WELLAND

Updated IDF curves to anticipate climate change

Source: *City of Welland*

THE SCIENCE

Southern Ontario is expected to experience an increase in the frequency and severity of extreme weather as a result of climate change. Climate change presents a challenge that may be most evident in the design, operations and maintenance of public infrastructure that seeks to provide service to the public over a lengthy period of time. For example, sanitary sewer pipes and stormwater management infrastructure typically remain in place for 50 to 100 years or more.

Across most of Canada, a significant increase is expected in the severity of extreme rainfall events under changing climate conditions. Local governments across Canada recognize that stormwater management systems must not only demonstrate their capacity to successfully cope with historic extreme events, but the design and construction of new systems need to anticipate the expected increase in future rainfall events. Climate change is an important priority for local governments, particularly with respect to the design, maintenance and operation of stormwater systems and extreme rainfall.

THE TRIGGER

In 2005, the Canadian Council of Professional Engineers created the Public Infrastructure Engineering Vulnerability Committee (PIEVC) to develop a tool to better design and manage the potential impact of climate change on public infrastructure. Welland applied the tool to identify the components of the City's wastewater and surface drainage collection system at risk of failure, damage or deterioration from extreme climatic events.

Stormwater management in Welland at the time was based on Intensity Duration Frequency (IDF) rainfall curves established in 1963 using data from Buffalo, NY from the 1930s, 1940s and 1950s that needed to be updated. The City also used a two-year design standard for buried stormwater management infrastructure, which needed to be reviewed. Faced with ongoing sewer separation and aging infrastructure, Welland wanted to ensure that new assets were designed to an adequate standard that would prevent obsolescence in the face of climate change. Also, the City experienced basement flooding and sewer overflows in the past, a risk that needed to be addressed. Furthermore, Welland was looking to review its standards for new development projects that would lead to additional loads on the sewer system in place.

THE APPROACH

Welland first identified the infrastructure components to be evaluated. Applicable design codes and policies, criteria, best practices and procedures were then identified for each of the infrastructure components when the information was available. The City then established a set of climate parameters describing climatic and meteorological phenomena relevant to the City of Welland and a general probability of occurrence of each climate phenomena, both historically and in the future. Once these components were identified

Duration	Comparison of Current and Projected Rainfall Intensities to 1963 Values							
	1963	2000	2020			2050		
			average	90th percentile	maximum	average	90th percentile	maximum
10 minutes	100%	82%	91%	98%	115%	94%	104%	122%
15 minutes	100%	82%	91%	97%	113%	94%	103%	119%
30 minutes	100%	88%	96%	105%	121%	100%	111%	124%
1 hour	100%	97%	110%	108%	117%	82%	112%	112%
4 hours	100%	99%	n/a	n/a	n/a	n/a	n/a	n/a
6 hours	100%	109%	110%	111%	118%	80%	112%	116%
10 hours	100%	143%	n/a	n/a	n/a	n/a	n/a	n/a

Duration	Comparison of Current and Projected Rainfall Intensities to 2000 Values						
	2000	2020			2050		
		average	90th percentile	maximum	average	90th percentile	maximum
5 minutes	100%	112%	122%	144%	117%	130%	154%
10 minutes	100%	110%	119%	139%	114%	126%	148%
15 minutes	100%	111%	118%	137%	114%	125%	146%
30 minutes	100%	110%	119%	137%	113%	126%	141%
1 hour	100%	110%	119%	139%	114%	128%	143%
2 hours	100%	110%	120%	139%	114%	128%	143%
6 hours	100%	110%	123%	145%	116%	129%	150%
12 hours	100%	103%	113%	134%	106%	120%	136%
24 hours	100%	110%	118%	138%	110%	124%	142%

Figure 15 : *The tables above compare the 1963 City of Welland and 2000 Environment Canada IDF data for Port Colborne weather station and the projected future IDF data for 2020 and 2050 for the two year design rainfall event, which is the current municipal standard used for stormwater system design. The comparison shows consistent increases for all durations for all scenarios.*
(Source: AMEC)

and the nature and levels of risk were established, a vulnerability assessment based on two future time frames - 2020 and 2050 - was developed. With this information in mind, the study assessed the adaptive capacity of the infrastructure in place and developed specific recommendations on adaptive measures.

THE OUTCOME

High priority vulnerabilities for the wastewater collection system were those associated with performance responses, like combined sewer overflows, which can

generate environmental contamination and risks to public health and safety. It was determined that increased rainfall and the associated increase in sewer flow were acting as triggers for these vulnerabilities. For this reason, it was recommended that Welland work with all levels of government to establish a consistent funding program for the sewer separation and maintenance program. It was also recommended that the City conduct further studies in specific areas such as the relationship between increased rainfall and inflow and infiltration rates in the collection systems. An assessment of the applicability of green infrastructure, as an additional tool to increase resiliency in adapting to climate change, was also recommended.

Welland is a two-tier municipality, which means that the Region looks after the wastewater treatment plant and pump stations. For the Region's wastewater treatment plant, the vulnerabilities identified as being of the highest priority were related to screening, grit removal and flow splitters. The operational life of these systems would be reduced with an expectation of more intense rainfall events, which would lead to maintenance and replacement costs.

One of the goals of the vulnerability assessment was to update the City of Welland's IDF curves to anticipate predicted changes in precipitation with climate change. With the tools available at the time of this study, it was estimated that the 1963 IDF curves provided conservative results for more frequent storms and it was therefore recommended to keep working with these curves.

After the publication of the PIEVC report, the City of Welland moved forward with the lower cost, high-priority recommendations, including further analysis of its IDF curve. At the moment, the City and the Region are also working on the preparation of a City Wide Sanitary Sewer Model and subsequent Pollution Control Plan update.

A WORD FROM WELLAND

To successfully complete the Vulnerability Assessment of Public Infrastructure to Climate Change, Marvin Ingebrigtsen, Technical Analyst, Infrastructure Programs for the City of Welland, recommended that cities first come up with good asset data and good storm event records to ensure the review of the infrastructure reaction is accurate. He added that "it is very useful to have senior staff including operators and Public Works and Operations foremen that can provide insight into how the infrastructure system reacts to climate variables, usually storm events." To conclude, Mr. Ingebrigtsen suggested that cities interested in implementing a similar project first gather specific data on how their infrastructure reacted to extreme events in the past. Once the final recommendations are made, he recommended following up on recommendations as soon as the report is finalized while the information is still fresh in peoples' minds.