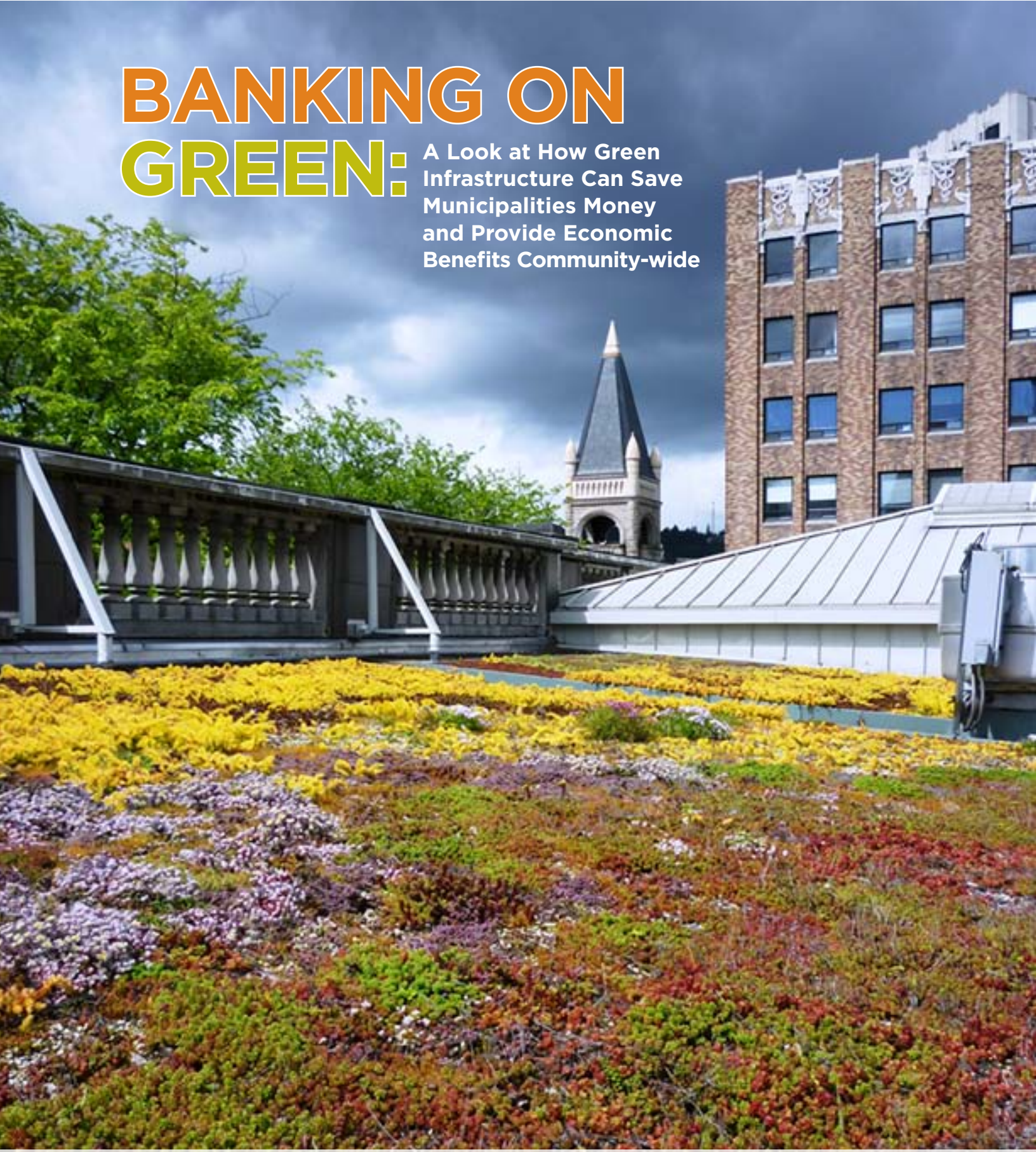

BANKING ON GREEN:

A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide

A Joint Report by American Rivers, the Water Environment Federation, the American Society of Landscape Architects and ECONorthwest

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Green Infrastructure Approaches Can Reduce Flooding Damage and Costs, Role of Green Infrastructure and Flood Control Management

Green Infrastructure and Flood Control in Ohio

The City of Cuyahoga Falls, Ohio used FEMA funds to acquire four flood-damaged residential properties located in a neighborhood which has suffered from repetitive flooding. The City intends to demolish the structures and turn parts of the newly created open-space into a series of rain gardens to mitigate localized flooding in the area. The innovative design measures of this Rain Garden Reserve create an additional 5 five acres of storage for runoff, and enhances outdoor educational and recreational opportunities for the community. (City of Cuayoga Falls, 2008)

City of Cuyoga Falls, Ohio (2008), "Rain Garden Reserve." Accessed December 2011, Available online at <http://planning.co.cuyahoga.oh.us/infrastructure/pdf/raingarden.pdf>.

City of Cuyahoga Falls

Flood Control Benefits of Green Infrastructure

Green infrastructure practices provide a variety of benefits across the range of flood magnitudes. Common green infrastructure practices used to target flood management include green roofs, bioretention, water quality swales, and infiltration basins and trenches. While most effective at managing localized flooding, runoff volume capture can also significantly reduce the impact of larger scale riverine flooding events. Recent research on the impacts of green infrastructure employed on watershed-scale flooding suggests that green infrastructure can be effective at reducing peak flows for large infrequent storm events as well as provide noticeable volume reduction for more frequent storms. The ability for green infrastructure to address flooding at a variety of scales can lead to significant reductions in flood loss damages on an average annual basis.[92]

Localized Flooding: The advantage of green infrastructure to alleviate local urban flooding in an urban setting by minimizing runoff volume and peak discharges within small urbanized catchments is evident. One such example is the City of San Francisco's Sewer System Master Plan that has incorporated a planned approach to implement green infrastructure (and low impact development (LID) techniques) as a part of their long-term strategy for the management of wastewater and stormwater. This approach includes identifying and prioritizing projects that can integrate green infrastructure into

built-out neighborhoods and can harness existing green spaces for stormwater management, thereby resulting in reduced flooding and CSOs. One of the projects underway includes pocket parks, pervious paving, street trees and stormwater retention on a block of Newcomb Avenue, which is located in a flood-prone area of the City.[93]

Riverine Flooding: When communities employ green infrastructure combined with appropriate management requirements, retrofit programs, and riparian preservation that function at a macro or watershed level, they can also reduce riverine flooding impacts. Thomas and Nisbet identified that by reducing the volume of runoff (e.g. by intercepting rain and providing storage areas to hold water in the catchment and on floodplains), promoting water infiltration into the soil, and slowing and reducing runoff to streams, runoff peak flows can be delayed and minimized. The effect of runoff capture on peak flow reduction and delay has been documented in research literature.[94,95] This effect helps to address a consistent problem in urbanized watersheds—the flashy peak flows caused by directly connected impervious surfaces and conveyance systems designed to move runoff as quickly as possible. The infiltration, evapotranspiration, and slow release associated with green infrastructure approaches can control flood flows throughout a watershed, which in turn will reduce flooding in higher order river and stream systems.[96] Another way riverine flooding is being addressed with green infrastructure is with river and floodplain restoration through greenway developments along flood-prone areas. Johnson County, Kansas, which had experienced significant floods along the Chagrin River in the past, opted to spend $600,000 to develop riparian setbacks and a park system rather than $120 million on traditional flood control projects.[97] Restoring a well-connected 'green' floodplain can reduce community flooding by providing flood attenuation and increased transmission storage.[98]

Coastal Flooding: Naturally occurring "green infrastructure" such as dune systems, wetlands (also known as living shorelines), and salt marshes can provide water storage and retention areas, mitigate tidal surges, reduce coastal erosion, and help to alleviate coastal flooding. The South Bay Salt Pond Restoration Project in the San Francisco area is the largest tidal wetland restoration project on the West Coast, and efforts are underway to transform 15,100 acres into a mosaic of tidal wetlands and managed pond habitats. One of the approaches being considered at the San Francisco Estuary, as part of South Bay Salt Ponds restoration project is a "living shoreline" of wetlands, natural stones, and sturdy plants created along shore margins and used as components of a protective strategy.[99]

Climate Change, Flooding, and Green Infrastructure: Global climate change will likely impact all forms of flooding. Over the coming century, climate change experts predict that urban regions will be forced to manage extremes in precipitation and temperature and sea-level rise. It is anticipated that episodic events (e.g., flooding and drought) will increase across the country,[100] which will place a strain on an infrastructure system that is already under great stress. Green infrastructure is a flexible and resilient approach that has an important role to play in the adaptation to and mitigation of climate change by "working with nature's capacity to absorb or control impacts in urban and rural areas than simply focusing on physical infrastructure."[101] By being adaptive, green infrastructure will more readily change with the expected increase in volatile climatic conditions.

Adapting to Coastal Climate Change Impacts with Green Infrastructure

Community concerns over combined sewer overflows (CSOs) and flooding in low lying neighborhoods drove interest in green infrastructure approaches to address the problem. After significant damage from a flood in 2004, San Francisco began to integrate green infrastructure planning into its Sewer System Master Plan. Relying on an integrated watershed management strategy that blends green and grey solutions, San Francisco has adopted new stormwater ordinances and standards that emphasize on-site management; evaluating the potential flood reduction benefits of daylighting four creeks, and an aggressive "Better Streets" retrofit program. Taken together, these approaches will significantly reduce stormwater volumes, minimize future flooding, and help make the city more resilient to coastal climate change impacts. (San Francisco Public Utilities Commission, 2010)

San Francisco Public Utilities Commission, (2010), "DRAFT San Francisco Sewer System Master Plan (Appendix W – Low Impact Development), June 2010", Accessed December 2011, Available online at <http://www.sfwater.org/modules/showdocument.aspx?documentid=650>