

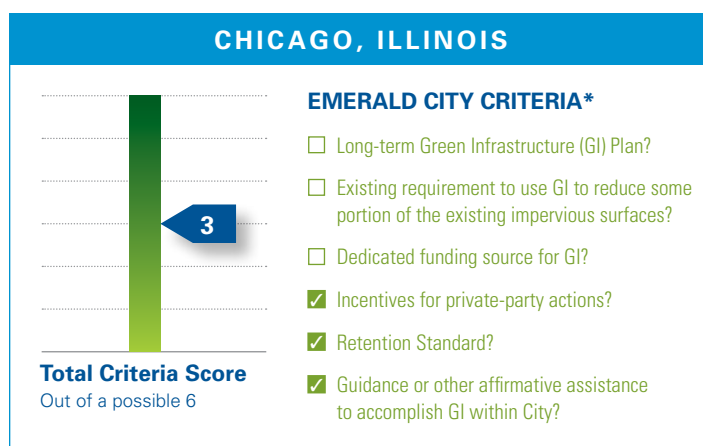
# CHICAGO, ILLINOIS

A CASE STUDY OF HOW GREEN INFRASTRUCTURE IS HELPING MANAGE URBAN STORMWATER CHALLENGES

**TYPES OF GREEN INFRASTRUCTURE USED:** Green roofs, rain barrels/cisterns, permeable pavement, rain gardens, infiltration trenches or vaults, vegetated swales, street trees, planter boxes, stream buffers



Chicago has been and continues to be a green infrastructure leader in many areas, including urban forestry, green roofs, and green alleys. Its Climate Action Plan recognizes the importance of green infrastructure in adapting to climate change and sets some ambitious goals in terms of canopy cover and green roofs, which the city is close to meeting. Its “Adding Green to Urban Design” manual provides guidance to implement green infrastructure, although many of its recommendations on ordinance changes have not occurred. Chicago has some challenges, most notably the lack of a comprehensive plan to integrate its GI programs and the absence of a requirement to use green infrastructure to reduce impervious surfaces. It also lacks a dedicated funding source, and although the city has successfully leveraged partners and outside funding sources to provide incentives and implement projects, those sources may not be available in the future. Chicago also has a new mayor, Rahm Emanuel (elected in May 2011), whose environmental agenda is still being formed. Mayor Emanuel’s challenge (and opportunity) is to take the individual green infrastructure successes the city has enjoyed over the past 20 years to the next level. For example, Chicago created a detailed sewer model that would allow the city to strategically place green infrastructure in areas to reduce basement flooding and (eventually) combined sewer overflows; however, there is currently no process to integrate green infrastructure into the sewer capital planning process.



## BACKGROUND

The city of Chicago, the third most populous city in the United States, lies at the confluence of the Chicago River and Lake Michigan. In 1856, Chicago built a combined stormwater conveyance system to help reduce flooding in the burgeoning city.<sup>1</sup> Worries about flooding were quickly followed by concerns about the water quality of Lake Michigan—the city’s source of drinking water—and in the early 1900s, city engineers from what is now known as the Metropolitan Water Reclamation District (MWRD) reversed the Chicago River’s natural flow to keep sewage and stockyard pollution from entering the lake.



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More than a century later, flooding and water quality still remain major issues for the city, and the River continues to receive CSO discharges following rain events of as little as 0.67 inch in a 24-hour period.<sup>2</sup> Additionally, MWRD currently does not disinfect the treated sewage effluent discharged to the river, as is done in virtually every other major U.S. city, although it recently agreed, under pressure from the U.S. EPA, to begin installation of disinfection equipment at two of its three major treatment plants.<sup>3</sup> These plants also discharge large amounts of phosphorus, known to fuel algal blooms, impacting downstream waters all the way to the Gulf of Mexico, where the Chicago watershed is the largest single contributor to Gulf “dead zone” conditions.<sup>4</sup>

The river also faces newer threats, such as climate change and invasive species. In fact, the most recent incursion of bighead and silver Asian carp is considered one of the most acute aquatic invasive species threats facing the Great Lakes region today.<sup>5</sup> As a consequence of these various issues, the Chicago River was recently named one of the “most endangered rivers” by American Rivers.

To tackle the flooding and CSO problems, the MWRD initiated the building of a \$3.4 billion deep tunnel and reservoir system in 1972. However, the end date has continually been pushed back, and the system remains many years away from completion.

While MWRD has been slow to consider the use of green infrastructure, the city of Chicago has embraced it since 1998 under the leadership of former Mayor Richard M. Daley. At that time, Chicago’s stormwater management program, as well as other initiatives throughout the city, began placing greater emphasis on the utilization of green infrastructure, such as vegetated swales, infiltration trenches, rain gardens, and green roofs. Two of Chicago’s initiatives profiled in the 2006 *Rooftops to Rivers* report, green roofs and green alleys, have seen significant growth in the past five years. In addition, the city launched the Chicago Climate Action Plan (CCAP) in 2008. It outlines how Chicago will achieve its goals of reducing greenhouse gas emission to 25 percent below 1990 levels by 2020, and 80 percent by 2050. Two green infrastructure strategies are central to the effort: capturing stormwater on-site and cooling the city with green roofs and trees.

## CHICAGO’S GREEN ROOF PROGRAM

A national leader in green roof installations, Chicago has nearly 500 green roofs totaling almost 5.5 million square feet either completed or under way.<sup>6</sup> The city is completing an assessment using satellite imagery to more accurately calculate the total square footage of green roofs that have been built and to evaluate their health. Results are expected to be released later this year.<sup>7</sup>

Chicago started its program in 2001 with the installation of a 20,000-square-foot green roof on City Hall. Since then, the city has initiated various incentives, including a density/building height bonus for green roofs in Chicago’s business district, a fast-track permitting process (the Green Permit Program), and, for those developments with a particularly high level of green strategy implementation, including exceptional water management, a maximum waiver of \$25,000 for processing the building permit and associated fees.<sup>8,9</sup> Between 2005 and 2007, Chicago also had a Green Roof Grants Program that assisted with the costs of more than 70 green roof projects.<sup>10</sup> According to the Green Roofs for Healthy Cities 2011 Annual Industry Survey, Chicago was the leading U.S. city in installing green roofs in 2010.<sup>11</sup>

Chicago requires all new city buildings to have at a minimum a partial green roof and to achieve silver LEED® certification. The majority of green roofs have been installed under regulations requiring every developer receiving city assistance (either financial or zoning) to include a cool roof, per city code, or vegetated roof, per the Sustainable Development Policy, with the remainder of the roof meeting Energy Star-level reflectivity requirements.<sup>12</sup> And with all the green roofs going up, Chicago has seen the cost of installation go down, with the average price dropping from \$25 to \$15 per square foot.<sup>13</sup>

## GREEN ALLEYS AND SUSTAINABLE STREETS

Greening strategies in the city are not limited to buildings. Another initiative, Greening Chicago’s Alleys, uses permeable pavements, as well as proper grading and pitch, in the city’s more than 13,000 alleys to improve infiltration and reduce runoff. As Chicago has grown, its originally gravel and dirt alleys, which allowed some water to infiltrate the soils, were paved over, increasing the likelihood of flooding both within the alleys and on surrounding properties during storm events.<sup>14</sup> In 2006, the city conducted five pilot projects to see whether permeable pavements would provide an alternative to connecting sewer mains from the alleys to the city’s sewer system, which would be cost-prohibitive, create an increased burden on the combined sewer systems, and

increase basement flooding.<sup>15</sup> The Chicago Department of Transportation (CDOT) incorporated green alleys into a term contract for alley reconstruction going out for bid in 2007; on average, 20 to 40 alleys are reconstructed per year. There was just one green alley identified in the first *Rooftops to Rivers* report, but since then, more than 150 have been installed.<sup>16</sup> As for costs, CDOT saw prices come down as a market for permeable paving began to develop;<sup>17</sup> the agency recently stated that the costs of constructing green streets is no more expensive than the cost of traditional alleys.<sup>18</sup>

CDOT is now integrating green stormwater management techniques into its street improvement projects; as of 2010, more than 215,000 square feet of permeable pavement have been installed in parking lots, sidewalks, parking lanes, bike lanes, and plazas. CDOT recently started construction on a comprehensive Sustainable Streetscape demonstration project. This 1.5-mile-long pilot project on the city's near southeast side demonstrates sustainable design techniques and associated benefits of green infrastructure for the urban ecosystem. The comprehensive streetscape project has established eight environmental performance goal areas. Background data and monitoring data are already being collected, and a final report will include pre-improvement conditions, predicted outcomes based on stormwater modeling, the monitoring plan, documentation of equipment installation, and monitoring results.<sup>19</sup>

## URBAN FORESTS AND RIVERBANK PROTECTION

Annually, Chicago spends roughly \$8 million to \$10 million to plant 4,000 to 6,000 trees (with another 2,500 trees planted by the Chicago Park District), which has helped to increase the tree canopy from 11 percent in 1991 to 17.6 percent in 2008.<sup>20</sup> In 2009, Chicago created an Urban Forest Agenda to continue to strengthen the city's natural environment by maintaining and conserving trees, expanding the urban forest, integrating green infrastructure, and fostering stewardship. The agenda, an effort to tie the maintenance and planting of street trees to stormwater management,<sup>21</sup> sets a goal of achieving a citywide average tree canopy cover of 20 percent by 2020 through a public/private effort called the Chicago Trees Initiative.<sup>22</sup> To account for the impacts of climate change, the city's planting experts are also reevaluating their tree planting standards and plant lists, with an eye toward comprehensive tree diversity and the use of only those species able to endure future climate conditions.<sup>23</sup>

Chicago has also made a concerted effort to protect land along the river from development. Since 1998, the city has built or expanded nine parks along the Chicago River,

reconstructed 4,000 linear feet of riverbanks, and, with the assistance of the private sector, installed 13 miles of river walk. The Chicago Park District has also purchased 43 acres of new parkland along the river since 2005.<sup>24</sup>

## FINANCE STRATEGY

Chicago does not have a dedicated stormwater fee. Its green infrastructure initiatives are embedded across a number of departments, each with its own finance stream, including the general fund, grants, the water enterprise fund, and the sewer enterprise fund. As a result, the costs and fees associated with green infrastructure are not separated out from those of traditional infrastructure services.<sup>25</sup>

The absence of a dedicated stormwater fund limits opportunities for the city to provide incentives for reductions in impervious surfaces or the use of green infrastructure practices. Regardless, Chicago has done a good job over the years of offering incentives through various programs. The Department of Environment oversaw the promotion of green development, environmental enforcement activities and conservation and energy policies. However, as of January 1, 2012, the Department will no longer exist as a stand-alone unit. Its functions will be absorbed by other departments and a Chief Sustainability Officer, reporting to the Mayor, will oversee and develop the City's environmental policies.<sup>26</sup> Chicago's Sustainable Backyard Program offers rebates to residents for up to 50 percent of the cost of trees, native plants, and rain barrels, building upon a rain barrel program that has offered nearly 7,000 subsidized barrels to residents since 2004.<sup>27</sup> The Sustainable Development Division and pilot tax increment financing Green Roof Improvement Fund (GRIF) fall under the new Department of Housing and Economic Development. However, the Green Roof Grants Program and GRIF are currently unfunded.

Green permits, which include green buildings and buildings with exceptional water management, are a function of the Department of Buildings.<sup>28</sup> A stormwater ordinance went into effect in 2008 (and was updated in 2011); while it places greater emphasis on reducing imperviousness and implementing green infrastructure techniques, it requires the capture of only the first half-inch of rain (or a 15 percent reduction in impervious surface<sup>29</sup>). Further, it applies only to developments of more than 15,000 square feet in size and impervious open-space areas (such as parking lots) of 7,500 square feet or more.<sup>30</sup>

Potable water, wastewater and stormwater runoff, and the cleaning and upgrading of sewer lines are the responsibility of the Department of Water Management, and revenues to support these services come primarily from two enterprise funds for water and sewer.<sup>31</sup> Green alleys and

green streetscapes projects are managed by CDOT, and tree plantings are primarily the responsibility of the Department of Streets and Sanitation's Bureau of Forestry, CDOT's Green Streets, and the Chicago Park District. Funding for these sources comes largely from the Capital Improvements Funds and neighborhood capital improvement bonds, as well as the vehicle tax and motor fuel tax funds, which are both special revenue funds.<sup>32</sup> As Chicago continues to advance its sustainability work, especially through increasing green infrastructure and permeable areas, the Chicago Climate Action Plan (CCAP) is intended to be an important tool for guiding next steps and prioritizing goals.

## \*EMERALD CITY RATING SYSTEM

Each of the cities profiled in *Rooftops to Rivers II* is a leader in green infrastructure investment—rethinking the design of municipal services and infrastructure. These cities leverage funding in creative ways. They provide tools to residential and commercial land owners to retrofit private properties and realize the multiple benefits provided by green infrastructure. In short, they are changing how cities look and function.

NRDC's Emerald City Rating System identifies six actions cities should undertake to maximize their green infrastructure investment. Our metric does not directly compare one city to another, due to geographical, population, budgetary and other differences. Instead, it identifies the presence or absence of common factors of success that NRDC believes are essential elements of a robust green infrastructure commitment. Only one city profiled, Philadelphia, is undertaking each of the actions identified, although each city is undertaking at least one.

## REFERENCES

- 1 City of Chicago, "Combined Sewers," accessed at [www.cityofchicago.org/city/en/depts/bldgs/supp\\_info/combined\\_sewers.html](http://www.cityofchicago.org/city/en/depts/bldgs/supp_info/combined_sewers.html).
- 2 Metropolitan Water Reclamation District of Greater Chicago, "The District and its History," accessed at [www.nrdc.org/water/Chicagoriver/files/Chicago%20River.pdf](http://www.nrdc.org/water/Chicagoriver/files/Chicago%20River.pdf).
- 3 Lyderson, K. "Pressures to Improve Water Quality in Chicago River," *The New York Times*, May 19, 2011, accessed at [http://www.nytimes.com/2011/05/20/science/earth/20cncriver.html?\\_r=1](http://www.nytimes.com/2011/05/20/science/earth/20cncriver.html?_r=1).
- 4 United States District Court for the Northern District of Illinois. Natural Resources Defense Council, Inc., Sierra Club, Inc., and Prairie Rivers Network v. Metropolitan Water Reclamation District of Greater Chicago. Case No. 11-CV-2937. May 3, 2011. [http://docs.nrdc.org/water/files/wat\\_11050301a.pdf](http://docs.nrdc.org/water/files/wat_11050301a.pdf).
- 5 Henderson, H., T. Cmar, and K. Hobbs (2010). "Re-Envisioning the Chicago River: Adopting Comprehensive Regional Solutions to the Invasive Species Crisis." NRDC, accessed at [www.nrdc.org/water/Chicagoriver/files/Chicago%20River.pdf](http://www.nrdc.org/water/Chicagoriver/files/Chicago%20River.pdf).
- 6 M. Berkshire, personal communication, September 28, 2011.
- 7 M. Berkshire, personal communication, May 18, 2011.
- 8 Taylor, D.A. (2007). "Growing Green Roofs, City by City," *Environmental Health Perspectives*, 115(6): A306 – A311, accessed at <http://ehp03.niehs.nih.gov/article/lookupArticle.action?articleURI=info:doi/10.1289/ehp.115-a306>.
- 9 More information on Chicago's green permits may be accessed at [www.cityofchicago.org/city/en/depts/bldgs/provdrs/green\\_permit.html](http://www.cityofchicago.org/city/en/depts/bldgs/provdrs/green_permit.html).
- 10 City of Chicago. "Green Roof Grants Programs," accessed at [http://www.cityofchicago.org/city/en/depts/doe/supp\\_info/green\\_roof\\_grantsprograms.html](http://www.cityofchicago.org/city/en/depts/doe/supp_info/green_roof_grantsprograms.html).
- 11 Green Roofs for Healthy Cities (2011). "Annual Green Roof Industry Survey", accessed at: [http://www.greenroofs.org/resources/2011\\_GRHC\\_Survey\\_Report.pdf](http://www.greenroofs.org/resources/2011_GRHC_Survey_Report.pdf), P. 5.
- 12 M. Berkshire, personal communication, May 18, 2011.
- 13 Hawkins, K. (November 13, 2009). "Chicago Green Roofs: Seven Million Square Feet and Growing," accessed at [hpigreen.com/2009/11/13/chicago-green-roofs-seven-million-square-feet-and-growing/](http://hpigreen.com/2009/11/13/chicago-green-roofs-seven-million-square-feet-and-growing/).
- 14 Buranen, M. (2008). "Chicago's Green Alleys," *Stormwater* 9(7), accessed at: <http://www.stormh2o.com/october-2008/chicago-green-alleys.aspx>.
- 15 "Green Alleys," City of Chicago, accessed at: [www.cityofchicago.org/city/en/depts/cdot/provdrs/alley/svcs/green\\_alleys.html](http://www.cityofchicago.org/city/en/depts/cdot/provdrs/alley/svcs/green_alleys.html).
- 16 Attarian, J.L. (2010). "Greener Alleys," *Public Roads*. 73(6). FHWA-HRT-10-004, accessed at [www.fhwa.dot.gov/publications/publicroads/10mayjun/05.cfm](http://www.fhwa.dot.gov/publications/publicroads/10mayjun/05.cfm).
- 17 "Green Alleys".
- 18 Kaufman, L. "A City Prepares for a Warm Long-term Forecast," *The New York Times*, May 22, 2011, accessed at <http://www.nytimes.com/2011/05/23/science/earth/23adaptation.html?pagewanted=all>.
- 19 A. Durnbaugh, S. Abu-Absi, personal communication, May 20, 2011.
- 20 Kaufman, L. "A City Prepares for a Warm Long-term Forecast," *The New York Times*, May 22, 2011.
- 21 City of Chicago (2009). "Chicago's Urban Forest Agenda," accessed at [www.cityofchicago.org/city/en/depts/doe/supp\\_info/chicago\\_s\\_urban\\_forestagenda.html](http://www.cityofchicago.org/city/en/depts/doe/supp_info/chicago_s_urban_forestagenda.html).
- 22 City of Chicago (2009). "Chicago Tree Initiative," accessed at <http://www.chicagotrees.net/>.
- 23 Kaufman, L. "A City Prepares for a Warm Long-term Forecast," *The New York Times*, May 22, 2011.
- 24 City of Chicago (2010). "Environment," accessed at [http://www.cityofchicago.org/content/city/en/progs/env/supp\\_info.html](http://www.cityofchicago.org/content/city/en/progs/env/supp_info.html).
- 25 The Civic Federation (2007). "Managing Urban Stormwater with Green Infrastructure: Case Studies of Five U.S. Local Governments," prepared for the Center for Neighborhood Technology, accessed at [www.cnt.org/repository/GreenInfrastructureReportCivicFederation%2010-07.pdf](http://www.cnt.org/repository/GreenInfrastructureReportCivicFederation%2010-07.pdf).
- 26 City of Chicago (2011). "Budget 2012 Overview," p. 3, accessed at [http://www.cityofchicago.org/content/dam/city/depts/obm/supp\\_info/2012%20Budget/2012BudgetOverview.pdf](http://www.cityofchicago.org/content/dam/city/depts/obm/supp_info/2012%20Budget/2012BudgetOverview.pdf).
- 27 City of Chicago (2011). "Department of Environment's Chicago Sustainable Backyard Program", accessed at [www.cityofchicago.org/rainbarrel](http://www.cityofchicago.org/rainbarrel).

28 The Civic Federation (2007). "Managing Urban Stormwater with Green Infrastructure: Case Studies of Five U.S. Local Governments," prepared by the Center for Neighborhood Technology.

29 Jaffe, M., et al. (June 24, 2010). "Using Green Infrastructure to Manage Urban Stormwater Quality: A Review of Selected Practices and State Programs," draft report to the Illinois Environmental Protection Agency, accessed at <http://www.epa.state.il.us/green-infrastructure/docs/public-act-recommendations.pdf>.

30 City of Chicago (2011). "Stormwater Management Ordinance Manual", accessed at <http://www.cityofchicago.org/content/dam/city/depts/water/general/Engineering/SewerConstStormReq/2011StormwaterManual.pdf>.

31 City of Chicago (2010). "Budget 2011: Overview and Revenue Estimates", accessed at [http://chicityclerk.com/citycouncil/budget/2011/2011\\_Overview\\_and\\_Revenue\\_Estimates.pdf](http://chicityclerk.com/citycouncil/budget/2011/2011_Overview_and_Revenue_Estimates.pdf).

32 Kaufman, L. "A City Prepares for a Warm Long-term Forecast," *The New York Times*, May 22, 2011.