CE 3372 – Water Systems Design
Exercise Set 5

Purpose: Compute flow distribution in pipeline networks
Gain experience in use of professional software (EPANET)
Gain expertise in interpreting output to answer specific hydraulic questions

Exercise

1. Figure 1 is a five-pipe network with a water supply source (a reservoir, not shown) connected at Node 1, and demands at Nodes 1-5. Table 1 is a list of the relevant pipe and node data.

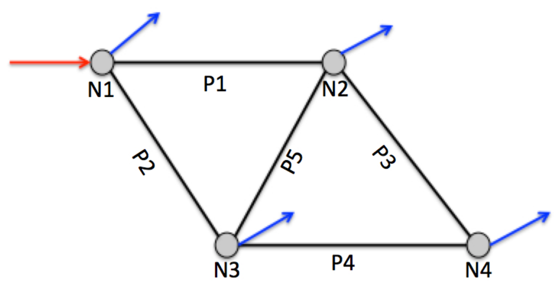

Figure 1: Layout of Simple Network

Table 1: Node and Pipe Data

Pipe ID	Diameter (inches)	Length (feet)	Material
P1	8	800	PVC
P2	8	700	PVC
P3	8	700	PVC
P4	8	800	PVC
P5	6	600	PVC
Node ID	**Demand (CFS)**	**Elevation (feet)**	
N1	2.0	0.0	
N2	4.0	0.0	
N3	3.0	0.0	
N4	1.0	0.0	

Build an EPANET model, using the Hazen-Williams head loss model of the network. From your preparation, or the completed model:

a) Write the node equations of continuity for Nodes 1-4.

b) Write the head loss equations for each of the pipes in the system.

c) Make a screen capture of the EPANET program showing your network map, with the Node ID and Node Pressures displayed on the map, and with the Pipe ID and Pipe Flow Rates on the map.

d) Make a table that lists each node name, node elevation, and the resultant pressure in U.S. Customary units.

e) Make a table that lists each pipe name, length, diameter, Hazen-Williams coefficient, and the resultant flow rate in U.S. Customary units.

f) Determine the flow rate in each pipe of the network, for the case where the total head at Node 1 is 100 feet.

g) Determine the Darcy-Weisbach friction factor in each pipe of the network.

h) Using the results of your flow distribution, determine the head loss from Node 1 to Node 4.

i) Determine the head at Node 4

j) Identify the node with the lowest pressure in your solution.

Attach the EPANET output report to your solution.

2. Figure 2 is a layout of a water distribution system for the SomewhereUSA subdivision. The blue line segments are pipes (ductile iron) and are labeled (P1, P2, . . .). The blue circles are nodes and are labeled (N1, N2, . . .). The yellow polygons represent the demand lots assigned to each node. For example, node N2 supplies the six (6) individual lots located near the node.

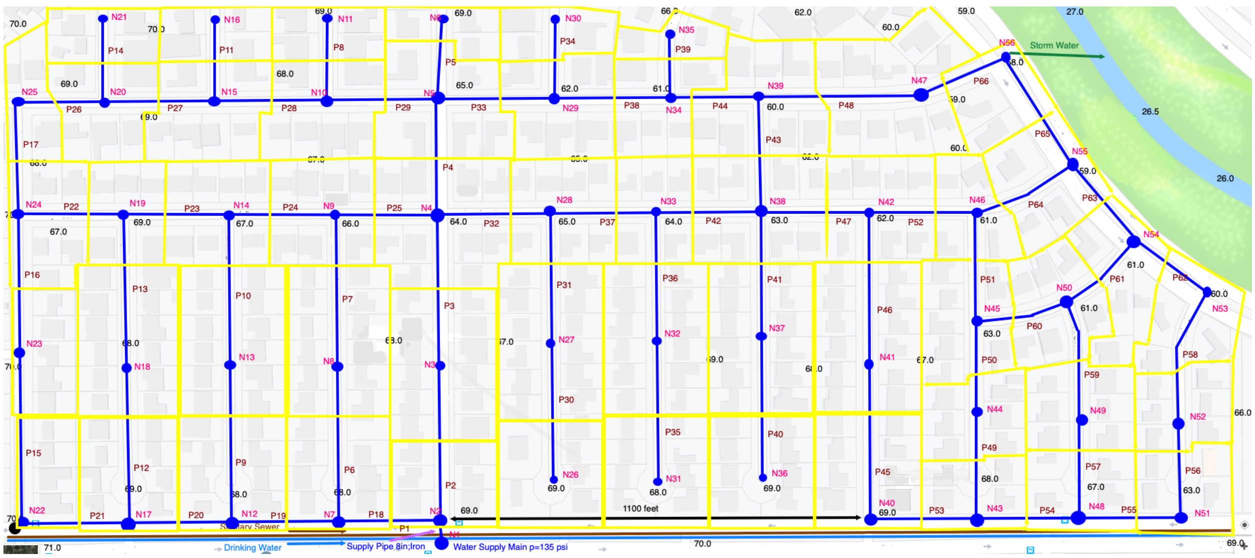

Figure 2: Somewhere USA Water Distribution (Skeleton) System

The distribution system is connected to the supply main at node N1. This large water main supplies water at 135 psi. pressure. The pipe connecting node N1 to N2 is an 8-inch diameter, ductile iron pipe. The remaining pipes are 2-inch diameter, ductile iron pipe.

The system is to be modeled using the United States Environmental Protection Agency, EPANET hydraulic and water quality simulator. Use RG-195 and the San Marcos Texas manual for statutory requirements as necessary:

1) Using the naming convention in the drawings, determine the individual pipe lengths and produce a table of pipe length, and diameter by pipe ID. Include this table in your solution report;

2) Produce a land surface elevation map; include the map in your solution report (you did this in an earlier exercise, you can reuse your map and need not create a new one;

3) Using the naming convention in the drawings, determine the individual node elevations (offset as necessary to ensure the pipe network is buried a sufficient depth throughout the subdivision) and produce a table of node elevation by node ID;

4) Determine magnitude and location of minimum pressure in the system at average demand (reuse your earlier exercise solutions);

5) Determine magnitude and location of minimum pressure in the system at peak demand;

6) Determine magnitude and location of maximum pressure in the system at average demand;

7) Determine magnitude and location of maximum pressure in the system at peak demand;

8) Determine if there are low-pressure portions of the system that need to be mitigated by changing pipe diameters, if so, adjust the diameters and present the adjusted design as a second, independent simulation;

9) Apply a demand pattern multiplier and simulate time-varying behavior in the distribution system;