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TECHNICAL MEMORANDUM

DATE: January 17, 2011

PROJECT: Water System Master Plan Update – Hydraulic Model Description

TO: Heidi Lansdowne/City of Bend

FROM: Murray, Smith & Associates, Inc.

RE: Description of January 2010 Water Distribution System Model

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Purpose

The purpose of this technical memorandum is to present a summary description of the scenarios and data included in the January 2010 InfoWater model delivered to the City.

Introduction/Background

In early 2009, the City contracted with Optimatics and Murray, Smith & Associates, Inc. (MSA) to provide a system-wide "optimization" of the water system capital improvement plan. This project focused not only on capital projects, but also operational settings. The optimization process requires a calibrated steady state and extended period model. MSA had responsibility to update the model and provide steady state and extended period simulation (EPS) calibrations. The document "Water Model Development Documentation for Water System Optimization" describes the model's development and calibration in detail. This memorandum provides a description of the scenarios and data in the model provided to the City.

The January 2010 hydraulic model does not include future scenarios or improvements identified as part of the optimization process. Two scenario place holders have been added to the model for "future" evaluations, but are not populated with valid information at this time. The working model scenarios are for existing condition and calibration scenarios used to develop and validate the model. The development of future scenarios that include the capital improvements identified as part of the Optimization Study are planned for 2011.

Key Model Components

The modeler should understand the following concepts when preparing to run a hydraulic analysis with the Bend model as it now exists:

1. Scenarios
2. Physical Elements Included in Scenario
3. Demand Datasets
4. Tank Datasets
5. Valve Datasets
6. Control Datasets

Each model scenario is essentially a folder that contains a number of datasets. The datasets contain the actual information that is critical to the analysis. Variables 3-6 identified above are "datasets". These are groups of data that define the characteristics of model elements. The definition of which physical elements (i.e. pipes, pumps, tanks, valves, junctions) are included or "active" in the run (or scenario), are defined using database queries in the Bend model, (other options exist within the software). The sections below describe each of these variables as they pertain to the Bend model.

It should be noted that there are other datasets included in the overall InfoWater software architecture, however only the ones listed here have been developed with multiple dataset options that the user can employ.

Model Scenarios

A scenario is defined by the complete set of inputs and conditions that describes how the model will be run and how components will be controlled. The hydraulic model provided to the City includes both steady state and extended period scenarios. Steady state scenarios provide results for a single time step or "snap shot in time". Extended period scenarios run the model over time and provide simulation results over a defined time period of several hours or days in length. The "Type" for each model scenario (steady state or EPS) is summarized in Table 1. To run an extended period scenario requires more input data than a steady state scenario, such as the desired duration for the simulation, the interval for reporting and calculating output, as well as input data that describes the way in which system demand varies over the course of a day, and system conditions (typically tank levels or system pressures) that trigger system pumps or valves to operate. This additional detailed input data has been defined for extended period scenarios provided in the January 2010 model, and is automatically associated with those scenarios. To run either an EPS or steady state scenario, the user only needs to select the desired scenario and run the model.

Table 1
January 2010 InfoWater Model -Model Scenarios

Scenario	Type	Demand	Tank	Database Query Set
ADD 2009	Steady State	2008 ADD	Full Tanks	2008SYSTEM
MDD 2009	Steady State	2008 MDD	Half Full Tanks	2008SYSTEM
PHD 2009	Steady State	2008 PHD	Half Full Tanks	2008SYSTEM
CALIBRATION_WINTER_EPS	EPS	Winter EPS	Winter Calibration	2008SYSTEM
CALIBRATION_SUMMER-EPS	EPS	Summer EPS	Summer Calibration	2008SYSTEM

Database Queries to Define Active Elements

As mentioned, all working scenarios are "current" scenarios and do not include future pipelines or improvements. A database query set, called 2008SYSTEM has been established to control which model pipes and facilities will be active in each scenario. For each type of model element, such as nodes, pipes, pumps, valves, and tanks, a query tests to see if the fields "YRACT" (year active) and "YRABAN" (year abandoned) indicate if the element is active in the current scenario. The multiple queries that identify currently active members of each element type are grouped together in the query set 2008SYSTEM.

The dates entered into the fields "YRACT" and "YRABAN" will therefore automatically determine the active or inactive status of each element. This activation or inactivation occurs as the scenario is switched. Once a scenario is activated, elements can be manually activated or inactivated (using the Facility Manager), however their status will be reset according to the query fields anytime the scenario is switched. If new model elements are added to the model and these fields are left blank the model will inactivate them the next time the scenario using the 2008SYSTEM query set is selected. With the development of future scenarios, this approach will provide a way to document and automatically control the active or inactive status of current pipes, future pipes, and other elements for each scenario. A new query set will be used to activate appropriate facilities for future scenarios as they are developed.

The only significant area that is included in the model, but not utilized is the “airport” system. This area was included in the GIS and converted into InfoWater, however was not actively modeled during the Optimization project.

Demand Datasets

The steady state ADD and MDD scenarios use the total system demand identified from 2008 production data. The distribution of demand in the model is based on geocoded 2008 customer billing records. The PHD scenario uses the demand calculated by applying the design peaking factor to MDD demand. For the EPS models, the days of calibration were selected because they had similar total production and SCADA behavior was relatively consistent indicating few operational changes. The average demand in the model for those scenarios is close to the average demand according to daily production on the days used for calibration.

Tank Datasets

The initial depth of water in the system's tanks varies by scenario. For EPS scenarios the initial depth was identified using SCADA data. For ADD analysis a "Full Tank" depth is assumed. The depths used for this "Full Tank" condition are shown in Table 2. A "Half Tank" initial depth is used for MDD and PHD analysis. The "Half Tank" depths are shown in Table 3.

Table 2
January 2010 InfoWater Model -Full Tank Depths

Tank	Base Elevation	Tank Max Depth	Initial Depth	Initial HGL
Awbrey	3,775.00	20.50	20.00	3,795.00
College 1	4,095.80	23.27	18.10	4,113.90
College 2	4,087.93	31.50	26.00	4,113.93
Outback 1	3,976.00	40.10	35.00	4,011.00
Outback 2	3,976.00	35.38	35.00	4,011.00
Outback 3	3,982.00	29.38	29.00	4,011.00
Outback CT Basin	3,980.00	31.00	30.00	4,010.00
Overturf East	3,844.00	27.00	26.90	3,870.90
Overturf West	3,844.00	27.00	26.90	3,870.90
Pilot Butte 1	3,750.00	31.50	31.50	3,781.50
Pilot Butte 2	3,839.90	39.50	39.00	3,878.90
Pilot Butte 3	3,757.25	24.25	24.00	3,781.25
Rock Bluff	3,839.78	39.00	39.00	3,878.78
Tower Rock	4,213.00	31.00	29.50	4,242.50
Westwood	3,842.00	28.00	23.40	3,865.40

Table 3
January 2010 InfoWater Model -Half Full Tank Depths

Tank	Base Elevation	Tank Max Depth	Initial Depth	Initial HGL
Awbrey	3,775.00	20.50	10.00	3,785.00
College 1	4,095.80	23.27	11.75	4,107.55
College 2	4,087.93	31.50	15.50	4,103.43
Outback 1	3,976.00	40.10	35.00	4,011.00
Outback 2	3,976.00	35.38	35.00	4,011.00
Outback 3	3,982.00	29.38	29.00	4,011.00
Outback CT Basin	3,980.00	31.00	30.00	4,010.00
Overturf East	3,844.00	27.00	14.00	3,858.00
Overturf West	3,844.00	27.00	14.00	3,858.00
Pilot Butte 1	3,750.00	31.50	16.00	3,766.00
Pilot Butte 2	3,839.90	39.50	20.00	3,859.90
Pilot Butte 3	3,757.25	24.25	12.00	3,769.25
Rock Bluff	3,839.78	39.00	19.50	3,859.28
Tower Rock	4,213.00	31.00	15.50	4,228.50
Westwood	3,842.00	28.00	14.00	3,856.00

Valve Datasets

Valve settings and sizes can be modified using valve datasets. For the Bend model, valve datasets are primarily used to define pressure reducing valve (PRV) settings. Those settings were being modified by O&M staff during the project and due to the operational differences between summer and winter. A summer and winter valve dataset were used during the summer and winter EPS analysis, respectively. The steady state runs focused on summer time peak events and utilized the summer valve dataset.

Control Datasets

Individual control datasets were developed for each steady state scenario (ADD, MDD, PHD) and for each EPS scenario (Summer and Winter). There is a corresponding dataset that is available for each of these scenarios.