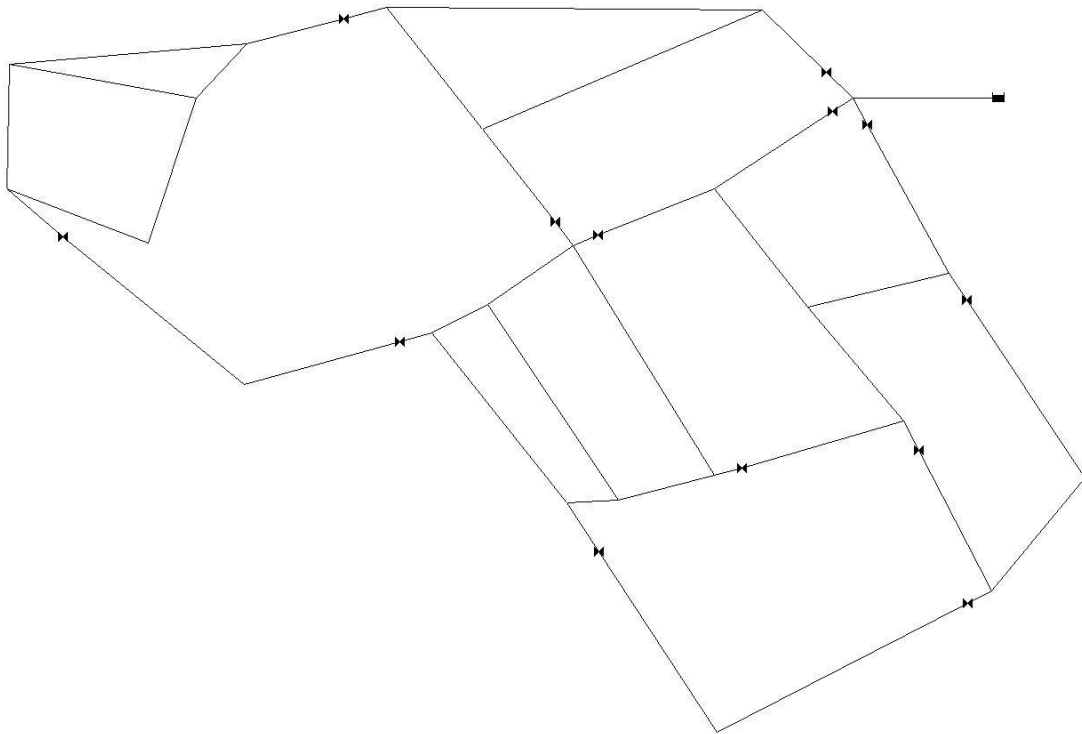# SYSTEM ID: Apulia

NARRATIVE DESCRIPTION

The Apulia system is based on a water distribution system in Apulia, Italy. The system has an average demand of 33,000 CMD. The network was developed by Giustolisi & Doglioni (2005). A general schematic of the system is shown below. The system has one reservoir and 24 kilometers of pipe.

NETWORK SCHEMATIC:

HISTORY OF THE NETWORK FILE

The Apulia system was originally developed by Giustolisi & Doglioni (2005) and was published in the book "Water Distribution System Analysis" which was published in 2005.

ORIGINAL REFERENCE:

Giustolisi, O., Doglioni, A., (2005), "Water Distribution Systems Analysis", Computer and Control in Water Industry (CCWI), Vol.1, pp. 51-56. 09 5391 402 X

AVAILABLE INFORMATION

Physical attributes	Yes
Schematic diagram	Yes
Network geometry data	Yes
GIS data file	No
Background map	No
Elevation data	Yes
Pipe data	Yes
Pipe material	No
Pipe age	No
Pipe pressure class	No
Nominal or actual diameters	Nominal
Pump data	NA
Useful horsepower	
Pump operating curves	
Tank data	NA
Elevation data	
Stage storage curves	
Water quality information	
Valve data	Yes
PRV/FCV data	No
Isolation valve data	Yes
Hydrant data	No
Demand data	Yes
Total system demand	No
Nodal demand data	Yes
Temporal data demands	No
System leakage	No
Hydraulic data	No
Hydraulically calibrated model	
Field hydraulic calibration data	
Water quality data	No
Disinfection method	
Chlorine residual data	
Booster station data	
Fluoride/Chloride field data	
Water quality calibrated model	
Operational data	No
SCADA datasets	
Operational rules	

SYSTEM CLASSIFICATION:

PIPE/LOOP HISTOGRAM:

Hoagland et al. (2015) designed a network classification algorithm for use in classifying water distribution systems as either "branched," "looped," or "gridded" based on the observed frequency of network loops with different numbers of distinct pipe segments. The frequency distribution for the Apulia system is provided below. Using this information, Hoagland et al., classified this system as being a LOOPED system.

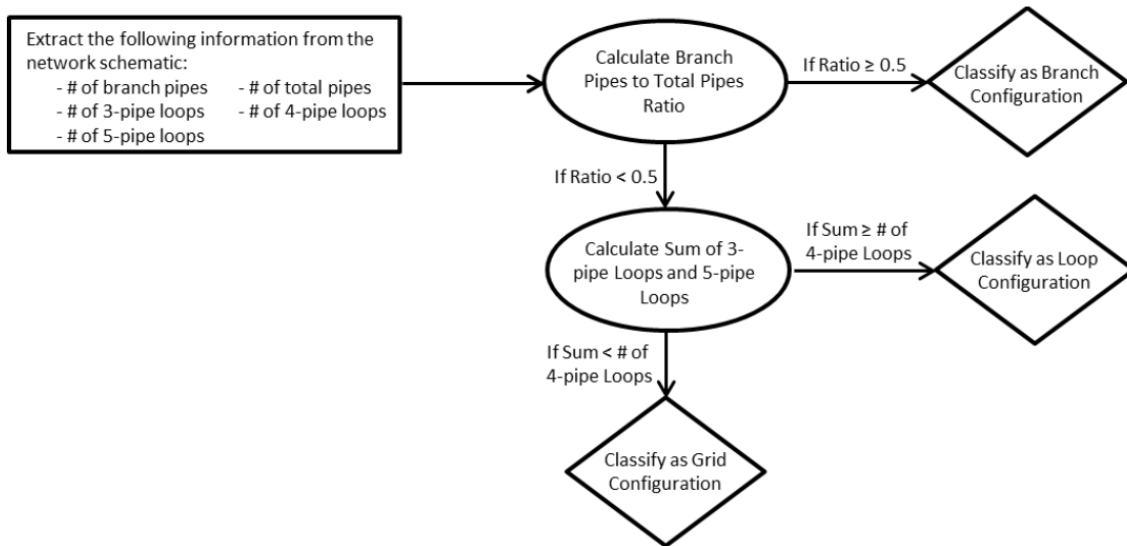| # Total Pipes:	73
# Branch Pipes:	1
Ratio (Branch Pipes / Total Pipes):	0.01
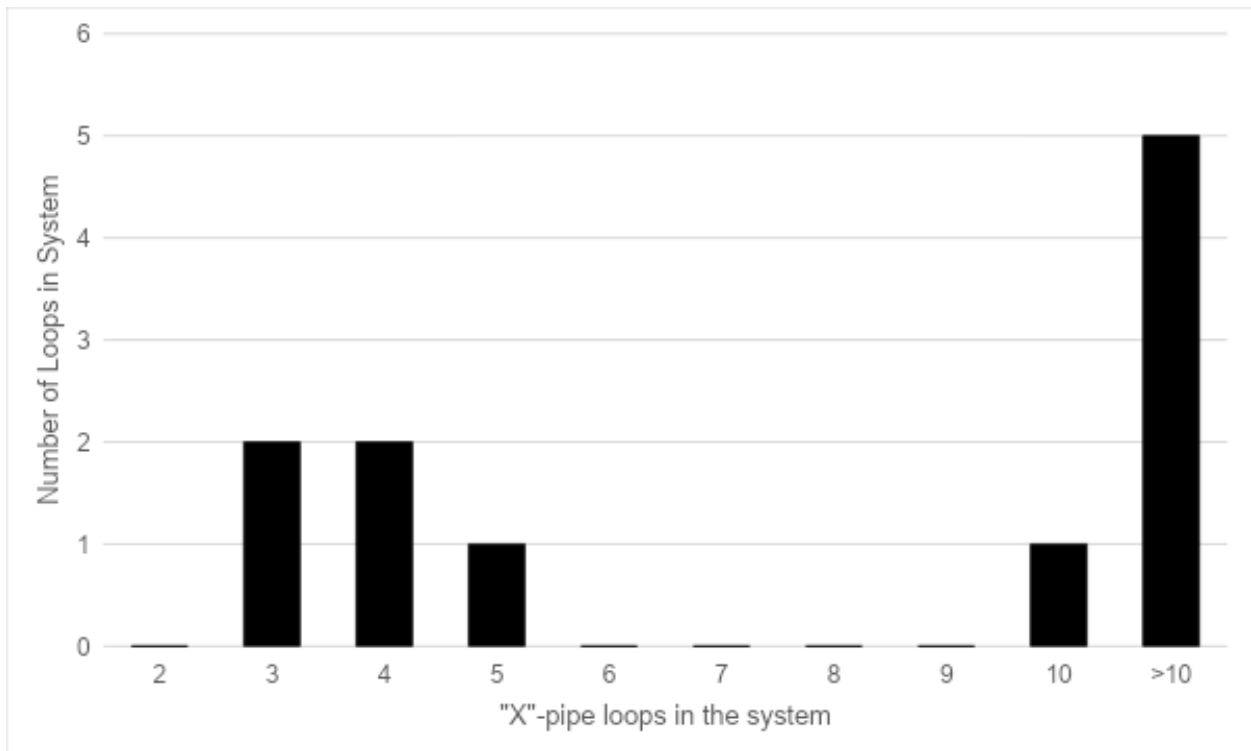
Figure 3.4. Classification Algorithm (Hoagland et al., 2015)

Hoagland, Steven & Schal, Stacey & Ormsbee, Lindell & Bryson, Lindsey. (2015). Classification of Water Distribution Systems for Research Applications. 696-702. 10.1061/9780784479162.064

NETWORK STRUCTURE METRICS:

Building on the work of Hoagland et al., (2015), Hwang & Lansey (2017) created an expanded classification system that allows for further classification of a system as being either a transmission or distribution branched, looped, gridded, or hybrid system. Their algorithm streamlines the classification system by removing unnecessary nodes that do not contribute to the structure of the system while still retaining their use as intermediate points for demand data entry. A full description of the algorithm can be found in the cited reference.

Application of the Hwang and Lansey classification algorithm to the system yields the following statics and associated classification:

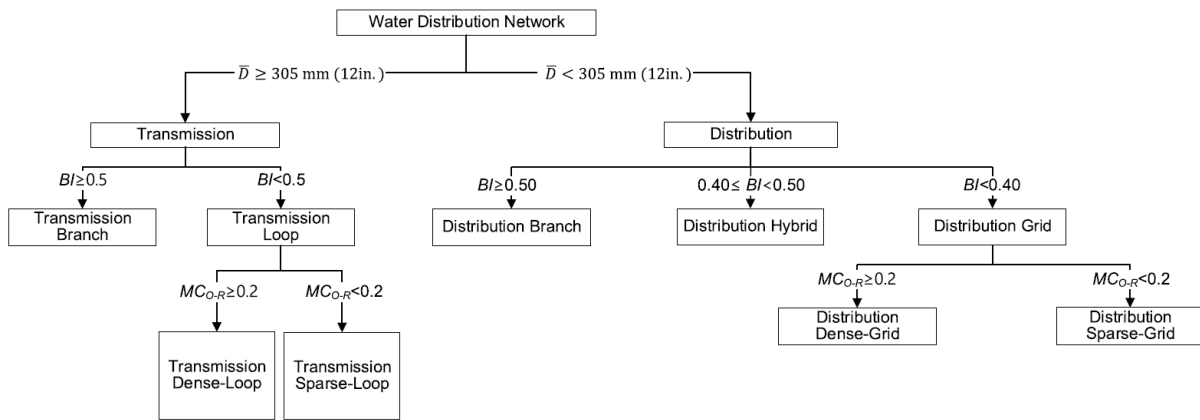| Parameter	Value
Edges	60
Pipes	47
Nodes	50
Average Diameter	0.15
Reduced Nodes	19
Reduced Edges	29
Branched Edges	1
Branched Index	0.0
Meshed Connectedness	0.1
Reduced Meshed Connectedness	0.33
Link Density	0
Average Node Degree	2.4
Hwang & Lansey Classification	Distribution Dense-Grid

Figure 7. Water Distribution System Classification Flowchart (Hwang & Lansey, 2017)

Hwang H. & Lansey, K. (2015) "Water distribution system classification using system characteristics and graph theory metrics." *Journal of water resource planning and management* 143(12) https://doi.org/10.1061/(ASCE)WR.1943-5452.0000850

DETAILED DATA SUMMARIES

PHYSICAL ASSETS:

Asset Type:	# of Assets
Master Meters	0
Tanks	0
Pumps	0
Water Sources	1

NETWORK CHARACTERISTICS:

# Total Pipes:	73
# Junctions	49
# Reservoirs	1
# Tanks	0
# Regulating Valves	0
# Isolation Values	13
# Hydrants	Unknown
Elevation Data	YES

PIPE DATA:

Diameter (m)	Length (m)
0.1	15,805
0.164	1,619
0.184	1,706
0.204	500
0.229	452
0.25	164
0.258	656
0.29	1,760
0.327	739
0.368	563
1.835	3

PUMP DATA:

Pump Horsepower	NO
Pump Curves:	NO

DATA FILE ATTRIBUTES:

ATTRIBUTE		UNITS
Pipe Length & Diameter	X	Meters
Pipe Age		
Node Elevation	X	Meters
Node Demand	X	LPS
Valves		
Hydrants		
Tank Levels		
Tank Volume		
PRVs		
WTP		
WTP Capacity		
Pump Data		