

Urban Flooding in the Great Lakes States

A Municipality/Utility Survey Report

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A Municipality/Utility Survey Report



**PREPARED BY
THE CENTER FOR NEIGHBORHOOD TECHNOLOGY**

JULY 2012

PROJECT PARTNERS:



COVER: GREAT LAKES STATES WATERSHED Rendering by Katrina Nygaard, CNT

Acknowledgments

The Center for Neighborhood Technology (CNT) owes thanks to a variety of people and organizations instrumental in the development of this survey report. They include our project partners—American Rivers, the Great Lakes Commission, and the Water Environment Federation—for their assistance and commitment to alleviating urban flooding.

The following advisors shared their time and expertise in a variety of ways. They include Seth Brown of the Water Environment Federation, Martin Jaffe of the University of Illinois at Chicago, Tim Loftus of the Chicago Metropolitan Agency for Planning, Bob Newport of U.S. EPA Region Five, and Jeff Wickencamp of Hey and Associates, Inc.

CNT is also grateful to the municipalities and utilities that participated in the survey and provided us with data and information necessary to understand the state of urban flooding in the Great Lakes region.

This research is part of CNT's **Smart Water for Smart Regions** initiative dedicated to inventive solutions and advocacy focused on water supply and stormwater in the Great Lakes states. Funding for this research was generously provided by The Joyce Foundation and State Farm.

Visit www.cnt.org/water for more information.

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Executive Summary

Great Lakes cities experience frequent flooding. The effects of urban flooding—sewer backups, basement seepage, property damage, and street ponding—collectively cause millions of dollars of damage each year.¹ Unlike flooding in rural areas, urban flooding typically affects areas with a high density of population and assets, thus increasing the loss to the economy and to society.²

For individuals, flooding can cause problems with personal well-being and health, loss of items of emotional value, and work hours lost to damage clean-up.³ For cities, flooding disrupts the economy, the environment and society. For the Great Lakes region, urban flooding is a major threat to the resilience of cities and diverts valuable assets to resolve frequent and often preventable problems.

As part of our **Smart Water for Smart Regions** initiative, the Center for Neighborhood Technology (CNT) is working with communities across Great Lakes states to alleviate urban flooding. The purpose of this survey is to develop an understanding of the effect of flooding on Great Lakes cities and to identify strategies to manage the problem. By providing a baseline of practices and policies among municipal stormwater/sewer utilities, the survey results are intended to support collaborative initiatives for dealing with flooding.

Our survey, the first of its kind in the Great Lakes, found that municipalities and stormwater utilities face significant challenges. The 30 survey respondents serve 330 municipalities with a population of approximately 19.7 million people—nearly 23 percent of the total population of the Great Lakes states and province.⁴ *All 30 respondents received flooding complaints, with 80 percent characterizing the annual number of complaints as medium or large.* Stormwater is flooding into people's backyards, streets, and parking lots (90 percent of respondents said), into the interior of buildings through sewer backups (83.3 percent), and through the walls of homes and buildings (46.7 percent).

Resolving these challenges is proving to be difficult. Although the intention is there—86.7 percent of respondents said they track flooding complaints and/or map areas of flood risk—only 53.3 percent have a plan for dealing with property flooding. Even fewer have a system in place for tracking the plan's success or failure. Just 20 percent have estimated the cost of flood-related damage in their community.

Perhaps most significantly, the survey reveals a desire for change. Most utilities, 73 percent, already provide some level of outreach and education to their customers about flooding and flood alleviation strategies, and 75 percent said they are interested in improving collaboration and developing best practices.

The survey highlights the opportunity to alleviate urban flooding through increased collaboration in the Great Lakes states. Doing so will save municipalities and property owners millions of dollars and ensure community vitality, economic stability, and resource reliability now and for future generations. CNT invites utilities and municipalities, partners and investors to work together to support this initiative.

1. http://www.floodsmart.gov/floodsmart/pages/media_resources/stats.jsp.

2. "Cities and Flooding: A Guide to Integrated urban Flood Risk Management for the 21st Century", World Bank Report 2012.

3. According to a household flooding survey results by the Center for neighborhood Technology, unreleased 2012.

4. Eleven of thirty respondents are from the Canadian province of Ontario—the only province with shoreline bordering the Great Lakes—the remaining nineteen respondents are from US states.

Introduction

Flooding is the most prevalent urban disaster in the United States: three fourths of all presidential disaster declarations are associated with flooding and 88% of U.S. counties experienced at least one flood disaster during the second half of the twentieth century. In Canada, water damage accounts for \$1.7 billion in annual claims, and is now the leading cause of property damage.⁵

Flooding is expensive. The National Flood Insurance Program has paid nearly \$40 billion in claims since 1973, and of course much urban flooding is not covered by insurance. The National Weather Service estimates flood damage in the U.S. at \$7.82 billion a year over the past three decades.

Flooding exacts a human cost. CNT research indicates that flooding is responsible for significant mental stress and ill-health and forces people to take time off from work.

Flooding is also likely to get worse. Research by Global Climate Impacts suggests that Midwestern states have experienced a 31% increase in very heavy precipitation events between 1958 and 2007 and this trend is expected to continue.⁶

As part of our **Smart Water for Smart Regions** initiative, CNT is working with communities across the eight Great Lakes states (Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin) to help cities deal with flooding. This survey report is a first step toward that goal. By establishing a baseline of current practices and policies, we seek to improve collaborative efforts for improved investment in infrastructure and services.

This survey was conducted in communities within the eight Great Lakes states and one Canadian province with a shoreline on the Great Lakes. Cities beyond the basin, but within the states and province were included in the survey to better understand the opportunities and challenges that exist for policy change at province or state level. Given the policy implications at state levels it was critical that cities throughout each state and province be included.

What Is Urban Flooding?

Urban flooding, or flooding, for the purposes of this survey, includes the inundation of land or property as a result of overland flow from water bodies, precipitation or sewage backup into homes from municipal sewers, water seepage through building wall and floors, and the accumulation of stormwater on property and in the public right-of-way. This survey used the phrase “neighborhood and property flooding,” to provide a short-hand definition for flooding in urban environments. For the purpose of this report, we use Urban Flooding interchangeably.

5. <http://www.newswire.ca/en/story/999989/from-coverage-to-claims-canadians-are-making-insurance-cutbacks-in-bumpy-economic-times>

6. According to research undertaken by Illinois State Water Survey, Prairie Research Institute, University of Illinois

Methodology/ Approach

The urban flooding survey was drafted and conducted between March and June of 2012. The survey sample pool was established by identifying the most populous cities in the Great Lakes region—including cities in the U.S. states of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin, and the Canadian province of Ontario. Population data was gathered from recent census reports—the 2010 U.S. Census and the 2006 Canada Census. A minimum of at least two cities from each state or province were selected to receive the survey, with a total of forty-eight potential cities selected to receive the survey via email. A complete list of recipient cities or the corresponding utilities or agencies is included in Appendix A.

Calls to establish the appropriate contact were conducted as were regular reminder emails and calls to various potential respondents throughout the survey timeframe. Survey respondents⁷ are predominantly managers of stormwater or combined sewer systems often employed in municipal government. In some locations, stormwater/sewer management is the responsibility of a public utility or regional agency or shared between municipal government and a utility or agency.

After respondents completed the survey, follow-up phone calls were done to clarify answers that may have been confusing or incomplete. Based on these calls, adjustments to the original data were made and tracked. ***In the interest of quality data, respondents that completed the survey were ensured confidentiality, thus survey results have been aggregated.***



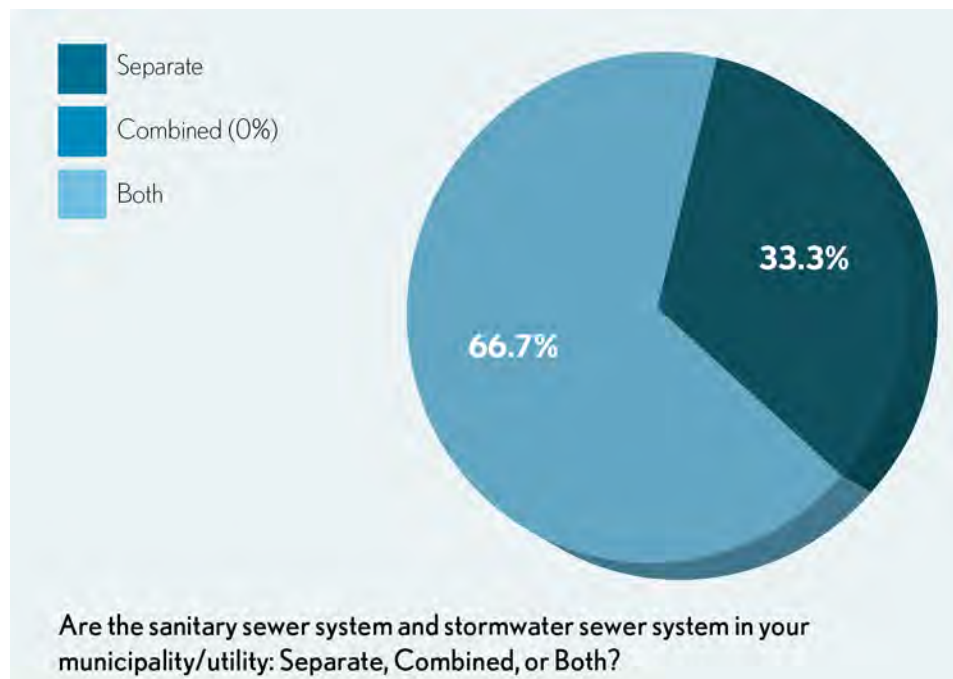
7. Respondent, for the purpose of this report, refers to responding agency as a representative of the corresponding City.

Respondent Information

Thirty of the 48 cities⁸ who received the survey responded, a rate of 62.5%. Cities from all states and provinces contacted in the region responded to the survey. Respondents service a combined total of 330 municipalities and a population of around 19.7 million people—nearly 23% of the total population of the Great Lakes region—with a median population value of 240,500 per city. All respondents are representatives of public entities.

Over 65% of the cities employ both combined sewer systems and separate storm sewer systems within their infrastructure, while the remaining cities employ only separate storm sewer systems. No respondents employ only combined systems.

To better understand the state of wet weather infrastructure, respondents were asked to estimate the number of miles of pipe in the public right-of-way that conveys stormwater, and the number of connections served by the corresponding sewer system. The amount of pipe in the public right of way ranges from approximately 190 to 3,800 miles, with a median value of 825 miles. The number of sewer connections range from approximately 18,000 to 600,000, with a median value of 74,000 connections.



To better understand the state of regulations that affect flood planning, respondents were asked to identify the types of water discharge permits to which they are subject, the status of compliance with discharge permits, and to provide any additional information of rules and/or regulations of enforcement obligations to addressing stormwater, flooding or water quality to which the community is subject. The majority of respondents are in compliance with their discharge permits, which are mandated by city, county, state, province or federal agencies. In addition, respondents cited other documents that affect their strategies for dealing with flooding, including: stormwater ordinances, stormwater planning documents, and federal, state, province or local legislation.

⁸ City, for the purpose of this report, refers to recipient city or to the corresponding utility or agency that services the recipient city, selected for inclusion in this survey.

Summary of Survey Findings

The following sections summarize responses for the nine primary questions asked in the survey. These answers were asked of all respondents to provide a baseline understanding of the impact urban flooding in the Great Lakes region.

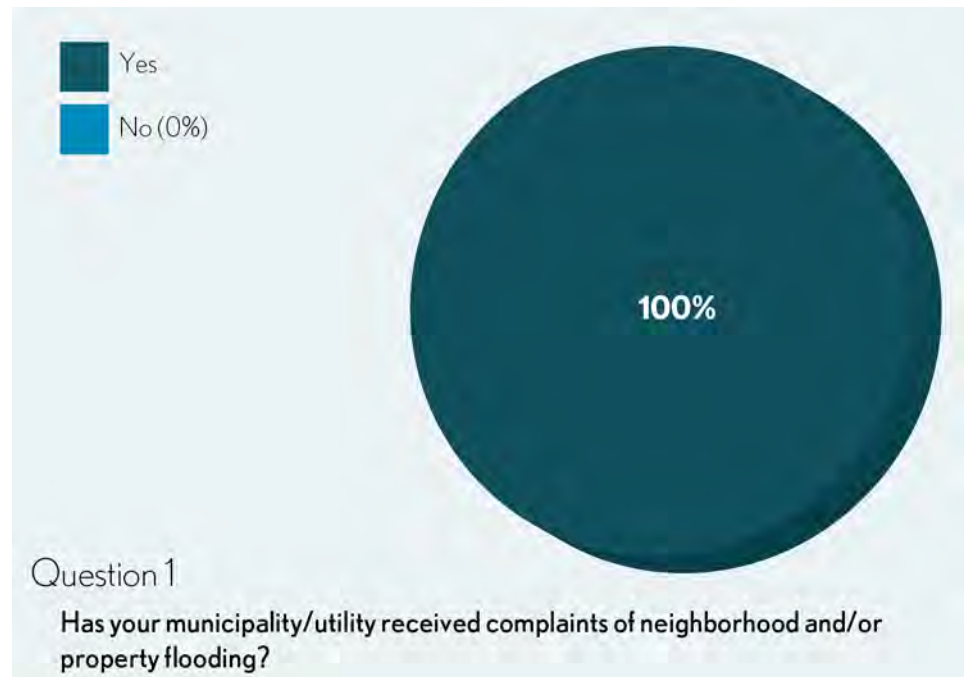
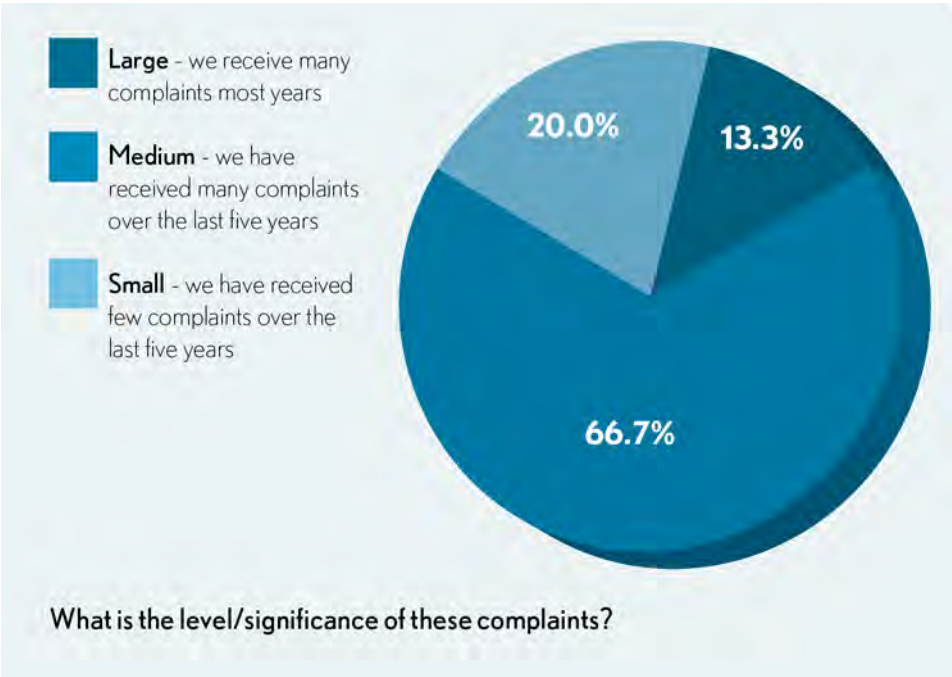


TABLE 1
Perceived Significance of Complaints (per 10,000 people)

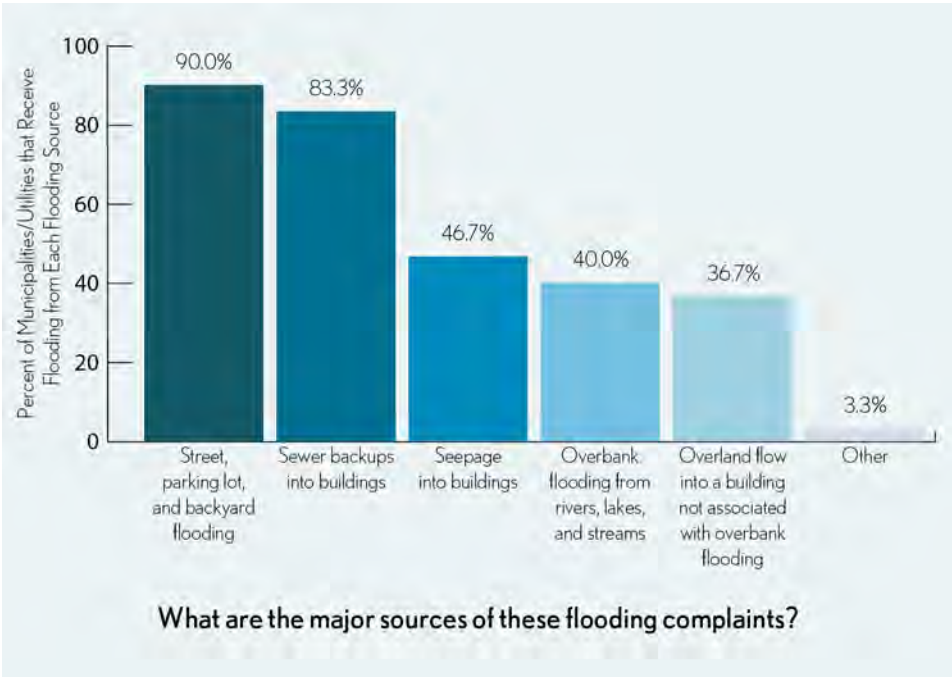
Level/Significance	Low Range	High Range
Small	5	376
Medium	<1	145
Large	<1	18

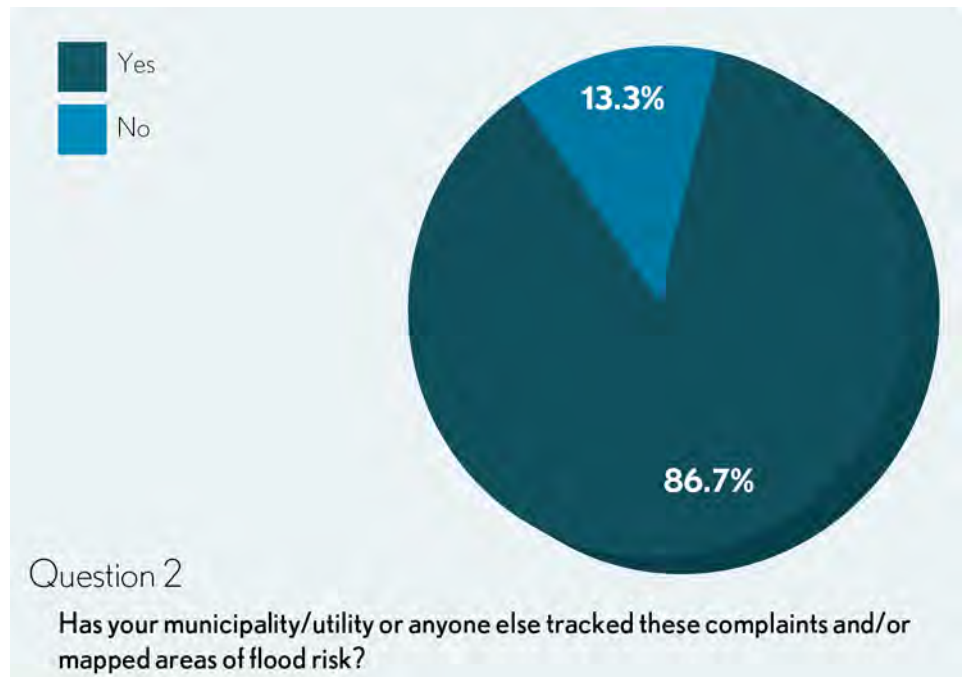
All thirty respondents stated they received flooding complaints, though only 70% provided an estimated number of annual complaints. Of all respondents answering in the positive, 66.7% consider their complaints as being of medium significance—a term indicating the city has received many complaints over the last five years—while 13.3% stated the number of complaints was large—a term indicating the city has received *many complaints in most years*. Of the 70% of respondents that provided their estimate of annual complaint, responses ranged from two to 12,000, with a mean value of 1,160 complaints. The annual number of complaints in each year per 10,000 customers varied from less than one to 376, with a median value of 5 and a mean value of 37 complaints.⁹

9. To normalize complaints across the range of city populations, the Number of Complaints was analyzed “per 10,000 residents.” Population data for this analysis was submitted by Respondent in the survey. Formula for calculation, [(# of Complaints / Population) * 10,000 = # of Complaints per 10,000 residents.]



“Street, parking lot and backyard flooding” (90%) and “sewer backups into buildings” (83.3%) were the major sources of flooding complaints.





Most municipalities (86.7%) stated they track flooding complaints and/or map areas of flood risk. Half of respondents use a Geospatial-enabled database to track flooding complaints, or map areas of flood risk. The methods used to track the information include:

Geospatial-enabled databases, including:

GIS mapping software

Infrastructure Management Systems software

Hydrologic/hydraulic modeling software

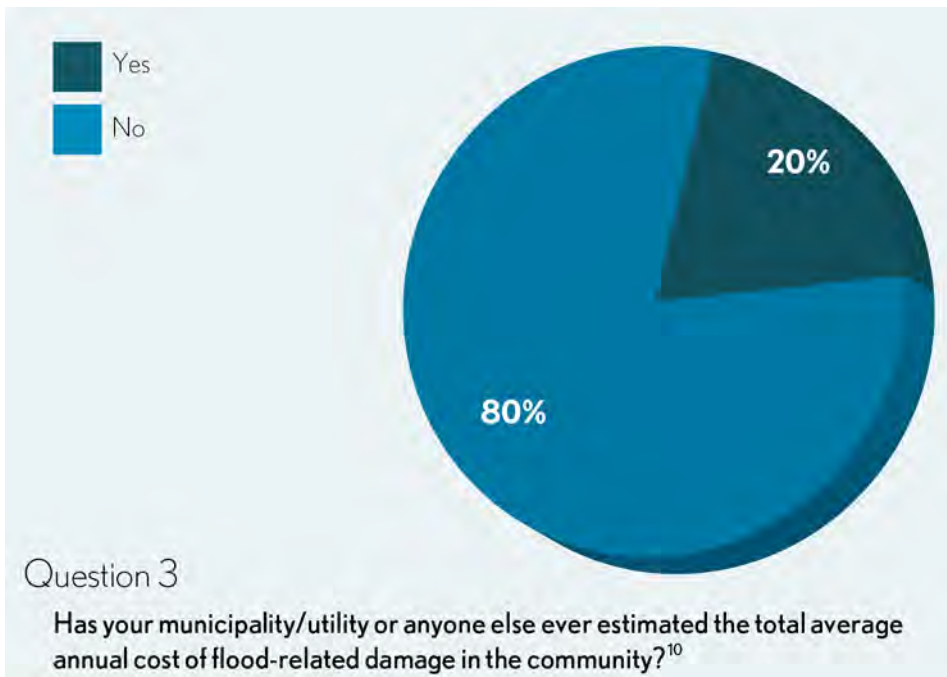
Non-Geospatial databases, including:

Spreadsheets

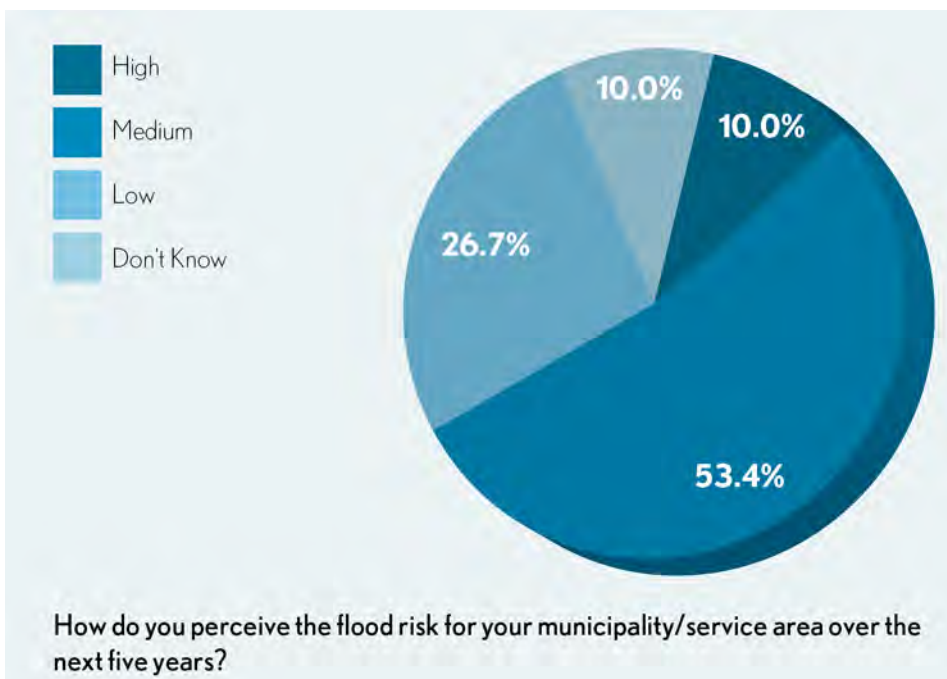
Call logs

Surveys

Unspecified Internal Systems



Only 1 in 5 respondents stated that they have estimated cost of flood-related damage in their community. A subsequent question asked the cost of flooding damage. Only 13 percent of respondents provided a monetary value for flood damages, with a median value of \$29,000,000 US Dollars and the mean value is \$75,475,000 US dollars.¹¹

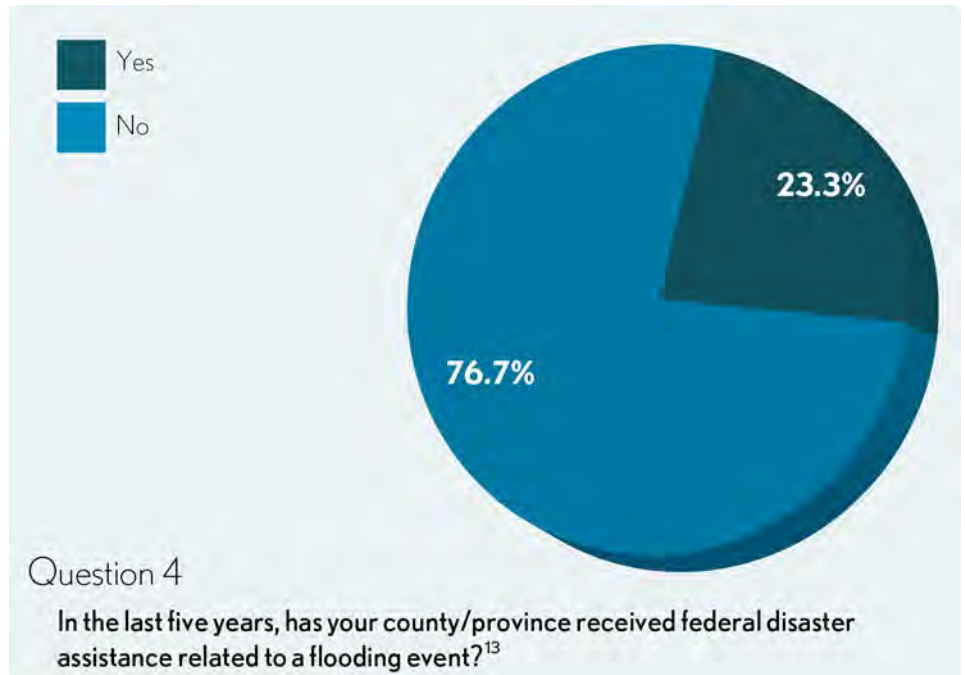


Most municipalities/ utilities perceived their future flood risk as medium (53.3%) or high (10%). A minority of them (26.7%) stated that future flood risk would be low. Relatively few participants (10%) could not predict future flood risk.¹²

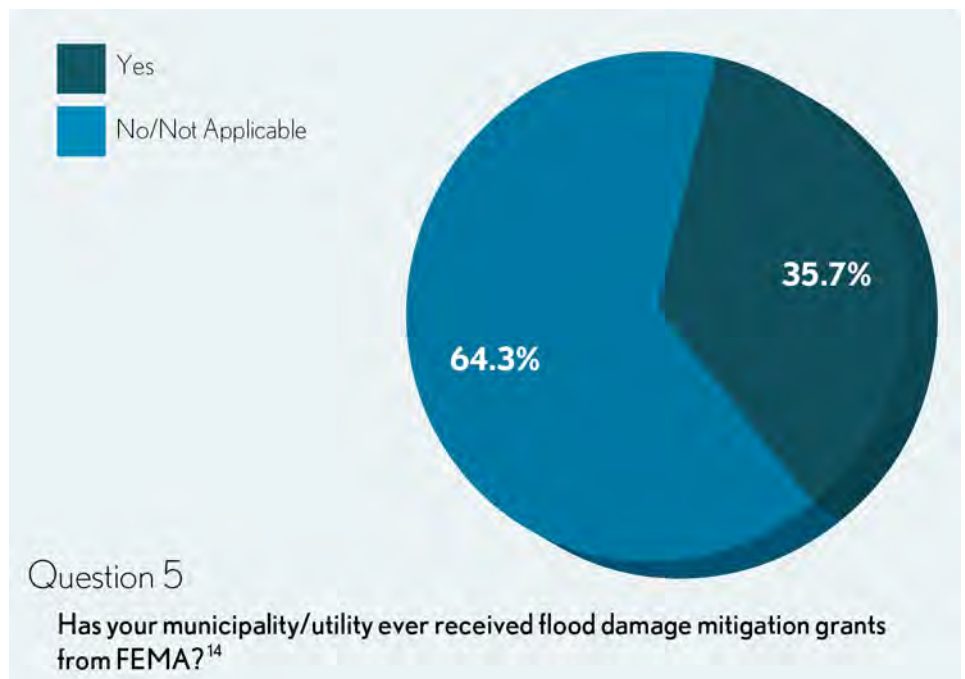
10. Respondents did not provide which measure of central tendency was used in calculating the average annual cost.

11. All the monetary values shown in this report are in 2012 US dollars. Canadian dollar values have been converted into US dollars. And the currency rate applied is 1.00 Canadian Dollar(s) = 0.9742 U.S. Dollar(s) as obtained from Bank of Canada. Source: <http://www.bankofcanada.ca/rates/exchange/daily-converter/>, 6/26/2012.

12. No qualifications were made regarding the levels of risk presented to respondents in the survey.



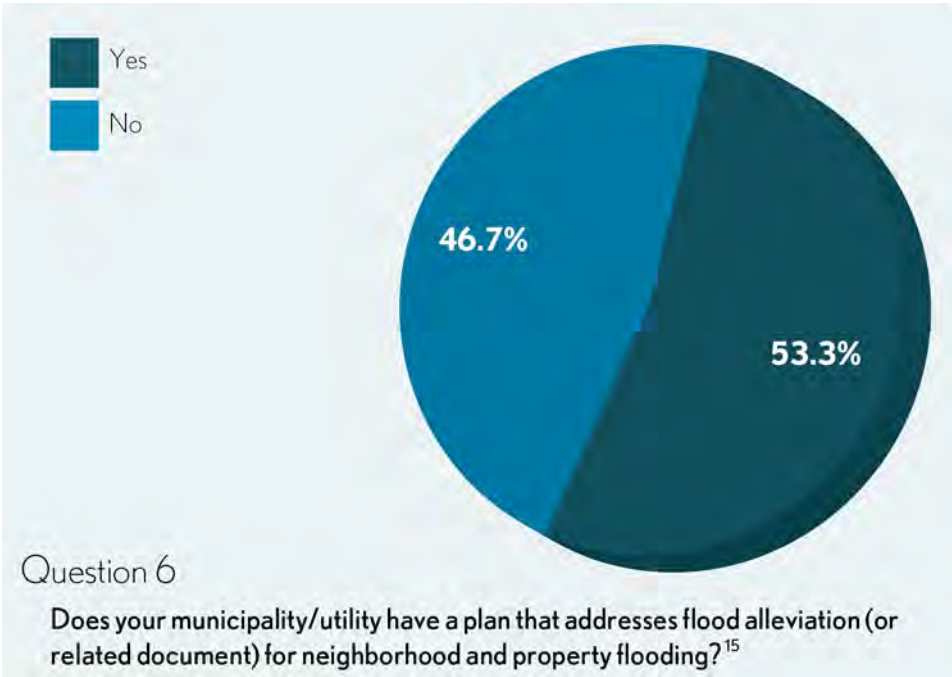
A minority (23.3%) of respondents stated their county/province received federal disaster assistance related to flooding. Note that all Canadian participants answered “No” to this question. For respondents in the US, 36.8% answered “Yes”.



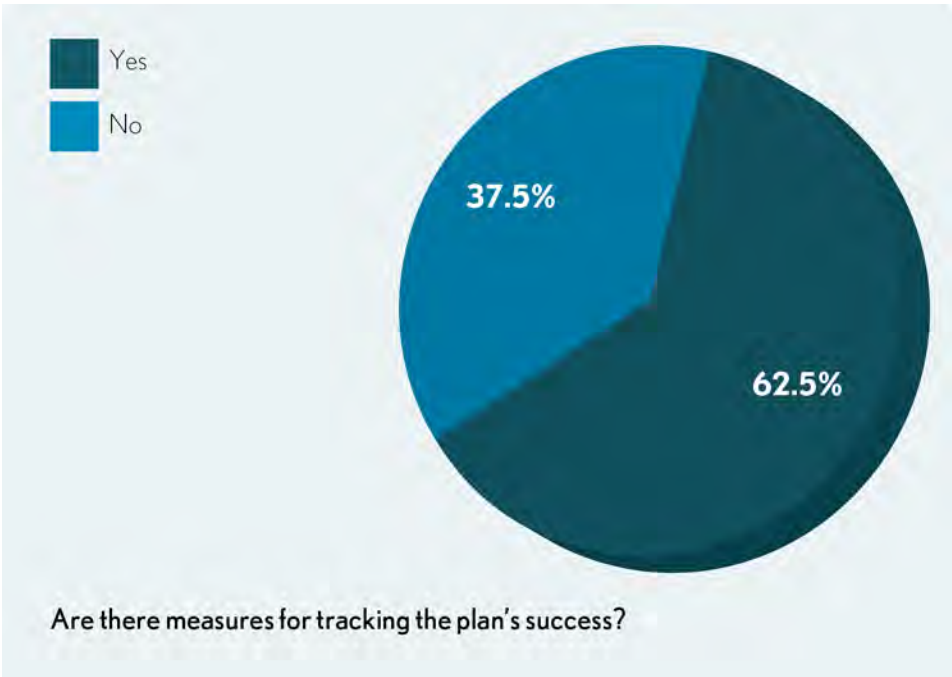
A minority (35.3%) of U.S. respondents stated that their county municipality/utility has received Flood Mitigation Assistance through FEMA –including planning grants, projects grants, or management cost grants.

13. This question is not applicable to Canadian municipalities, because of the federal government structure. Ontario, a province of the Canadian federation, operates a province-level disaster relief program-Ontario Disaster Relief Program. Source, <http://www.mah.gov.on.ca/Page1579.aspx>, Accessed 7/19/2012.

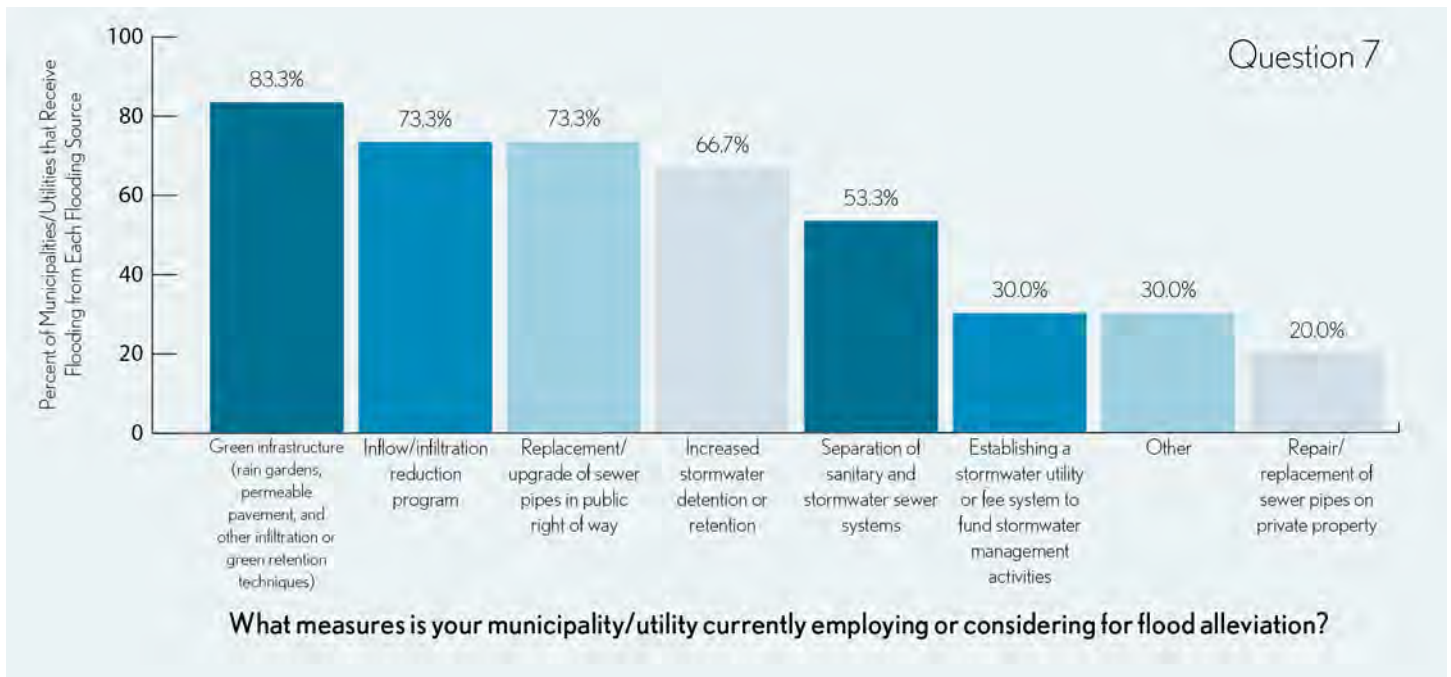
14. This question is not applicable to Canadian municipalities, because of the federal government structure. Canada Source, <http://www.ec.gc.ca/eau-water/default.asp?lang=En&n=0365F5C2-1>, Accessed 7/19/2012.



Slightly over half (53.3%) of respondents stated they had a plan to address flooding, such as a stormwater management program. Of those stating they have a plan, 62.5% have a system for tracking the plan’s success or failure.



15. “FEMA provides FMA funds to assist States and communities implement measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program.” Source, <http://www.fema.gov/government/grant/fma/index.shtm>, Accessed 7/19/2012



All respondent locales have employed or have considered measures for flood alleviation. The main alleviation techniques were:

Green infrastructure (rain gardens, permeable pavement, and other infiltration or green retention techniques), 83.3%.

Inflow/infiltration reduction programs, 73.3%.

Replacement/upgrade of sewer pipes in public right of way, 73.3%.

Increased stormwater detention or retention, 66.7%.

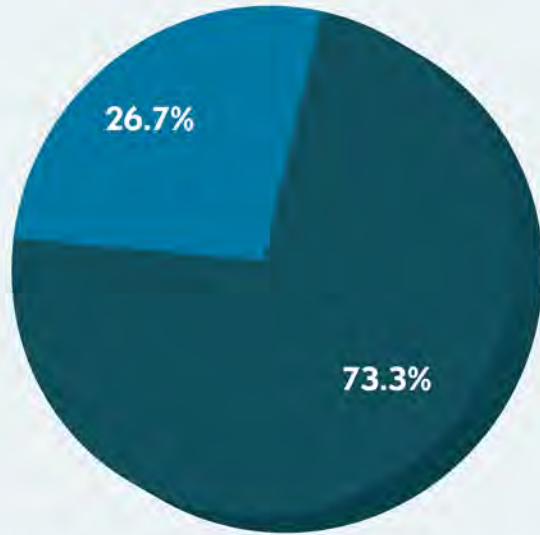
Separation of sanitary and stormwater sewer systems, 53.3%.

Other methods that cities employ include: controls for the volume of water entering storm sewers (inlet control devices, offline storage facilities, downspout disconnection, Inflow & Infiltration monitoring, and increase of stormwater user fees) and the construction of flood protection facilities (levees and floodwalls.)

When asked about their total annual stormwater budget in 2011, 29 of 30 respondents provided answers.¹⁶ Six respondents stated that their budget was “None”. Of the 23 respondents that allocated stormwater budgets in 2011, budgets ranged from \$15,000 to \$124 million, with a median value of \$10,000,000. In 2011, the stormwater spending per capita in these 23 cities ranged from less than one dollar to \$121 per capita, with a mean value of \$32 per capita. For respondents that provided both number of miles of stormwater pipe and 2011 stormwater budgets, these cities allotted a mean value of \$13,593/mile of stormwater pipe in the public right-of-way in their 2011 stormwater budget.¹⁷

16. Survey question did not ask the respondent to clarify the range of activities included in stormwater budget. Budgets may include planning, maintenance, capital improvement and/or other costs.

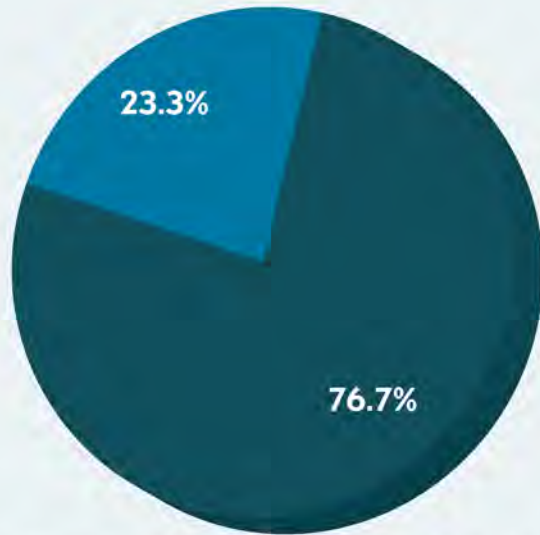
17. Respondents were not asked to qualify what planned costs (capital improvements, operations, planning, maintenance, etc.) were included in their 2011 stormwater budgets.



Question 8

Does your city/utility provide any education and/or outreach to your residents regarding the impact of flooding and flood alleviation strategies?

A majority (73.3%) of respondents stated that they provide education and outreach to residents concerning flooding and flood alleviation strategies. Outreach and education employed include websites, brochures, grants, and public talks and presentations at schools and other venues.



Question 9

We are interested in working with a number of municipalities and utilities within the Great Lakes states to improve collaboration and best practices on flood alleviation policies. Would you be interested in discussing this with us?

Over 76% of cities that responded to this survey are interested in collaborating with CNT to improve flood alleviation policies.

Observations

While all water systems stated they receive flooding complaints and over sixty percent considered their flood risk to be medium to high, nearly half of respondents stated they have no comprehensive plan to mitigate flooding. Water systems without a plan to mitigate flooding serve a combined population equivalent to 23% of the total Great Lakes population.

All communities track complaints, but only 1 in 7 regularly track the total annual cost of flooding. Only larger municipalities with populations over 1 million provided cost information.

There is no industry-wide standard in place for reporting on the impacts of urban flooding. Some municipalities considered 30 complaints per year as a medium number, while others considered 1,500 as medium number, even after adjusting for the size of the service population. Thus, it appears that participants have different opinions regarding the significance of complaints they receive.

Green infrastructure is the most common measure currently employed or considered for flood alleviation. These practices are being implemented at the site, corridor and regional scales, and take advantage of public and private partnerships.

Water systems with a plan to alleviate flooding are more likely to invest in stormwater management, measure the impact of urban flooding, and conduct public education/outreach. Systems with a plan spend \$1.60 per capita annually. Systems without a plan spend \$1.00 per capita. Systems with a plan are also more likely to track the annual cost of flooding (31.3% versus 7.1 %.) Systems with a plan are more likely to conduct education and public outreach concerning flooding (93.8%). In contrast, systems without a plan are less likely to do so (50%).

There is no clear correlation between the budgets for stormwater management and the costs of flood-related damage. While 76% of respondents indicated that they have an annual stormwater budget, only 20% stated they estimate the annual cost of flood-related damage.

Over 75% of surveyed water systems indicated they are interested in improving collaboration to reduce urban flooding. Eighty-eight percent of the interested respondents already have some flood reduction plan in place. This shows a desire by cities to work together to alleviate the impacts of urban flooding in the Great Lakes region.



PHOTO: CNT

Conclusions

The cities in the Great Lakes region are affected by urban flooding to an extent that is significant, yet not fully known. U.S. government attempts to track annual flood damage, but there is concern this estimate underreports total damage.¹⁸ The private sector is beginning to account for loss where data is available. TD Insurance says water damage causes Canadians \$1.7 billion per year in private property claims, while Aviva Canada, a private insurer, identified a 160% increase in water damage claims between 2000 and 2010. Our public dialogue lacks a clear statement of the economic, social and environmental costs of not addressing urban flooding.

This lack of understanding has created an environment where measuring the impacts of flooding across the region is difficult and uncoordinated, and comprehensive strategies for dealing with flooding are infrequent or inadequate. Great Lakes cities receive complaints from residents that urban flooding is damaging their property and neighborhoods. Our survey depicts cities that are grasping for the right response to deal with urban flooding. Within reach is the opportunity to collaborate among cities and across the Great Lakes region to re-state the problems of urban flooding, understand its costs, and share best practices and engage the public.

There are bright spots in the ways cities alleviate flooding. Green infrastructure practices, which bring additional benefits beyond stormwater management, is the most frequently employed flood alleviation measure. Geospatial technology is being utilized to track and analyze problems and to target locations for flooding solutions. Cities are making better efforts to share flood risk through transparency in reporting online.

Through this survey, CNT identified questions that remain to be answered. How do cities engage residents to receive complaints and estimate actual damage? Which sources of urban flooding are most costly and which are most frequent? What is the cost of urban flooding to residents? What role will public and private sector agencies play in mitigating flood risk? What is an acceptable level of risk for urban flooding?

Next steps to alleviate flooding damage in Great Lakes cities require greater collaboration, increased public dialogue on flood damage, and investment in effective flood alleviation strategies and polices. The Center for Neighborhood Technology's



Smart Water for Smart Regions initiative supports this transition to collaboratively deal with urban flooding.

18. Pielke, Jr., R.A., M.W. Downton, and J.Z. Barnard Miller, 2002: Flood Damage in the United States, 1926-2000: A Reanalysis of National Weather Service Estimates. Boulder, CO: UCAR.

PHOTO: CNT

Appendix A

List of Survey Recipients

Water systems in the following 48 communities were asked to answer a survey regarding flooding and related issues. Of these, 30 responded. To enhance the likelihood of response, all water systems were offered anonymity. The reader should not assume that the presence of a community on this list indicates that it did, or did not, participate in the survey.

Illinois

City of Aurora
City of Chicago
Metropolitan Water Reclamation District of Greater Chicago
City of Joliet
City of Naperville
City of Peoria
City of Rockford
City of Springfield

Indiana

City of Evansville
City of Fort Wayne
City of Indianapolis

Michigan

City of Detroit
City of Grand Rapids
City of Lansing
City of Sterling Heights

Minnesota

City of Minneapolis
City of Rochester
City of St. Paul

New York

City of Buffalo
City of Monroe County
City of Rochester
City of Syracuse
City of Yonkers

Ohio

City of Akron
City of Cincinnati
City of Cleveland
City of Columbus
City of Dayton
Northeast Ohio Regional Sewer District
City of Toledo

Ontario

City of Burlington
City of Kingston
City of Kitchener
City of London
City of Markham
City of Mississauga
City of Oakville
City of Oshawa
City of Ottawa
City of St. Catharines
City of Toronto
City of Windsor

Pennsylvania

City of Allentown
City of Philadelphia

Wisconsin

City of Green Bay
City of Madison
Milwaukee Metropolitan Sewerage District
City of Milwaukee

ABOUT THE CENTER FOR NEIGHBORHOOD TECHNOLOGY

The Center for Neighborhood Technology (CNT) is an award-winning innovations laboratory for urban sustainability. Since 1978, CNT has been working to show urban communities in Chicago and across the country how to develop more sustainably. CNT promotes the better and more efficient use of the undervalued resources and inherent advantages of the built and natural systems that comprise the urban environment.

As a creative think-and-do tank, we research, promote, and implement innovative solutions to improve the economy and the environment; make good use of existing resources and community assets; restore the health of natural systems and increase the wealth and well-being of people—now and in the future. CNT's unique approach combines cutting edge research and analysis, public policy advocacy, the creation of web-based information tools for transparency and accountability, and the advancement of economic development social ventures to address those problems in innovative ways.

CNT works in four areas: transportation and community development, water, energy and climate. CNT has two affiliates, I-GO™ Car Sharing and CNT Energy.

CNT is a recipient of the 2009 MacArthur Award for Creative and Effective Institutions.

More information about CNT is available at www.cnt.org