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Section 3

Infrastructure Model

3. Infrastructure Model

3.1 Software Platform

The City selected InfoSewer modeling software produced by Innovyze as the platform for the model. This software is an extension of ArcGIS, and includes the most up-to-date GIS capabilities. It is capable of performing steady-state calculations and extended-period simulations (EPS).

The EPS uses diurnal patterns to peak base loads, and InfoSewer allows for up to ten different diurnal peaking patterns at any given loading point. Base sanitary loads are peaked with diurnally-varying patterns, while the design I&I rate is applied with a unit hydrograph. This ensures a peak-on-peak approach to estimating design flows. Section 4 describes the diurnal patterns used in this study.

Model Database

The InfoSewer platform uses open-format dBase (DBF) and personal geodatabase feature classes for modelling data storage. The advantage of this arrangement is that interoperability between the infrastructure geodatabase for model build and the model is nearly seamless. In addition, the user is able to simultaneously take advantage of the GIS tools offered with ArcGIS and the modelling tools provided with InfoSewer.

The sewer infrastructure data (e.g. pipe size, manhole inverts, etc.) for this study was provided in AutoCAD format (or as-constructed drawings in PDF) instead of a standard ESRI format. In order to transfer the system data to the model easily, a system GIS database was created by extracting the required infrastructure attributes from the CAD drawing through a series of data manipulation processes, together with manual input based on the as-constructed drawings.

The created sewer infrastructure GIS database also provides the City with a robust management tool and a start point for future updates.

For modelling purposes, the following parameters were entered within the model environment:

- COEFF (Num) – pipe roughness – 0.013 (Manning's 'n') for gravity main; 120 (Hazen-Williams C) for forcemain;
- TYPE (Num) – element type – specifies gravity/force main for pipes and loading manhole, chamber, or wet well for nodes; and
- DIAMETER (Num) – nodes only – generally set to 1.05 m for manholes.

3.2 GIS Data Quality Assurance/Control

There were a few missing data records for pipes and manholes based on the drawings received from the City. In order to ensure the accuracy of the model the GIS data was thoroughly examined and a number of elements were updated with assumptions that are normally accepted in general practice. The modifications made to those elements are described in "DESCRIPT" of the model data field.

3.3 Sewer Network Topology

The sanitary networks in InfoSewer for the study area are developed from manhole and pipe building blocks that were created from the available AutoCAD drawing.

Network topology requirements for InfoSewer follow simple link-node rules, which means that each link must begin and end at a node point. Some modifications were made to the GIS data in preparation for model development, such as insertion of additional nodes to split pipes, and addition of KWL notes indicating what changes were made. A record of changes accompanies the model so that the City can review the source data.

Logical Network

A logical network defines connectivity in a table by specifying start and end nodes, with unique ID's for each link feature. This is the system that the InfoSewer model uses to determine flow sequence. It is absolutely necessary to have this system defined correctly in order for the model to operate with reliable results.

Logical sequences were examined using the software until the graphic directions of all pipes matched their defined connectivity in CAD.

3.4 Attribute Data

There are several key physical attributes that are required for hydraulic analysis. For pipes this includes invert elevations, diameter and length. For manholes the required data are rim elevation and diameter.

Manhole diameters and rim elevations were not provided in the source CAD drawing. The manhole diameters were assumed to be 1.05 m dia. for all manholes. Manhole elevations were assigned based on interpolated ground elevations from available 1-m contours provided by the City.

Missing invert elevations for pipes were updated based on the connected manhole invert elevations. Where a pipe has a known invert elevation for one end only, a slope of 0.5% was assumed to calculate the invert elevation of the other end.