Section 4

Development of the Water System Model

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Section 3 described the development of water demands as they will be incorporated in the hydraulic model. This section describes the construction and application of the water system model for CCSD's existing and future water system analysis. The modeling software utilized to evaluate CCSD's water system is H_20NET Analyzer by MWH Soft, Inc.

4.1 Existing Water System

Section 4.1 and Figures 4-1, 4-2, and 4-3 have been deleted due to web security issues

4.2 Development of Water System Model

The CCSD water system model was constructed based upon the GIS "Waterlines" layer, developed by Spacegraph and the Cambria Water System and Facilities Map (Revision # 6, 2-27-97) prepared by North Coast Engineering. Utilizing AutoCAD and H_2ONET Analyzer, a plan-view, preliminary layout of the distribution system was developed. A review of the model configuration was performed by CCSD operations and maintenance personnel and the resulting comments were incorporated. The model development was performed in accordance with the following guidelines:

- Model nodes were placed at pipeline intersections, near fire hydrant locations and service connections.

- Baseline pipe sizes and lengths are as shown in Appendix C. This table provides the pipe no. which corresponds to the hydraulic model, lengths and pipeline diameters. Appendix C shows that CCSD's system is made up of nearly 54% of 6-inch pipelines, which may be significant when considering fireflow availability, pressure requirements (due to high amounts of headloss), and general system circulation to fill and drain for tank storage.

- Elevation data for the model nodes was obtained from digital orthogonally corrected photographs that were flown in 1997. This data was provided on a GIS layer named "contours" (5 ft. contour intervals) as part of the Phase I planning effort.

- Node demands were assigned in accordance with the discussion in Section 3.

- Model pipe elements were constructed for all existing piping.

- Model pipe elements were inserted connecting nodes in accordance with the actual piping sizes and lengths determined from existing plans, maps and GIS data provided by the CCSD.

- According to CCSD personnel, a 6-inch pipe which runs from Windsor Boulevard to Pembrook Street is in need of repair. The model assumes that anticipated repairs have been completed.

- Hazen-Williams C-factors (pipe roughness coefficient) for all piping were initially set to 140 for Asbestos Cement pipe. However, the C-factors for the pipelines are subject to change with model calibration. This is an assumed value typically based on the age of pipe, pipe material, soil characteristics, and detected/known growth on pipe-lining.

- Pressure reducing stations containing two PRV's were modeled with the pressure differentials and control settings that were indicated by CCSD personnel.

- All CCSD reservoirs, hydro-pneumatic tanks, wells, and pump stations were included in the model.

- The following table (Table 4-1) summarizes the upstream and downstream pressure zones of each PRV.

The locations of model nodes are shown on Figure 4-2. The existing, modeled pipelines are shown in Figure 4-3. Each Figure also illustrates pressure zone layout.

Additionally, further refinement to model parameters has been completed with the currently ongoing Boyle Engineering study, *Draft CCSD Water Model Calibration and Leimert Fire Protection Analysis* for subsequent sizing and design of a potentially new Liemert tank. This study has identified points of revision in the model to consider the model and results derived from it, current with the District's 2004 system operations.

TABLE 4-1
PRESSURE REDUCING/SUSTAINING VALVES

PRV Name	Upstream Zone	Downstream Zone	Hydraulic Model ID/Diam./Setting
Charring and Chiswick	6 - Upper Leimert	8 - Lower Leimert	9013/2"/60 psi 9025/8"/45 psi
Ellis and Norton	4 - Top of the World	3 - Lower Top of the World, Upper Lodge Hill	9021/2"/15 psi 9011/10"/10 psi
Stuart Street Facility-Normally Closed	4 - Top of the World	3 - Lower Top of the World, Upper Lodge Hill	9009/8"/Closed
Ardath and Madison	2 - Lodge Hill	5 - Marine Terrace	9023/10"/45 psi 9005/2"/60 psi
District Water Yard	2 - Lodge Hill	7 - Upper Pine Knolls, Upper Happy Hill	9017/8"/180 psi
Zone 8 to 1 Valve	Lower Leimert	1 - Town, Park Hill, Moonstone Beach, Lower Happy Hill, Lower Pine Knoll	9027/8"/ Usually closed

Existing gate and ball valves that were modeled as closed except during specified alternative evaluations are as follows:

- Gate valve isolating Zone 8 from Zone 1 Charring Lane (NC)
- Check valve which separates Zone 7 from Zone 1 below the Pine Knolls Reservoir on Iva Court (NC)

4.3 Water Demand Scenarios

Demands developed in Section 2 were incorporated into the model by assigning a meter record demand to the closest geographical node. The adjusted average demands, summer demands and winter demands were incorporated into the model and peaking factors were applied to obtain the following planning scenarios.

- Average Daily Demand
- Average Daily Demand – Existing Summer Conditions
- Average Daily Demand – Existing Winter Conditions
- Maximum Daily Demand – Existing and Future Winter Conditions
- Peak Hour Demand – Existing Summer Conditions
- Peak Hour Demand – Future Summer Conditions (6700 Residential Units, 2.21 Persons/Dwelling Unit)
- Maximum Daily Demand – Summer Conditions for dwelling unit densities of 1.66 and 2.21 for the following Housing Unit Alternatives
    - 6700, 5700, 5250, 4650 Housing Units.

4.4 Water System Model Calibration Approach

Hydraulic system model validation was completed with CCSD staff to provide an acceptable level of comfort with model results presented. Validation as defined in this report, is the acceptable quality of data input and the resulting reasonable tolerance by which the hydraulic model emulates field operations.

Model calibration was originally postponed for this report in lieu of model validation to input accurate attributes, run the model, and receive pressures and flows which were acceptable to CCSD . Calibration is the empirical matching of model simulated pressures, flows, or other system criteria with field tests, SCADA, or any field measuring device (meters, gauges, etc.). The American Water Works Association Engineering Computer Applications Committee indicated that "true model calibration is achieved by adjusting whatever parameter values need adjusting until a reasonable agreement is achieved between model-predicted behavior and actual field behavior" (AWWA Engineering Computer Applications Committee 1999).

The aforementioned report conducted and currently in Draft form by Boyle Engineering, has undergone calibration using the H2ONET Analyzer hydraulic model originally developed for this Plan. Section 2.3.1 of this Study, entitled “Correlation” , discusses pressure measurements taken in the field and being compared to the hydraulic model results using the Average Day Demand scenarios and demands as discussed in this Task 3 Report. Fire hydrant tests were taken at various locations in the system while recording tank levels and pump settings to confirm with model settings. Zones 1 through 8 were tested and calibrated to an acceptable tolerance. For details on calibration specific to this Study, please refer to Boyle’s *Draft CCSD Water Model Calibration and Leimert Fire Protection Analysis.*

All settings which for calibration developed by Boyle were integrated to the hydraulic model for use in this Task 3 Report and have achieved a 0.2% average difference in results across all model nodes. Therefore, the model used for this Task 3 Report is considered calibrated and is used for subsequent results analysis and recommendations.