and whether or not there are restrictions placed on clearing which would result in leaving certain trees, structures, or other existing items in place shall be ascertained.

Prior to trenching, the right-of-way shall be cleared of all standing or fallen brush, timber, stumps, or other debris, which may obstruct the construction operation, damage the completed installation, or detract from the appearance of the site on completion of construction. This material shall be burned or otherwise disposed of to the satisfaction of the Regional District.

The restrictions of all authorities established to control burning in the area shall be complied with. If burning cannot be done on the clearing site, the material

shall be hauled to an approved location for burning or disposal. Burning permits, as required, shall be obtained by the applicant.

3.4. Trench Alignment and Depth

Following clearing and prior to excavation of the trench, the location at which the pipe shall be installed shall be established by setting appropriate survey control. As a minimum this shall include marking of the manholes and any horizontal or vertical curves in the pipe, with suitable elevation data provided. A laser should typically be used to maintain grade during pipelaying, and for all grades of 2% or less.

Where pipe is to be installed to a predetermined grade, a cut sheet will be provided showing the depth of the pipe invert relative to the grade stake elevation at the respective locations along the pipeline.

The trench shall be excavated so that pipe can be laid to the established alignment and depth, with allowance made for specified trench wall clearances and bedding as shown in the standard drawings of this Schedule for various conditions, or otherwise required.

All trenching and excavations shall be carried out in the manner recommended by the Workers' Compensation Board of British Columbia, or as may be necessary to protect life, property, and structures adjacent to the work and the work itself.

3.5. Trench Backfill

Trench backfill shall be carried out as shown in the standard drawings of this Schedule for various conditions.

3.6. Pipe Bedding

1. Granular material for pipe bedding within the pipe zone shall be sand or clean gravel or crushed rock, evenly graded from coarse to fine, and conforming the following specifications and gradations limits:
2. The standard trench section is shown in the standard drawings of this Schedule for various conditions. The nominal minimum depth of cover shall be 1.5 m in traveled areas and 1.0 m in untraveled areas unless otherwise permitted by the Regional District. Water mains shall be located not less than 3 m centre-to-centre from all sanitary lines, unless otherwise permitted by the Regional District and the Vancouver Island Health Authority.

3. Bedding material shall conform to the following gradation limits:

Gradation Limits
(Percent by Weight Passing)

<u>Sieve Designation</u>	<u>Type 1</u>	<u>Type 2</u>
19.0 mm	100	90-100
12.5 mm		65-85
9.5 mm	85-100	50-75
4.750 mm	70-100	25-50
2.36 mm		10-35
1.18 mm	20-65	
0.850 mm		5-20
0.6 mm	0-45	
0.425 mm		0-15
0.18 mm		0-8
0.15 mm	0-10	
0.075 mm	0-5	0-5

4. Type 1 is the standard acceptable bedding material. Type 2 shall be used where specified by the design engineer to meet special design loading. Dry sieve analysis shall be carried out in checking material gradation.
5. Other acceptable bedding materials, for use only where shown on the construction drawings or as approved by the Engineer, are drain rock, pea gravel or native material. In rock, pipe zone shall have filter fabric between rock and bedding material. Filter fabric shall be non-woven, minimum grade Armtec 200 or equivalent.
6. The bedding material shall cover the full width of the trench bottom and have a minimum depth of 100 mm on completion of compaction. In rock excavation the minimum depth of bedding below the pipe shall be 150 mm after completion of compaction.
7. Bedding material shall be compacted in maximum 150 mm lifts to 95% of Modified Proctor Density (ASTM D1557). Side tamping shall be carried out with bedding material placed to the pipe springline, to provide haunch support.
8. Bedding material shall be placed in such a manner that the pipe is evenly supported throughout its length by the pipe bedding material.
9. Placement and compaction of the bedding material shall not damage or displace the pipe.
10. Bedding material shall be leveled across the full width of the trench to an elevation of 300 mm above the crown of the pipe.

3.7. Repairs

Any system approved and built to these standards which requires maintenance work, shall be repaired with materials and construction methods conforming to the specifications contained herein.

3.8. Pipes and Fittings

The size and type of the pipe to be used are to be shown on the design drawings.

Only the pipe types listed in this section shall be used for lateral sanitary sewers or services.

Pipe shall be installed in strict accordance with all of the manufacturer's recommended practice.

All products used shall conform to the Regional District of Nanaimo's Approved Product List.

1. Polyvinyl Chloride (PVC) Pipe, Lateral Sewers

- (a) PVC pipe shall be DR 35.
- (b) Pipe and fittings shall be manufactured to the following standards:
 - 100mm to 375mm ASTM D3034 and CSA B182.2
 - 450mm to 675mm ASTM F679 and CSA B182.2
- (c) All PVC sanitary gravity main pipes should be green in colour.
- (d) Sanitary sewer main pipe, fittings and service connections shall be joined with a rubber gasket or other preformed, factory manufactured gasket or approved material designed for use with the specified pipe. Solvent connected joints and fittings will not be permitted.

2. Polyvinyl Chloride (PVC) Pipe, Service Pipes & Fittings

- (a) PVC pipe of 100 mm pipe diameter shall be DR 28.
- (b) Services larger than 100mm shall be as specified the same as lateral sewers.
- (c) All sanitary services 100mm in diameter shall be white.
- (d) Service connections to be PVC mainline pipe shall be made with PVC fittings manufactured to ASTM D3034, CSA 182.1 and CSA 182.2.
- (e) The use of saddles instead of manufactured wye fittings shall require approval of the RDN.

3. Polyvinyl Chloride (PVC) Pipe, Pressure Pipe

- (a) Pipe shall be white in colour.
- (b) Pipe and fittings shall be manufactured to the following standards:
 - 100mm to 300mm AWWA C900 and CSA B137.3
 - 350mm to 900mm AWWA C905 and CSA B137.3
- (c) Pipe shall be compatible with mechanical and push-on joint fittings and valves without the use of special adapters.
- (d) Pipe shall include push-on integrally thickened bell and spigot type joints conforming to ASTM D313.9 with single elastomeric gasket conforming to ASTM F477.

4. High Density Polyethylene (HDPE) Pipe (Smooth Profile)

- (a) Pipe shall conform to CGSB 41-GP-25M. Pipe material shall conform to ASTM D1248 Type III, Class C, Category 5, Grade PE 35-10
- (b) Minimum Acceptable pipe class shall be DR 26 with a hydrostatic design stress of 10MPa.
- (c) HDPE pipe used for pressurised applications shall be a minimum pipe class of DR21.
- (d) All pipe shall bear the pipe series designation and manufacturers name.
- (e) Fittings for HDPE, if required, shall be detailed and manufactured by the pipe manufacturer. Mitre bends shall be fibreglass reinforced. Fittings shall have a pressure rating at least equal to that of the pipe it is being joined.
- (f) Pipe may be deflected up to the manufacturer's recommended minimum radius. Deflected pipe may be used instead of manufactured or mitred bends.
- (g) Joints shall be by thermal butt-fusion and constructed in accordance with the manufacturers specifications.

- (h) Flange joints shall be used to join long sections of butt joined pipe or as shown on the design drawings.
- (i) Flanges for HDPE pipe shall be slip-on type installed in conjunction with stub ends supplied by the pipe manufacturer. The flanges shall be class 150 meeting ANSI B16.5 drilling dimensions. Flanges shall be carbon steel.
- (j) All flanged joints shall be separated by a neoprene gasket bonded to one of the flange faces. Neoprene for flange gaskets shall be 3mm thick with holes drilled for flange bolts and size equal to flange diameter.
- (k) Bolts and nuts for flanges shall be hot dipped galvanized.
- (l) HDPE pipe shall only be used where approved by the RDN.

5. Concrete Pipes

- (a) Concrete pipe should only be used for sewer mains larger than 450mm in diameter.
- (b) Concrete pipe should be reinforced, ASTM C 76 Specification.
- (c) Lifting holes in concrete pipe shall be plugged with prefabricated plugs in non-shrink grout or other plugs recommended by the pipe manufacturer.
- (d) Concrete pipes shall have every joint grouted.
- (e) Testing for concrete pipes shall be carried out hydraulically. Air testing will not be permitted.

6. Ductile Iron Pipes (DI)

- (a) Ductile iron pipe may be used with the specific approval of the Regional District.
- (b) Soil corrosion survey will be required, and suitable corrosion protection measures installed.
- (c) Testing for ductile iron pipes shall be carried out hydraulically. Air testing will not be permitted.

3.9. Manholes

1. Manhole Sections

- (a) Unless otherwise approved, all manhole sections shall be precast reinforced concrete in accordance with ASTM C478.
- (b) All precast sections shall be complete with ladder rungs as the manhole steps section listed below.
- (c) O-ring rubber gaskets shall be placed between Manhole sections. The O-ring rubber gaskets shall conform to ASTM C443.
- (d) The inside surface of the precast barrel at the O-ring joints shall be filled with cement grout to a smooth finish.
- (e) Precast manhole barrel sections shall be placed plumb.

2. Manhole Bases

- (a) All manhole bases are to be precast unless otherwise approved.
- (b) Manholes bases shall be constructed so that the first section of a precast base can be set plumb with a uniform bearing pressure throughout its circumference.
- (c) Precast manhole bases shall be placed on 150mm thick base of 40mm drain rock.
- (d) Precast manholes and Cast-in-place manhole bases shall conform to the applicable standard drawings.
- (e) Cast in place manholes or connections to existing manholes shall utilize a rubber adaptor ring to seal the connection.
- (f) If the material at the bottom of the trench is unsuitable for support, the bottom shall be over excavated to a firm base, and backfilled with base gravel and thoroughly compacted.

3. Manhole Tops

Manhole tops shall be flat slab, precast concrete. Tops shall be reinforced to meet H20 loading conditions. Precast tops shall conform to ASTM C478 with approved offset opening for frame and cover.

4. Manhole Covers and Frames

- (a) Covers and frames shall be cast iron and certified to meet H20 loading requirements.
- (b) Covers and frames shall conform to the standard drawings.
- (c) Covers shall have “RDN SANITARY SEWER” permanently embossed on the cover.
- (d) Utility chamber manhole frame and cover shall conform to the standard drawings.
- (e) A watertight manhole frame and cover, if required shall conform to the standard drawings.
- (f) Covers located in statutory rights-of-way shall be permanently embossed with the additional wording “DO NOT COVER”.
- (g) Frames shall be set on precast concrete grade rings to bring the cast iron manhole frame to grade as shown on the drawings.
- (h) In unpaved areas, covers shall have a 1m circular 50mm thick asphalt apron sloping away from the manhole cover at a minimum grade of 2%.

- (i) In paved areas covers shall not protrude above the finished pavement.
- (j) In streets manhole covers shall not be placed in the wheel paths of vehicles.

5. Manhole Steps

- (a) Steps shall conform to ASTM C478 for manhole steps, they shall be 19mm either hot dipped galvanized cold rolled steel or aluminum alloy.
- (b) All steps shall be complete with approved polyethylene anchor insulating sleeves and installed in 25mm to 26 mm precast drilled holes in a manhole section.
- (c) Distance between manholes steps shall be maximum 400 mm, with the first manhole step being a maximum 500mm from top of the manhole. Manhole steps shall conform with the most up to date Worksafe BC's standard *G13.2(1)(b) Ladders in manholes*.
- (d) Manhole steps shall be installed 75mm into the manhole section wall.

6. Manhole Platforms

- (a) Manhole platforms are generally not required. Design of manholes shall consider use of appropriate safety equipment.
- (b) A cage, well or ladder safety device shall be provided where the length of climb is greater than 6 metres.
- (c) If platforms are necessary, ladders shall meet the following requirements:
 - The ladder shall consist of multiple sections.
 - Each section shall be horizontally offset from adjacent sections.
 - A landing platform shall be provided within the length of climb.
 - Refer to the standard drawings for additional details.

7. Concrete for Manholes

- (a) The compressive strength of concrete used shall not be less than 20 MPa at 28 days.
- (b) All concrete shall contain an air entrainment agent to provide 4% to 6% air content.

3.10. Service Boxes

Service boxes for sanitary services shall be 305 mm x 508 mm Concrete boxes complete with cast iron lid. The lettering shall read "SEWER".

Service boxes shall not be installed, they shall be supplied to the Regional District of Nanaimo's works yard.

3.11. Service Connections

Service connection piping shall be as detailed elsewhere in this standard.

Each service shall have its own independent connection into the main sewer.

Service connections shall have a minimum grade of 2% unless otherwise directed by the Engineer.

Services shall be constructed in accordance with the standard drawings.

Minimum cover for services shall be 0.75m at property line.

In rock, the trench is to be excavated minimum 1m into the property.

Approved watertight caps suitably supported by sandbags to prevent leakage shall be installed on sewer services at the terminus of each service.

A 50 mm x 100 mm wood marker stake shall be placed at the end of the service connection. The stake shall be painted red with the depth to invert of service to the nearest 0.01m marked. The wood marker stake shall be a minimum 3m from the service box

4. TESTING AND INSPECTION

4.1. Written Reports

The applicant shall submit reports to the Regional District certified by a Professional Engineer of the tests and requirements specified herein.

4.2. Materials Testing

If, in the opinion of the Engineer, testing is required, the Engineer will arrange for a testing firm to carry out tests to determine whether the applicable standards and specifications have been met. Where initial testing indicates inadequacies additional testing may be required by the engineer.

The Contractor as directed by the engineer shall supply specimens or samples for testing.

The types of tests listed below may be required by the engineer unless in the opinion of the Engineer other testing is required.

Joints for sanitary sewer main pipe and fittings and service connection pipe fittings shall be capable of meeting the following exfiltration tests. The Engineer may require that these tests be carried out by the contractor or his supplier prior to the acceptance of pipe on the project.

- (a) Pipes in Proper Alignment:
Not fewer than 3, or more than 5, pipes selected from stock by the Engineer shall be assembled according to standard installation instructions issued by the manufacturer. With ends bulkheaded and restrained against internal pressure, the section shall be subjected to 70 kPa hydrostatic pressure. Pressure shall be maintained for a period of 24 hours. There shall be no leakage at the joints.
- (b) Pipes in Maximum Deflected Position:
At least 2 of the joints of the assembly shall be deflected to the maximum amount recommended by the manufacturer. 35 kPa internal hydrostatic pressure shall then be applied to the test section and maintained for a period of 24 hours. Joints shall show no leakage.

- (c) Pipes in Maximum Lateral Misalignment:
The test section shall be supported on blocks or otherwise so that one of the pipes is suspended freely between adjacent pipes and bears only on the jointing material. The suspended pipe shall then be loaded on the bell or coupling by a load equal to one-third of the ultimate 3-edge bearing strength required by the applicable ASTM specification, except that pipe having a laying length of more than 1.2 m shall be loaded no more than the amount computed for a 1.2 m length. While under this load, stressed joints shall show no leakage under 35 kPa internal hydrostatic pressure.

4.3. Leakage Testing of Gravity Sewers & Manholes

Leakage test shall be performed by the contractor on all sanitary sewers and service connections, manholes and appurtenances

1. Type of Test:

- (a) Leakage testing on gravity sewers shall be tested with low pressure compressed air.
- (b) Leakage tests on concrete, ductile iron and HDPE gravity sewers shall be ex-filtration water tests.
- (c) Leakage tests on manholes shall be ex-filtration water tests
- (d) Testing shall only be carried out after the pipe has been backfilled, and only on completed sections between manholes.
- (e) All test results to be witnessed by the Engineer or the Engineer's Representative.

2. Testing Equipment:

The Contractor shall furnish all the necessary testing equipment, including suitable removable watertight plugs and test balls and shall perform the tests in a manner satisfactory to the Engineer. Testing equipment must provide readily observable and reasonable accurate measurements of leakage under the specified conditions. The Contractor must comply with all Worksafe BC regulations covering the use of air testing, and ensure that safe working practices are used in the application of the test.

3. Leakage Testing with Water:

Ex-filtration Testing:

On an exfiltration test, the test section shall be sealed at the lower extremity by means of a watertight plug. The test section shall be filled with water such that a minimum hydrostatic head of 600 mm minimum head shall be maintained for a period of not less than one hour, and unless excess exfiltration requires further testing, not greater than 8 hours. Pressures in excess of 3 metres water are not recommended. Damage resulting to pipe as a result of testing shall be repaired by the Contractor at his own expense.

Manholes shall be tested for leakage by filling the chamber to the underside of the roof slab with water. Water level shall be rechecked following a minimum time period of four hours. No leakage shall be permitted in manholes.

In areas where the groundwater table is above the sewer invert level, the test shall be increased by a height equal to the distance from the sewer invert level to the water table elevations.

Ex-filtration test sections shall normally have a manhole at both extremities. If, however, sewer grades are such that a test section cannot be terminated at a manhole without placing excess pressure on the pipe or joints, apparatus shall be provided to enable testing without having manholes at the upper and lower ends of a test section.

Gravity sewers, service connections appurtenant structures thereon shall be constructed such that leakage, as evidenced by exfiltration tests, is less than that calculated using the following formula:

$$\text{Allowable leakage in litres} = \frac{HDL}{5200}$$

Where: H = duration of test in hours,
D = inside diameter of the pipe in millimetres, and
L = length of pipe in the test section in metres

The above leakage limit will constitute the total maximum allowable leakage of any test section of gravity sewer. Where service connections exist along the test section, the allowable leakage from service pipe calculated by the use of the above formula will be added to that of the main sewer to arrive at the total allowable leakage unless the elevation of the service connection pipe is greater than the maximum water elevation. No additional leakage allowance will be made for manholes existing along the test section.

The maximum allowable leakage for an ex-filtration test will be that calculated by the above formula regardless of the test head of water employed. Where a section of sewer is found to have leakage exceeding the allowable limit, replacement or repairs shall be made to reduce the amount of leakage to or below the allowable limit. Repaired sections shall be retested until they meet the allowable limit.

All point sources of leakage discovered during the leakage testing shall be made watertight by the Contractor to the satisfaction of the Engineer.

The Contractor shall dispose of the water used for testing in a manner approved by the Engineer.

4. Leakage Testing With Air:

On an air test, the section to be tested shall be plugged at each end and all service laterals, stubs and fittings properly capped or plugged.

Air shall be supplied to the test section slowly, filling the line to a constant pressure of 24.0 kilopascals (kPa). The air pressure inside the pipe shall not exceed 27.5 kPa except in the case where the groundwater level is above the sewer line being tested. In the event of the groundwater level being above the invert, the air test pressure must be increased by 1.0 kPa for each 100 mm of groundwater above the invert.

The air supply is throttled to maintain the internal pressure above 20.75 kPa for a minimum of 5 minutes to stabilize the temperature in the pipe. After stabilization, the air pressure is adjusted to 24.0 kPa, timing commences and the time required for the line pressure to drop to 17.25 kPa is noted.

If the time required to drop from 20.75 to 17.25 kPa is greater than allowable, the test section shall have passed.

For the air test the minimum time allowable is calculated from the following tables:

Time Requirements for Air Testing

PIPE SIZE (Millimetres)	TIME	
	Min.	Sec.
100	02	32
150	03	50
200	05	06
250	06	22
300	07	39

PIPE SIZE (Millimetres)	TIME	
	Min.	Sec.
375	09	35
450	11	34
525	13	30
600	15	24

Where various pipe sizes are to undergo the air test, the average size shall be used.

5. Testing of Forcemains

Following final trench backfilling, leakage tests shall be performed on all installed piping.

Leakage tests shall be carried out between valved sections of the installation such that every valve in the system is tested for leakage in the shut-off position.

Leakage tests shall be performed in the following manner. The section to be tested shall be filled with water and all air expelled from the piping. It is recommended that the test section be filled with water for at least 24 hours prior to testing. By pumping water into the test section, the pressure within the piping shall be increased to 0.7 MPa, or 1-1/2 times the system operating pressure at the point of test, whichever is the greater. This pressure shall be maintained constantly in the pipe throughout the duration of the test by the addition of make-up water. The duration of the test section to maintain the specified pressure over the period of test shall be considered to be the leakage.

Piping will not be accepted until the leakage is less than the maximum allowable leakage determined from the following formula:

$L = ND \times \text{the square root of } P$ in which:

L = the allowable leakage in litres per hour,
N = the number of joints in the test section,
D = the nominal diameter of the pipe in millimetre,
P = the average test pressure during the leakage test in megapascals.

Should any test disclose leakage greater than that specified above, the defect shall be located and repaired, and the section shall be retested to ensure that the leakage is within the allowable limits.

4.4. Cleaning and Flushing

On completion of sewer pipe installation, the pipes shall be cleaned to the satisfaction of the Engineer and the Regional District of Nanaimo.

Sewer lines shall be cleaned and flushed prior to video inspection.

Material displaced from flushing sewer lines shall be collected with a vacuum truck at a downstream manhole. Under no circumstances shall the material be flushed into the downstream system.

4.5. Video Inspection of Sewer Mains

All gravity sewers except services shall be video inspected to check alignment, grade, and condition of the sewer pipe.

1. Video inspections shall be of the following quality:
 - (a) Camera lens shall be free of grease or other deleterious matter to ensure optimal clarity.
 - (b) Videos shall be free of steaming and fogging encountered during the inspection.
 - (c) The camera shall pan to the service connections and pause for at least five seconds.

- (d) Illumination depth of field shall be no less than 3 joints for standard joint and spigot pipe types to allow for pipe deflection assessments (9m). No dark circle shall be visible in the middle of this depth of field viewing area.

2. The inspections submission shall include:

- (a) A pipe condition report including code descriptions used for describing the condition of the pipe.
- (b) Video shall be submitted on a 4.7GB DVD.

The Engineer shall review all videos and certify that the pipe is installed in accordance with these standards and in accordance with the manufactures recommendations.

If directed by the Engineer, the contractor shall arrange for a re-inspection of the pipe at the contractors cost, for the warranty inspection one month prior to the end of the maintenance period.

Video inspection and pipe condition coding shall be undertaken only by personnel with current certification by a Regional District approved agency.

If video inspection does not meet the standards set out here, the contractor shall re-video and re-submit the video at their own cost.

4.6. Inspection

- 1. The Regional District of Nanaimo shall be given 48 hours notice of all tests.

5. TRANSFERRING THE SEWER SYSTEM TO THE RDN

5.1 Final Inspection by RDN

Prior to requesting a Final Inspection, the registered B.C. Professional Civil Engineer shall submit to the Regional District complete Record Documents, a completed letter Certification of Installed Works, all applicable inspection and test results (video inspection DVD's, leakage testing, etc.), and Certificate of Approval for electrical works (pump stations, wells, lighting, controls, etc.) The Final Inspection shall be arranged by the Professional Engineer on completion of the work. This shall be directed by the Professional Engineer in the presence of approved representatives of the Regional District and the installation Contractor. A complete list of deficiencies identified during the final inspection shall be prepared by the Professional Engineer. Once the deficiencies have been satisfactorily rectified, the Professional Engineer shall so notify the Regional District. The date of the Final Inspection will generally be regarded as the commencement of the guarantee period, unless significant deficiencies critical to the effective operation of the system are found at the inspection, at the discretion of the Regional District.

5.2 Preparation/Execution of Transfer Agreement by Developer

The Developer shall prepare and execute the Transfer Agreement for the works to the Regional District.

5.3 Preparation/Execution of Maintenance Agreement

The Developer shall guarantee the workmanship and the performance of the work as per the Maintenance Agreement, from the date of acceptance (generally the RDN final inspection date) for a period of two years. This shall be additionally secured by way of cash or an irrevocable letter of credit in the amount of 5% of the cost of construction as certified by a B.C. Professional Civil Engineer, or \$10,000.00 (whichever is greater).

The RDN may reduce the length of the guarantee period and/or the amount of the security. The RDN may also require additional payment, or payout a credit as appropriate, related to an adjustment of the initial engineering fee to final construction cost values, in accordance with RDN Bylaw No. 1259.03 or most recent amendment. Any change to the guarantee period, security amount or the engineering fee is required to be in writing.

5.4 Preparation/Execution of Latecomer Agreement

Where a latecomer agreement may be applicable to a portion of the costs of the works, as agreed by the Regional District and any other applicable jurisdictions, the Developer shall pay all costs of both the Regional District and the Developer associated with the preparation, execution, and registration of the necessary Latecomer Agreement. The Regional District will assume any internal staff costs involved in planning, reviewing, approving, and administering the Latecomer Agreement preparation, and any administrative and financial costs involved during the effective time-period of the agreement. Based on current legislation, a Latecomer Agreement expires 10-years after its initial registration.

5.5 Letter of Acceptance of the Works by RDN

Following completion of all the foregoing requirements, the Regional District will issue the formal Letter of Acceptance of the Works.

The Regional District will also issue a written statement that the new works can be connected to the District's existing system. Such connection shall be undertaken by the applicant under the direct supervision of the District or by the District at a cost to the applicant.

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SCHEDULE 7E**

COMMUNITY SEWER SYSTEM STANDARDS

APPENDIX 1

SUBDIVISION SERVICING AGREEMENT

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COMMUNITY SEWER SYSTEM STANDARDS

APPENDIX 2

STANDARD DRAWINGS

**REGIONAL DISTRICT OF NANAIMO
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COMMUNITY SEWER SYSTEM STANDARDS

APPENDIX 3

APPROVED PRODUCTS LIST

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APPENDIX 4

LETTER OF ASSURANCE

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CERTIFICATE OF DESIGN

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APPENDIX 6

CERTIFICATION OF INSTALLED WORKS

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COMMUNITY SEWER SYSTEM STANDARDS

APPENDIX 7

TRANSFER AGREEMENT

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COMMUNITY SEWER SYSTEM STANDARDS

APPENDIX 8

MAINTENANCE AGREEMENT

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COMMUNITY SEWER SYSTEM STANDARDS

APPENDIX 9

STANDBY IRREVOCABLE LETTER OF CREDIT

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COMMUNITY SEWER SYSTEM STANDARDS

APPENDIX 10

LATECOMER AGREEMENT