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## Technical Memorandum

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**DATE:** December 18, 2012

**TO:** Russell Tibbles  
Vice President, Development and Operations - Fairwinds

**FROM:** Ryan Lesyshen, M.Sc., P.Eng.  
Project Engineer

**RE: DESIGN WATER DEMANDS – Lakes District and Schooner Cove at Fairwinds**  
**Our File 2964.001**

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### Background

Based on the Regional District of Nanaimo (RDN) Land Use and Subdivision Bylaw No. 500, 1987 (including updates to March 2012), the water source and supply mains for new development must provide for an average daily demand (ADD) of 480 litres per capita per day (lpcd) and a maximum day demand (MDD) of 1,180 lpcd (Section 2.1). However, Bylaw No. 500 allows discretion to the Regional District to vary from the standards based on a written request by the applicant with supporting data (Section 1.5).

We are proposing to use the BC Government's new 2012 Design Guidelines for Rural Residential Community Water Systems for the calculation of water demands. The methods proposed in this document allow for sizing of irrigation demands based on lot area and make allowances for water losses (leakage) based on water system characteristics. We believe these new standards provide more accurate estimation of residential water demands.

Also presented in this tech memo are design demands for planned non-residential water uses at Lake District and Schooner Cove at Fairwinds.



## Residential Water Demand Calculation – BC Government Methodology

In a recent update of its water system design guidelines<sup>1</sup>, the BC Government set out a methodology for calculating MDD based on the following formula:

**MDD = Indoor Usage + Water Loss Allowance + Irrigation Demand – Conservation Incentives**  
where:

**Indoor Usage** = 230 lpcd

**Water Loss Allowance** is calculated as follows:

$$\text{Water Loss (m}^3 \text{ / day)} = 5 \times (0.4704 \times L_m + 0.0303 \times N_c + 0.8 \times L_c) \times \left( \frac{P}{49.26} \right)^{1.5}$$

Where:

$L_m$  = mains length (km)

$N_c$  = # of service connections

$L_c$  = total length of service connections (km)

$P$  = average system pressure (meters water column)

**Irrigation Demand** is calculated as follows:

$$\text{IrrigationRate (m}^3 \text{ / ha / day)} = \left( \frac{Et \times \text{Crop Coefficient} \times \text{Allowable Stress}}{\text{Irrigation Efficiency}} \right) \times 10 \left( \frac{\text{m}^3 \text{ / ha}}{\text{mm}} \right)$$

Where:

$Et$  = Evapotranspiration rate (mm / day)

$\text{Crop Coefficient} = 1$  for turf

$\text{Allowable Stress} = 0.7$  (Default for turf grass in B.C. conditions)

$\text{Irrigation Efficiency (Percent / 100)} = \text{See below}$

It is recommended that for low-density residential lots smaller than 1,600m<sup>2</sup>, irrigated area be taken as 50% of total lot area, and for multi-family lots, irrigation be taken as 40% of total lot area.

### **Water Conservation Incentives**

A 10% reduction in irrigation demands can be applied to the calculation of irrigation demands for developments that preserve and enhance existing topsoil thickness by following the requirements of an existing municipal topsoil bylaw. It is noted that the Regional District of Nanaimo's OCP states minimum required topsoil depths along with other tangible water conservation requirements and objectives. A 10% reduction is therefore warranted for the irrigation demand calculation.

<sup>1</sup> Design Guidelines for Rural Residential Community Water Systems. Utility Regulation Section, Water Management Branch, Ministry of Forests, Range and Natural Resource Operations. Government of British Columbia, Canada. March 2012.



## Calculated MDD Values for Fairwinds

Applying the BC Government methodology, design MDD values can be calculated for the proposed Fairwinds development.

**Indoor (base) water demand for all dwelling types is taken to be 230 lpcd** and applied to the following Nanoose Bay area occupancy statistics:

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

Distribution leakage allowance is calculated based on the following assumptions:

Parameter	Unit	Single-Family	Townhouse / Duplex	Apartment / Multi-Family
Length of main/connection	km	0.02	0.015	0.002
Length of service/connection	km	0.01	0.005	0.001
Dwelling units/connection		1	2	20
Average pressure	m H2O	50	50	50
Household size	(pop/connection)	2.2	1.9	1.4

Using these parameters, **leakage losses per capita are calculated to be:**

- **Single-Family Residential: 111 lpcd**
- **Townhouse / Duplex: 71 lpcd**
- **Apartment / Multi-Family: 12 lpcd**

Proposed average lot areas per dwelling unit are as follows<sup>2</sup>:

- Single-Family Residential: 809 m<sup>2</sup>
- Townhouse / Duplex: 648 m<sup>2</sup>
- Apartment / Multi-Family: 142 m<sup>2</sup>

<sup>2</sup> The Lakes District and Schooner Cove Preliminary Phasing Plan, Internal Draft, June 1, 2012



Using the default assumptions for irrigated area (50% for low density, and 40% for multi-family), the irrigated areas per capita are:

- Single-Family Residential: 184 m<sup>2</sup>
- Townhouse / Duplex: 136 m<sup>2</sup>
- Apartment / Multi-Family: 41 m<sup>2</sup>

The Fairwinds development site is taken to be in the “Temperate 2” climate zone, having maximum Et of 5mm/day for turf grass. Using this assumption, an assumed irrigation efficiency of 70%, and a 10% topsoil conservation reduction, **irrigation demands are calculated to be:**

- **Single-Family Residential: 827 lpcd**
- **Townhouse / Duplex: 614 lpcd**
- **Apartment / Multi-Family: 183 lpcd**

Adding the base demand, leakage and irrigation demands yields maximum day **design demands for each housing type based on the BC Government methodology:**

- **Single-Family Residential: 1,168 lpcd**
- **Townhouse / Duplex: 914 lpcd**
- **Apartment / Multi-Family: 424 lpcd**

## Non-Residential Water Demands

The table below presents non-residential water uses that are applicable to the Lakes District and Schooner Cove at Fairwinds. The best metric for estimating commercial water demands is leasable floor area. A recent AWWA publication is referenced for the commercial floor area based demands provided below<sup>3</sup>. A 1.2 service factor (safety factor) is added to the MDD demands given in this document.

Non-residential use	MDD (LPD)	ADD (LPD)	Units
Commercial – Retail	480	370	Per 1000 sf leasable
Commercial – Office	640	490	Per 1000 sf leasable
Commercial – Restaurant	3500	2800	Per 1000 sf leasable
Commercial – Pub	3500	2800	Per 1000 sf leasable
Fitness Centre	490	400	Per 1000 sf leasable

<sup>3</sup> *Estimating Commercial, Industrial, and Institutional Water Use on the Basis of Heated Building Area*, Morales Et Al, Journal AWWA, June 2011



Summarizing the above into a single table analogous to sections 2.1.1 Water Demand Residential and 2.1.2 Water Demand Commercial in the RDY Bylaw 500 shows the following:

Replacement Section 2.1.1 Water Demand - Residential

Housing Unit	Max Litres per Day per Person	Max Imperial Gallons per Day per Person	Persons Per Household	IGPM per Housing Unit
		(A)	(B)	(A/24/60XB)
Single-Family/detached house	1,168	250	2.2	0.38
Townhouse (attached, semi-detached) unit	914	200	1.9	0.26
Apartment / condominium unit	424	90	1.4	0.09
Secondary suite (carriage house)	424	90	1.1	0.07
Seniors Living unit	424	90	1.1	0.07

Replacement Section 2.1.2 Water Demand - Commercial

Non-residential uses	Max Litres per Day	Max Imperial Gallons per Day	Max Imperial Gallons per Minute	
Commercial – Retail	480	105	0.073	Per 1000 sf leasable
Commercial – Office	640	140	0.097	Per 1000 sf leasable
Commercial – Restaurant	3500	770	0.53	Per 1000 sf leasable
Commercial – Pub	3500	770	0.53	Per 1000 sf leasable
Fitness Centre	490	105	0.073	Per 1000 sf leasable

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### Revision History

Revision #	Date	Status	Revision	Author

