ISO Survey Using Hydraulic Modeling to Replace Hydrant Flow Tests

Keith Browning and Brad Bain

The fire insurance data and analytics company *Insurance Services Office Inc.* (ISO) provides risk analysis and classification services to the property insurance industry. Insurers and their agents may use the ratings produced by ISO during public protection classification surveys for underwriting and evaluating insurance premiums.

ISO rates about 45,000 communities in the United States. A favorable rating generally lowers the cost of fire insurance for the community.

In 2004, ISO completed a Public Protection Classification survey for the city of Orlando. During the survey, ISO rated the city based on the Orlando Fire Department, the Orlando Utilities Commission (OUC) water supply, and communications.

The water component accounted for 40 percent of the classification, and fire hydrant flow tests were included in the water score. A unique aspect of this survey was OUC's use of a computer hydraulic model in lieu of actual field flow tests.

Benefits

Using a computer hydraulic model to replace field flow tests saves time and water; it is also good public relations. In our case, OUC provided two employees with vehicles to assist the ISO representative with the flow tests. Each flow test consumed about 45 minutes to drive, set up, test, and clear up the scene.

Every hydrant test uses water and carries the possibility of stirring up debris in the system that would require flushing to clear up. Also, customers frequently ask why we are wasting so much water while they are being asked to conserve. Each avoided flow test reduces these impacts on the utility, the community, and ISO.

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Limitations & Requirements

During a survey, ISO chooses a number of sites that should be field tested for needed

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fire flow (NFF). The NFF is a calculated fire flow in gallons per minute (GPM) that ISO projects would be needed to protect a building in the event of a fire. The calculation is based on the size of the building, its type of construction, occupancy, and the fire sprinkler system within that structure.

Commercial NFFs range from 500 GPM to 12,000 GPM. Most of the NFFs in the Orlando survey were 3,000 GPM or greater. ISO will test any property with an NFF greater than 3,500 GPM because these buildings are individually classified. To be acceptable, the water system should provide fire flow to the area without drawing the water system residual pressure below 20 PSI.

To produce useful results, the utility must have a computer hydraulic model that accurately represents the sizes and lengths of water mains in the area of the test. Water plant supply pressures and flows during the test should be similar to those used in the model. The model should have been calibrated and/or have a successful history of predicting field conditions.

The ISO field representative provides a list of buildings requiring field flow tests. Once the model accurately represents the locations to be tested, then the total available flow in GPM at 20 PSI is projected. The flow available at 20 PSI is a calculated flow using the static pressure in the system without hydrant flow, the water flowing from the test hydrant, and the residual pressure in the system on a different hydrant.

For the hydraulic model to be acceptable to ISO, 15 percent of the hydrants on the list must be field tested. The actual flow for field-tested hydrants must be within 20 percent of the model projection, with no more than two hydrants exceeding the 20 percent limit. When more than two tests exceed the limit, more field testing must be done.

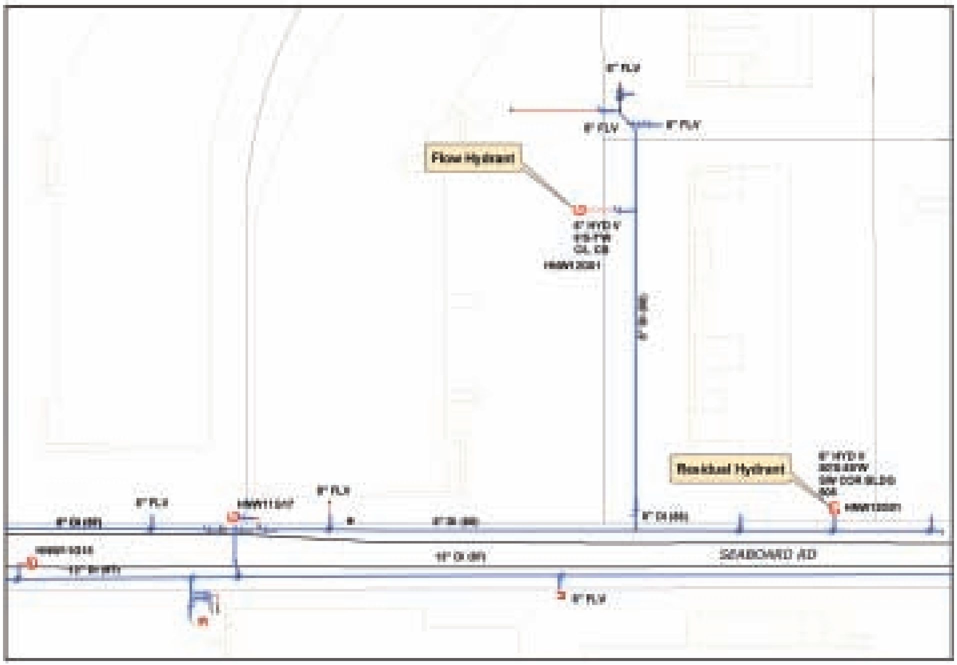

Figure 1: Flow Test Map

Test	Junction	Elevation (feet)	ISO NFF	Model Flow At 20 PSI	Comments
1	5209	94	3000	2600	Field test off 8” on N side street
2	1230	110	1750	5300	Busy area avoid lunch time traffic
3	5227	105	1750	3100	Good Location
4	5183	100	1750	5300	Good, parking lots, good drainage
5	5229	100	2000	6700	Tough test due to traffic
6	5091	80	SF Res	3050	Good Location
7	5223	100	4000	6200	Need multiple hydrants

Table 1: Hydrants to Field Tested for Model Comparison

Criteria to Choose Hydrants

The hydrants chosen for field flow test are the single most important component of the field work. Most of the buildings chosen by ISO are commercial property, and commercial NFF tends to be large. If the property was developed using generally accepted fire design standards or the test location is very close to a water plant, the actual hydrant flows in that area are generally large.

To be accepted by ISO, the field flow tests must match the hydraulic model projections within previously described limits. For accurate field flow results, the field flow tests must use separate flow and residual hydrants and stress the system enough to lower the residual pressure.

A single hydrant test is a poor representation of the available flow in the water system and is difficult to predict with a hydraulic model. Flows greater than 2,000 GPM usually require large hydrant ports and/or multiple ports.

A very large hydrant flow test presents some special challenges. There may not be enough hydrants nearby to perform the test properly. The large amount of water discharged during this activity can stir up debris in the water pipes, disrupt traffic, and cause erosion damage. Test locations should be chosen to minimize problems of property damage, water quality, and traffic disruption.

If the model predicts high velocities in the surrounding pipes, water quality issues are more likely. Site-specific knowledge of water quality history is highly beneficial, and customer notification may be required.

Other possible complications of extremely large flows are the disruption caused to plant operations and to the area by the volume of water required. If the model projects large flows, try to avoid this location.

The location of the residual hydrant on the pipe grid is important as well. It should be close to and/or downstream of the flow hydrant(s) to produce accurate results. The model should be used to predict the flow at the hydrant(s) as well as the residual hydrant pressure, as shown in Figure 1.

Results

ISO selected 41 locations for field flow tests. The NFF for these locations ranged from 500 GPM to 6,000 GPM. Actual flow projected by the hydraulic model ranged from 2,380 GPM to 20,000 GPM.

OUC actually field tested the seven locations in Table 1. All were within required 20 percent of the model projected flows.

A total of 34 field tests were avoided in busy areas of Orlando. Approximately six man-days of field time were avoided. The tests were successful; ISO accepted the results and completed its classification based on computer modeled flow tests predictions.

OUC earned 97 percent of maximum possible points for the water supply portion of the classification. ISO graded the city a Class 2 rating on a scale of Class 1 to Class 10, with Class 1 being best.

In 2007, ISO upgraded Orlando to a Class 1 rating using computer hydraulic modeling for the new flow tests. The classification placed Orlando in the top 0.1 percent of communities in the country, as shown in Figure 2.

OUC was one of a select few utilities in the nation that has used the hydraulic model for the ISO survey. ISO was sufficiently pleased with the accuracy and time savings that they have modified their procedures to encourage the use of a hydraulic model in future surveys.

Acknowledgements

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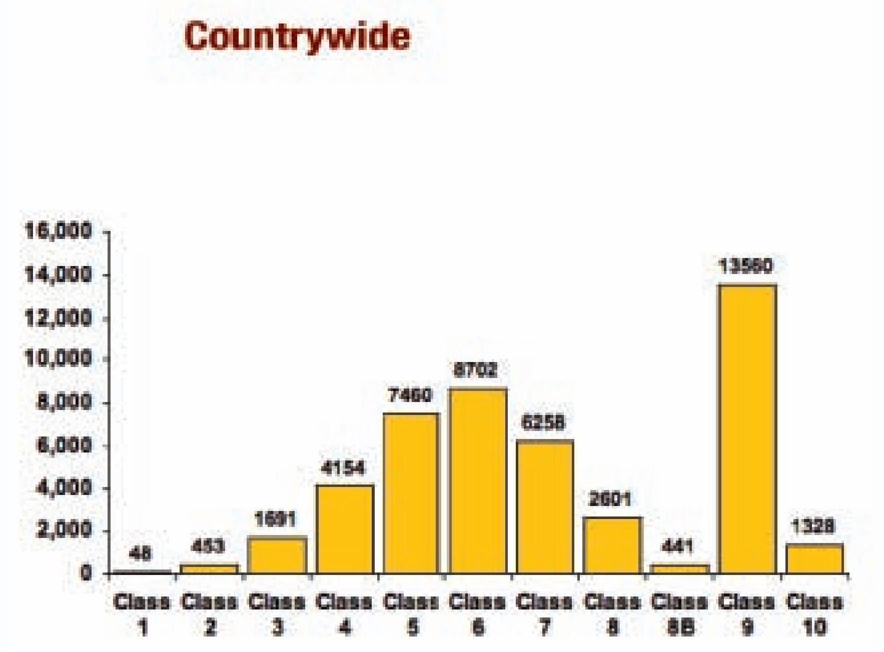

Figure 2

Figures 2 and 3
Distribution of Communities by PPC Class Number within Classification

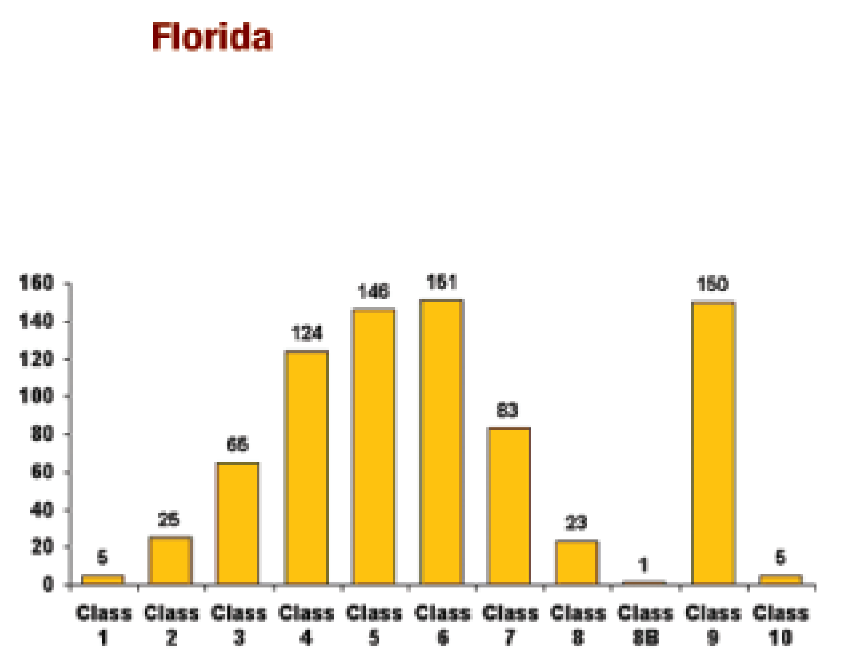

Figure 3