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Section 4

Model Population and Loading

4. Model Population and Loading

4.1 Lot-to-Node Association

KWL's methodology for loading sewer models uses each legal lot in the City's GIS cadastral dataset as an individual catchment. This ensures that nearly every pipe in the system receives some level of sanitary loading.

As only a portion of the City lands are currently serviced by the sanitary sewer system, only the parcels shown as being connected to the sewer system were included for domestic flow calculation in the model existing scenario based on the provided AutoCAD drawing.

Within the InfoSewer model, loads are introduced at loading manholes. This was accomplished in two steps. First each lot was spatially joined to the closest pipe, and then the closest of the nodes attached to that pipe was assigned to the lot. These connections were mapped in GIS and subject to a visual examination based on the service connections shown in the AutoCAD drawing. Connections that were deemed incorrect were reassigned manually in GIS.

The model future scenario has lots connected to the City's sewer system. The future serviced lots will be either connected to the potential connecting points in the existing system or to the future network that is proposed as part of this study, based on topography, existing system alignment, and land expansion.

4.2 Residential Population

Census distribution is based on Statistics Canada's Dissemination Area Boundary Files, which portray the boundaries for the 2011 Census data. A dissemination area is a small area composed of one or more neighbouring blocks and is the smallest standard geographic area for which all census data are distributed. Each dissemination area has residential population and dwelling unit estimates associated with it.

The residential population in the existing serviced lots is 5,426 based on the 2011 census data. To develop the residential population loading for the sewer model, KWL performed a distribution of the 2011 Census data within the City's GIS cadastral dataset. As the BC Assessment Authority (BCAA) actual use codes were not available for this assignment, the City's existing zoning was used instead to allocate population to active residential lots.

Using the existing zoning information, the number of single family (SF), and multi-family (MF) lots within each dissemination area can be found. For each area a SF lot is assigned one dwelling unit, and the remaining dwelling units are assigned to MF lots based on relative area. The distribution of the 2011 Census population results in an average occupancy ratio of 2.7 pop/unit for single-family type of residential lot, compared to the City-wide 2.5 pop/dwelling based on the 2011 Census.

4.3 Base Sanitary Flow Rate

Base sanitary loads are flows generated from domestic and ICI sources, and are population-based. For the existing scenario, the per-capita loading rate was calculated based on the measured dry weather flows (less GWI) from residential areas. GWI was estimated to be 85% of the minimum night time flow in each sub-catchment. Table 4-1 displays the calculated per capita loading rate for each residential pump station sub-catchment.

Table 4-1: Calculation of Per Capita Loading Rate

Catchment	Serviced Population	ADWF (L/s)	GWI (L/s)	BSF (L/s)	Per Capita Rate (L/cap/day)
Pelican	311	0.46	0.04	0.42	117
Metchosin (less Pelican)	1,030	1.96	0.24	1.72	144
Sewell	58	0.1	0	0.1	149
Ocean	534	1.19	0.2	0.99	160
Hatley	99	0.21	0.02	0.19	166
Portsmouth	175	0.45	0.05	0.4	197

As can be seen from the above table, the calculated per capita loading rate is generally in the range between 140 and 200 L/cap/day (except for Pelican), comparing to a typical loading rate of 225 L/cap/day for the core area of the Capital Region found in other studies[4]. Based on the model calibration exercise (see Section 6), the calibrated per capita loading rate is 200 L/cap/day. The number is then adopted as a typical domestic sewage loading rate for Colwood and applied in the existing scenario model for all residential people and ICI population equivalents.

It is understood that the CRD is implementing a wastewater management strategy that involves future water conservation efforts. Potential reduction in the per-capita rate could occur based on some design assumptions regarding current and future usage. However, we have used only a slightly reduced 195 L/cap/day as a future design number thus providing some level of flexibility and allowance for future land-use changes.

4.4 ICI Equivalent Population

The typical industrial, commercial and institutional (ICI) equivalent population (PE) densities developed from the CRD flow meters are described in Section 2.

Royal Roads University and Other DND Lands

It has been reported by the University that there are more students on campus during summer time than in winter time. This is also evident by looking at the pump station SCADA data, which shows that multiple pumps ran often during the summer period (mainly from June to September) while only single pump ran during the off-summer period. Although more domestic flows are expected in the summer, the winter period flows were used in the model as significant I&I normally occurs in winter. The derived equivalent populations for the Royal Roads University and other DND lands are summarized in Table 4-2:

[4] Capital Regional District Core Area Wastewater Management Program, Wastewater Flow Management Strategy Discussion Paper – Design Flow Tables 033-DP-2, Sep 10, 2008, KWL

Table 4-2: Summary of Flow and Population Equivalents for DND and Juan de Fuca Lands

Name	ADWF (L/s)	Estimated Area (ha)	GWI[1] (L/s)	BSF (L/s)	PE (cap)	Note
Royal Roads University	0.95	12.3	0.63	0.33	140	Based on Mar-May, 2011 pump flow data
Juan de Fuca Recreation Centre	0.69	7.6	0.39	0.3	132	Based on May-Aug, 2011 pump flow data
DND Colwood	1.6	12.9	0.66	0.91	393	Based on F. Jetty Apr-Sep, 2004 pump flow data
DND Belmont[2]	5.48	47.9	2.44	3.04	1,354	Based on DND Belmont PS 2008 data; PEs include residents in 473 houses and PE from Ecole John Stubbs Memorial Elementary School

Notes:

[1]GWI rate of 4,400 L/ha/day is derived from DND Belmont PS flow data, and is applied to all the other lands in the above table.

2 The populations are the sum of the distributed census population in DND Belmont and school student equivalent people. This number compares to 1,313 PEs if 200 L/cap/day is used to calculate the total PEs.

4.5 Total Serviced Populations

Based on the distribution of 2011 Census data and estimation of ICI equivalent populations based on the available flow data or general density criteria, the existing total serviced populations are displayed in the table below.

Table 4-3: Total Serviced Populations

Existing Serviced Residential Populations	5,426
Existing Serviced ICI Equivalent Populations	2,177
Existing Total Serviced Populations	7,603

4.6 Diurnal Patterns for Extended Period Simulation

A diurnal pattern specifies the shape of the base sanitary flow as a function of time of day. Several diurnal patterns have been used in the model, as explained in the following table.

Table 4-4: Diurnal Patterns

Pattern ID	Denotation	Source	Description
1	Residential Weekday	Metchosin Flow Signals	Weekday residential pattern derived from the Metchosin PS flow data.
2	Industrial	KWL Pattern	Industrial pattern from KWL database
3	Commercial	KWL Pattern	Typical commercial pattern from KWL database
4	Institutional	KWL Pattern	Institutional signal from KWL database
5	Base II		Constant, used for I&I

Residential lots use the pattern ID "1", which was derived from the Metchosin Pump Station catchment flow signals. This is typical for residential-dominated areas. The ICI use patterns are based on KWL's past experience in the flow monitoring of similar type of land-uses.

The pattern "5" applied for I&I is a constant distribution (i.e. peaking factor = 1). This ensures a 'peak on peak' application of I&I with the base sanitary flow.

All these patterns are applied to the existing and OCP scenarios for system EPS runs.

All of the patterns are shown in Figure 4-1.

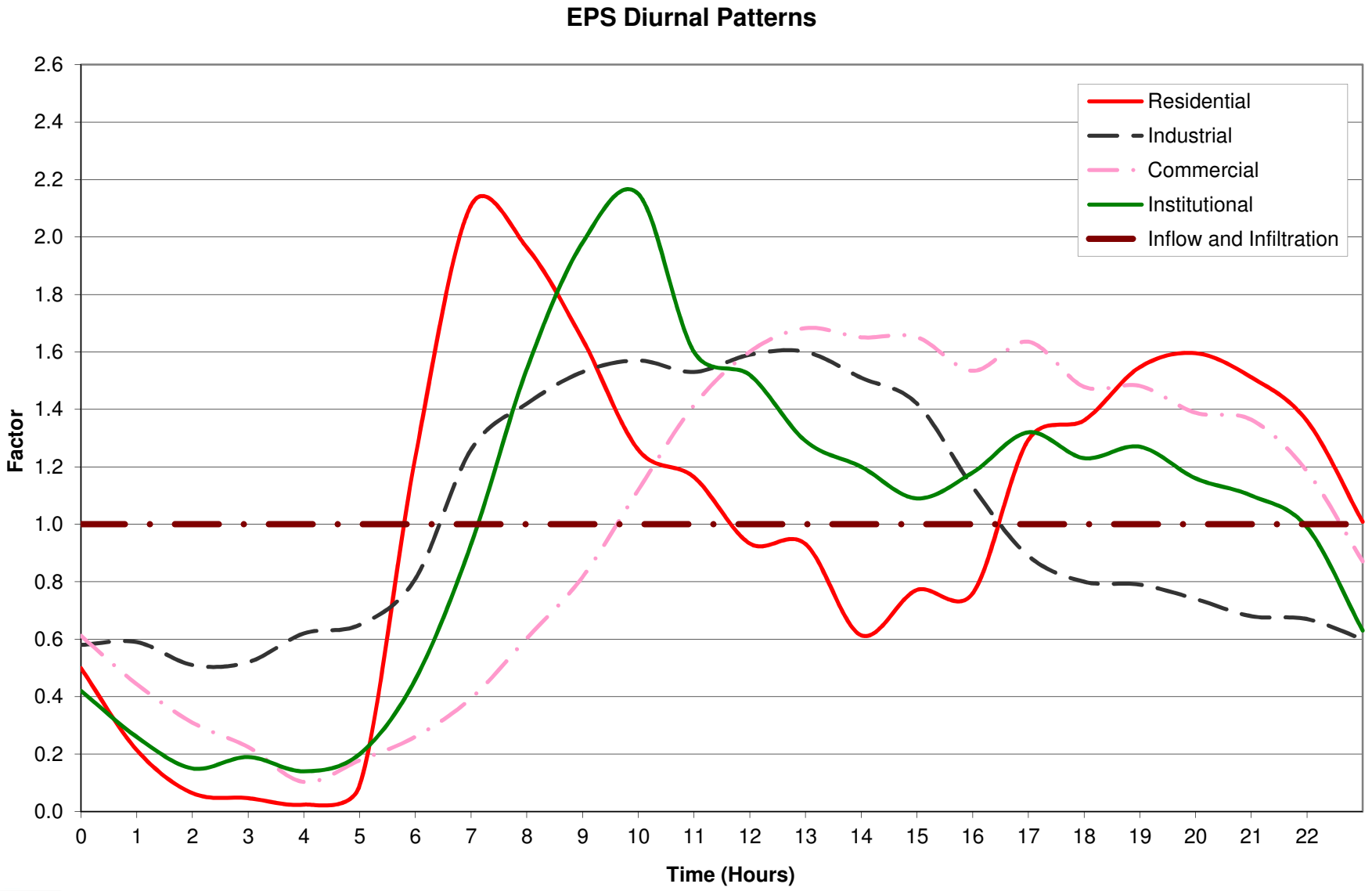

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Figure 4-1