BIOGRAPHICAL INFORMATION

Alida Cameron, P.Eng.
Project Engineer
EPCOR

Specific Responsibilities

I joined EPCOR Water Services in August of 2000 as the GIS Engineer responsible for all GIS-related enquiries, support, and management from the business unit perspective. I then branched into an infrastructure and distribution engineering support role, where I use the GIS and hydraulic modeling software to perform analysis. This past year, I was part of a project team that adapted a plant maintenance management system into a distributed asset maintenance management system. The system was created with a one-way link to our current GIS (for asset attribution information), while allowing for a future GIS/WMS integration to occur after the GIS upgrade is completed. The GIS upgrade is planned for 2004. I also serve as the Secretary for the GITA Alberta Chapter, allowing me to remain involved in the GIS Industry.

Past Experience

My previous experience includes various engineer-in-training positions with a variety of companies. The most relevant experience to my current position was implementing a work management system for Alberta Hospital through the consulting firm, Ready Engineering.

Educational Information

1998 Bachelor of Science in Mechanical Engineering from the University of Alberta
1999 Began working towards my Masters of Engineering in Engineering Management at the University of Alberta part-time.

Professional Memberships

GITA – Geospatial Information & Technology Association
APEGGA – The Association of Professional Engineers, Geologists and Geophysicists of Alberta

FIRE HYDRANT PAINTING PROGRAM

Alida Cameron
EPCOR
10065 Jasper Avenue
Edmonton, AB T5J 3B1 Canada

ABSTRACT

Fire protection is an important service required by the community. In order to aid the fire department with this service, the National Fire Protection Association (NFPA) has developed fire hydrant painting guidelines. These guidelines call for the hydrants' dome and steamers to be painted light blue, orange, red or green according to the hydrant's capacity. In 2003, the City of Edmonton's fire department requested EPCOR Water Services Inc. (EWSI) to begin a fire hydrant painting program to align the hydrant dome and steamer colours with those outlined by the NFPA. A pilot project included field and modeling analysis in two neighbourhoods to determine whether or not the information provided by technology was indicative of real life. EWSI selected the neighbourhoods based on criteria of efficiency and diversity using a GIS analysis tool and hydraulic modeling software. Five hydrant flow tests were conducted in both neighbourhoods. These fire flows were simulated in the model with imported SCADA data from the time of the flow tests. This paper will describe the methods used and whether or not technology was a good fit.

INTRODUCTION

EPCOR Water Services Inc. (EWSI) is a business unit within the Canadian based utility EPCOR – also a supplier of power and gas. EWSI owns and operates 3100 km of water main, 14,500 hydrants, and 44,000 valves within the City of Edmonton. EPCOR is an investor owned company, with the sole shareholder being the City of Edmonton. As such, agreements are made between various city departments and EPCOR to ensure that requirements are being met. In 2002, EWSI renegotiated the **Fire Hydrant Services Agreement** with the City of Edmonton's Emergency Response Department (ERD). This agreement was to be effective as of January 1st, 2003. One of the amendments to the agreement was the decision to modify the standards for hydrant painting to match the recommended paint colours as defined in the **National Fire Protection Association Standard (NFPA) 291 – Recommended Practice for Fire Flow Testing and Marking of Hydrants, 2002 Edition**. The standards for fire hydrant painting within the City of Edmonton are specified in the **City of Edmonton Design and Construction Standards, Volume 2 – Section 02513 Hydrants, Item 2.1.11.2.** The main driver for the ERD to ask for this amendment was that it enabled them to enter into mutual aid response agreements with surrounding municipalities who would also need to follow the same standard. The NFPA standard was chosen, as it is an industry standard that is recognized across North America.

PROGRAM PLANNING

Understanding the Problem

Classifying hydrants by colour is only done with the dome, steamers, and sometimes nozzle caps, with the remainder of the hydrant staying yellow. Hydrants within the City of Edmonton boundary have had their domes, steamers and nozzle caps painted using the following classification:

- Black – hydrants connected to water mains that are greater than 200mm diameter or greater, or hydrants that are connected to a 150mm diameter main that is further connected within 30m to a 200mm diameter or larger water main
- Yellow – hydrants connected to water mains that are 150mm in diameter
- Red – hydrants that are connected to water mains that are 100mm diameter or smaller

According to the NFPA 291 standard, the following colour classifications should be used for painting the hydrant domes and steamers:

- Class AA Light Blue Rated Capacity of 1500 US gpm (5860L/min) or greater
- Class A Green Rated Capacity of 1000 – 1499 US gpm (3785-5675 L/min)
- Class B Orange Rated Capacity of 500 – 999 US gpm (1900-3780 L/min)
- Class C Red Rated Capacity of less than 500 US gpm (1900L/min)

Problem #1 - The change to the classification means that basically every hydrant needs to be painted - all 14,500 of them.

Problem #2 - The original standard used within the City of Edmonton was based on pipe size, but due to network configurations and age of pipe the classifications do not necessarily provide an accurate grouping of the hydrants by capacity. The NFPA classifications are capacity based and hence require more detailed engineering analysis to determine the capacity at each hydrant. This problem is further compounded by the fact that our hydraulic network model does not have nodes for hydrants and hydrant tees, and hence the hydrant's capacities are more difficult to determine.

Recommended Approach

In order to understand how big the problems were, it was recommended to have a pilot program in 2003 to confirm manpower estimates and to determine a method for calculating the hydrant capacity. The pilot program would need to be communicated to the ERD and EWSI's dispatch to ensure that all understood what the change in colours meant. Class A, B, and C hydrants would then need to be painted before December 31st, 2006. Class AA hydrants would remain black until the regular painting program, which requires the total refurbishment of the hydrant paint, paints them light blue. (This assumes that any Class AA hydrants that are yellow or red would be painted to light blue prior to December 31st, 2006.)

To obtain an efficient estimate, it was decided that the program would be completed by neighbourhood. For the pilot project a residential and commercial neighbourhood would be selected, as the difference in hydrant spacing due to the land use classification could provide different effort estimates. Also, the difference in network design between the two types of neighbourhoods would provide a slightly different scenario for engineering analysis.

Hydraulic network analysis would be completed to determine the initial rated capacity at each hydrant location in the two neighbourhoods. As the current network model does not have hydraulic nodes at each hydrant connection, the network analysis also needed to determine whether not an exact node is required or the closest node is sufficient. Guidelines would be developed for cases where the closest node is not sufficient.

Five hydrant flow tests would be completed per neighbourhood to calibrate the hydraulic model.

The new paint colours, manufacturer and paint type would be selected and the result confirmed as appropriate by ERD.

All this information would then be used to plan the full-scale 2004-2006 painting program.

PILOT PROJECT

Neighbourhood Selection

The neighbourhoods were selected based on the total number of hydrants, the rough number of hydrants that would require paint before 2006, land use, and community activity. EWSI wanted to paint at least 150 hydrants, so the neighbourhoods had to be of a fairly good size. As the entire neighbourhood was to be painted, it was beneficial, based on the agreement, to paint the neighbourhoods that had the least black hydrants and the least proposed light blue hydrants. The proposed colour was a rough estimate based on the capacity of the closest node. The land use was also needed so that a mainly residential and mainly commercial neighbourhood could be selected. A geographical query tool was used to relate the criteria to each neighbourhood in order to come up with a ranking. Figure 1: Pleasantview Neighbourhood depicts the criteria. The bold outline is the neighbourhood boundary, the triangles are the current category and location of the hydrants and the circles are based on the NFPA capacity criteria at the location of the hydraulic nodes. Data already existed by neighbourhood about its land use. All this information could then be summed up for each neighbourhood using the within boundary query ability of the graphical query tool.

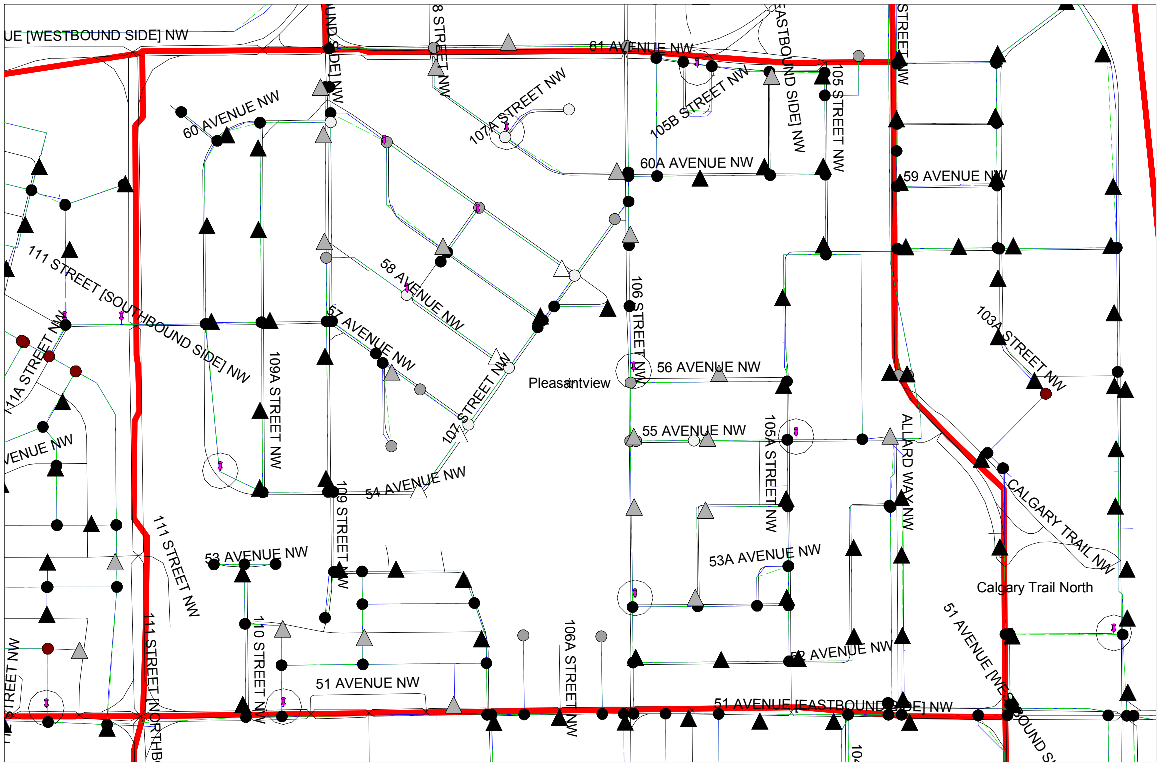

Figure 1: Pleasantview Neighbourhood

Based on the query output, neighbourhoods were ranked. However, some of the highly ranked neighbourhoods had major community events planned and were in fairly busy locations, so the next highest ranked neighbourhood was selected. In the end, the two neighbourhoods that were selected included Pleasantview and Alberta Avenue. This information was communicated to the engineers at ERD with the City of Edmonton.

<u>Hydraulic Network Analysis</u>

In order to know the capacity at each hydrant, detailed hydraulic network analysis (HNA) needed to be done. This analysis was completed for each neighbourhood. The analysis was performed in such a way that future guidelines for when hydrants require their own node could be developed. A node was created for each hydrant tee and for each hydrant, with a new route introduced for the hydrant lead as shown in Figure 2: Hydrant Tees and Hydrant Nodes. The fire flow simulator in the hydraulic model was then run to determine the available flow rate from each node in the neighbourhood at 20psi during a maximum day demand scenario.

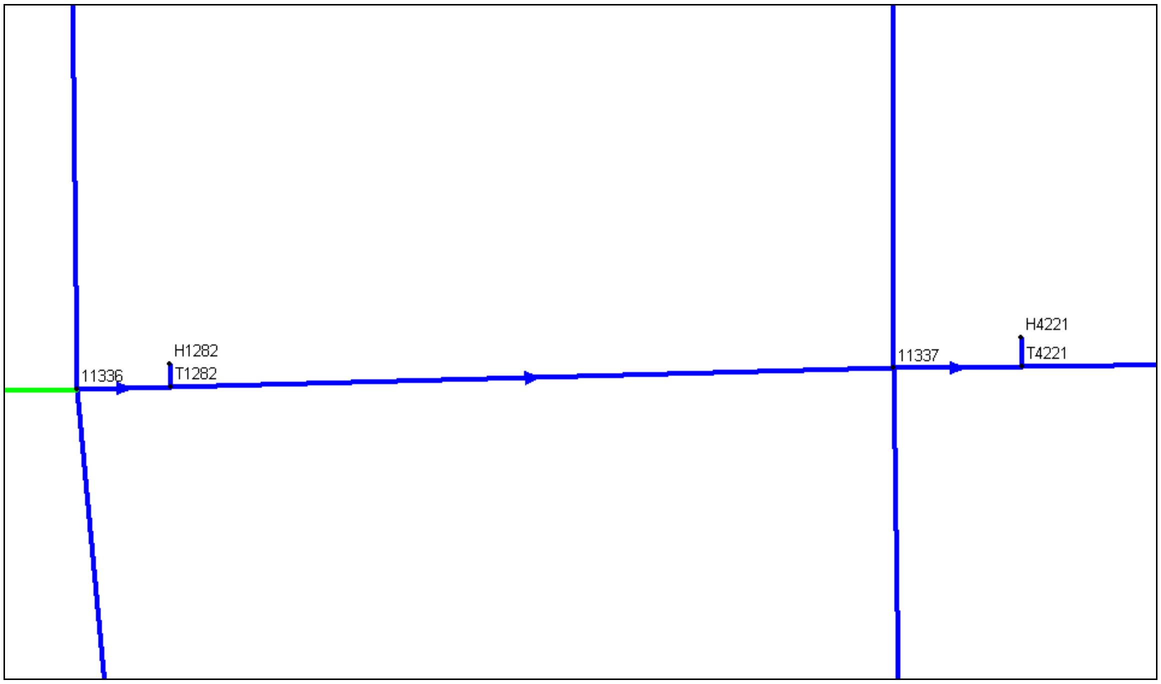

Figure 2: Hydrant Tees and Hydrant Nodes

Looking at the available flows, five hydrants per neighbourhood were chosen as candidates for performing hydrant flow tests. They were chosen based on differing network configurations, pipe diameter, and material in order to micro-calibrate the model. These flow tests were then simulated in the hydraulic model. This was done using a home-built tool that extracts the pump settings, meter readings and various pressure settings from the SCADA system at a specified time and creates a data input file that is in the correct format for the hydraulic model. The data input file is then loaded into the hydraulic model and the flow tests are simulated at their respective nodes. The micro-calibration found that the residential neighbourhood's friction factors needed to be adjusted to represent the real system more accurately. These numbers were compared to friction factor tests of EWSI and other utilities for pipe of that diameter and age to confirm that they were realistic. The commercial neighbourhood did not require any adjustments, although a closed valve was found when trying to simulate the flow test results.

After micro-calibration of the hydraulic model was complete, the fire flow simulator in the hydraulic model was run again to determine the available flow rate from each node at 20psi during a maximum day demand scenario. The data was then compiled into a spreadsheet for simpler analysis. A small section of this data is displayed in Figure 3: HNA Data Collected for Analysis. A colour was assigned to each hydrant, based on the available flow rate obtained in the hydraulic model.

Hydrant #	Closest Node #	Dist. from Node (m)	Flow at Node (ML/day)	Tee to Node dist. (M)	Route Dia. (m)	Route Roughness (m)	Flow at Tee (ML/day)	Tee Node #
10134	22524	6.2	18.78	3.5	200	AC	8.95	T10134
1068	20964	163.3	20.51	159.1	150	CI-10	9.07	T1068
1086	22745	229.8	36.31	185.8	150	AC	15.54	T1086
1133	22745	13.1	36.31	10.6	150	CI-37	17.92	T1133
1141	19395	189.6	43.53	186.2	150	CI-10	8.96	T1141
11504	22745	235.9	36.31	188.6	150	AC	15.52	T11504
1262	32395	8.5	5.1	5.4	150	CI-36	5.24	T1262
13594	22547	52.4	26.92	49.1	200	PVC	32.32	T13594
14095	22546	11.8	22.59	8.4	200	PVC	23.14	T14095
14148	22498	5.1	16.86	1.3	200	PVC	16.91	T14148
15532	35431	26.3	21.4	23.3	250	PVC	21.61	T15532
158	37674	3.1	38.55	0	n/a	n/a		n/a

Tee to Hydrant dist. (m)	Hydlead Dia.	Hydlead Roughness	Flow at Hydrant (ML/day)	Node #	Current D&S Colour	New D&S Colour	Flow (L/s)
2.7	150	PVC	8.88	H10134	Black	Light Blue	102.777778
4.2	150	AC	8.95	H1068	Yellow	Light Blue	103.587963
44	150	AC	11.53	H1086	Yellow	Light Blue	133.449074
2.5	150	CI-37	15.6	H1133	Black	Light Blue	180.555556
3.4	150	PVC	8.87	H1141	Yellow	Light Blue	102.662037
47.3	150	PVC	11.34	H11504	Yellow	Light Blue	131.25
3.1	150	CI-36	5.15	H1262	Yellow	Orange	59.6064815
3.3	150	PVC	28.78	H13594	Black	Light Blue	333.101852
3.4	150	PVC	21.7	H14095	Black	Light Blue	251.157407
3.8	150	PVC	16.26	H14148	Black	Light Blue	188.194444
3	150	PVC	20.54	H15532	Black	Light Blue	237.731481
3.1	150	CI-08	22.71	H158	Yellow	Light Blue	262.847222

Figure 3: HNA Data Collected for Analysis

Hydrant Painting

Due to the new colours required to fulfill the NFPA standard, a supplier and shade of paint needed to be found. The hydrant paint supplier of choice did not supply standard paint in the shade of light blue, but would prepare a bulk order for it. An estimated number of gallons per year of light-blue paint was calculated for the supplier, based on the average number of new hydrants installed per year, and the number of hydrants that are normally repainted in a given year. It was thought that this number would be adequate, as the majority of hydrants would be of Class AA – light blue. Once the paint was obtained, the crews completed the painting of the two neighbourhoods as per the hydraulic network analysis results. Some examples of the new paint are shown in Figure 4: Hydrants with New Paint Colours. The colours were then updated in the GIS.

Figure 4: Hydrants with New Paint Colours

Pilot Project Results

An interesting side effect of this pilot project was that the engineers at EWSI discovered how poor their communication was. People started to call dispatch and approach field workers, asking about the different hydrant colours, many complaining that the colours clashed, or didn't look as nice. An article was published internally titled "Why Those Crazy Hydrant Colours" to help explain the reasoning to the dispatchers and field workers. Communication was also an issue with the ERD, as fire hall captains were calling EWSI engineers to see what was going on. In the end, EWSI was able to meet with a member of the ERD training team, and they were able to take the information back to the firemen.

Painting on a per neighbourhood basis was found to be efficient. It was estimated that to paint the dome and steamer only, 10-15 minutes per hydrant would be required. But the hydrants in these neighbourhoods needed to be fully repainted, as they were in poor shape. This took about 1 hour per hydrant. The paint was found to be satisfactory. As such, the design and construction standards for hydrant painting were updated to reflect the new classifications and paint specifications. Approximately 4 gallons of paint (at $40 per gallon) were required to paint the 169 hydrants.

NEXT STEPS

With the pilot project complete the analysis remains outstanding and the painting program needs to be developed for 2004-2006. The next steps should include:

- Analysis of the flows at the hydrant tees vs. the hydrants vs. the closest node. For nodes with high flow rates, the hydrant tees and hydrants will likely not need to be modeled, but for the lower flow rates guidelines will need to be developed to determine whether or not a hydraulic node is required for the hydrant tee or the hydrant node.
- Upon completion of the guidelines, a list of all hydrant tees and hydrants that requires nodes needs to be created. These in turn will need to be added to the most current hydraulic network model.
- In addition, guidelines will need to be created as to whether or not micro-calibration of the hydraulic model using hydrant flow tests is desired at particular points in the network. This will likely have something to do with the classification thresholds to ensure a hydrant is put

into the correct category. Micro-calibration should then be performed and the model updated accordingly.

- The fire flow module will need to be run for the entire city. This should be done using the most up to date model and a maximum day demand scenario. The available flow rates will then need to be assigned to the respective hydrants (likely using a geographical query tool) to determine the capacity of each hydrant and the NFPA Class that it needs to be in.
- A schedule will then need to be created using the current hydrant colour, the NFPA class calculated and the neighbourhood. The schedule will need to ensure that by the end of 2006 all hydrants that have not been painted are those that are black that are supposed to be light blue under the new standard. The budget and resource estimates should also be made based on the schedule.

CONCLUSION

Without technology, such as hydraulic modeling software, GIS and SCADA, the pilot project would likely still not be completed. It would have meant that a hydrant flow test would have had to be completed at each of the 169 hydrants, instead of the 10 that were completed in order to determine hydrant capacity. The link between SCADA and the hydraulic modeling software was extremely beneficial, as it allows for fairly simple calibration and hence a good representation of the real world. GIS allows for simpler analysis, and will likely be of extreme value in completing the next steps of developing the guidelines. Even the work management system will have a role to play, as it will enable the engineering group to communicate exactly which hydrants in which neighbourhoods should be painted a particular colour within the two years.