ONTARIO CENTRE FOR MUNICIPAL BEST PRACTICES

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BEST PRACTICE SUMMARY REPORT

October, 2006

Water – Water Distribution

ENERGY MANAGEMENT WITH WATER DISTRIBUTION OPTIMIZATION MODELING

Practice Identification: Water Distribution – Water Distribution Optimization Modeling

Case Study Municipalities:

- City of Thunder Bay

Municipal Profiles:

Municipality	City of Thunder Bay[1]
Population	102,500
Water Distribution	711 km of watermains with 36,872 service connections, and 7 pump stations
Wastewater Collection	502 km of sanitary sewers, with a total of 33,672 sewer service connections, and 3 pump stations
Water Treatment Plant	Bare Point serves a population of 61,500, with an Average Day Demand (ADD) of 40.55 ML/day from Lake Superior
	Loch Lomond serves a population of 41,000, with an Average Day Demand 14.36 ML/day from Loch Lomond
Wastewater Treatment Plants	The Thunder Bay WWTP serves a population of 100,000, with an Annual Average Flow (AAF) of 67 ML/day

Key Words:

- Water Distribution, Energy, Optimization

[1] Municipal Profile is 2004 Data

Related National Benchmarking Goal(s):

- Meet Service and Performance Requirements at Sustainable Cost

Related Performance Measures:

- Pump Station Energy Consumed ('000) kWh / Total Pump Station Horsepower
- Cost of Pump Station Energy / Total HP

Related InfraGuide Best Practices:

- None

Description of Case Study

Water Modeling for Fire Flow Requirements

Thunder Bay utilizes their hydraulic water model to simulate fire flow conditions in the City's 3368[2] fire hydrants. The fire flow testing and modeling program is conducted by the City's Engineering Division on behalf of the Environment Division. The model is used to output the fire flows for hydrants in the distribution system under various operating conditions. The modeled results are confirmed by comparing simulated and measured results from other hydrants in the system. The model should be re-calibrated periodically and should include hydrant testing, pressure and flow monitoring and should take into consideration changes in water system demand. This procedure satisfies fire flow testing requirements and can be used to identify problem areas that require additional fire flow. In addition Thunder Bay is able to budget and plan for improvements to areas that have been identified and confirmed as requiring additional fire flow. (It is important to note that in addition to this modeling exercise, Thunder Bay also operates and inspects their hydrants during their major fall maintenance program. The operating of the hydrants during the fall maintenance program conforms to the requirements of the fire code).

Thunder Bay has been fine tuning and utilizing their hydraulic model for fire flow testing for approximately 8 years; model results are confirmed with field tests. It is difficult to estimate the energy savings they have been achieving over the years compared to manually testing each hydrant, however the City feels they are attaining energy savings in terms of reduced water treatment and pumping requirements by testing only a sample of the City's hydrants. As estimated below there is a potential savings of 33,343 m^3/year from 75,780 m^3/year. Based on Thunder Bay's 2004 per capita average day residential consumption, this is enough water to serve approximately 370 to 835 people. In addition, the manpower requirements and equipment (vehicles and fuel) is reduced because of the reduction in manual testing of hydrants. The disruption caused during fire flow testing, (traffic disruptions, flooding, etc.) is also reduced.

[2] 2004 Data

Estimated Water Requirements for Fire Flow Testing:
Flow Range: 30 – 125 liters per second (Φ = 150 – 300 mm)
Time Range: 0.5 – 3 min for performance testing
Volume Range: 0.9 – 22.5 cubic meters / hydrant
(33,343 – 75,780 m^3 for Thunder Bay's 3,368 hydrants)

Thunder Bay is now further enhancing the model to include water quality, and energy management and operations modeling. These enhancements will assist in identifying existing or future chlorine residual problem areas, areas for prioritized flushing and recirculation improvements. The energy management and operations models will incorporate pump efficiency curves, hydro patterns, demand charges, pump optimization schedules, energy consumption minimization, and emergency response planning and operational studies for planned outages.

Benefits

- Utilizing the hydraulic water distribution model, energy consumption can be reduced for fire flow testing in terms of water treated and pumped
- System operators gain a greater understanding of the water system network and water system hydraulics
- Fire flows can be tested under various operating conditions such as average day demand and max day demand
- Once calibrated the model offers a standard platform to assess fire flows, compared to field tests where the results can be impacted by number of variables such as time of day, demand, and the operator's testing techniques

Efficiency

Utilization of a hydraulic model in Thunder Bay has produced savings for the City in terms of reduced water production and pumping in addition to reduced manpower requirements, equipment requirements and disruptions from fire flow testing.

Effectiveness

As demonstrated in these case studies, hydraulic models are a tool, providing additional information and resources optimize system operations.

Community or Environmental Outcomes

The increased system knowledge provided by hydraulic models provides improved operational safety and efficiency. This also assists in providing increased customer service that is cost effective.

Statutory Requirements

The Fire Protection and Prevention Act, 1997 – O.Reg. 388/97 requires annual "inspections" of hydrants: "The main valve of the hydrant shall be fully opened and the hydrant operated with one port open and the water flow "checked." ("Inspect" means physical examination to determine that the device or system will apparently perform in accordance with its intended function, and "Check" means visual observation to ensure the device or system is in place and is not obviously damaged or obstructed.)

Replication of the Case Study
The case study can be implemented with a calibrated hydraulic model.

Supporting Documentation
None
Other OMBI Members that have implemented this practice:
There are several other municipalities investigating how models can be utilized to optimize system operation, and in turn saving energy. Durham, Toronto, and Peel and are currently in various stages of investigating distribution optimization with hydraulic modeling.

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