BLUE JOBS FOR NORTH CAROLINA:

a role for water in economic development

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Executive Summary

This policy brief explores the conceptual connections between water and economic development — what we refer to as "blue jobs" — with a specific focus on encouraging green (environmentally and ecologically-friendly) water-infrastructure technologies. Water systems in the U.S. are currently degraded and overextended, requiring critical improvements in both wastewater and drinking-water facilities, and population growth will require additional facilities in the future. Blue-green infrastructure (BGI) can address these critical issues while simultaneously generating needed jobs in many sectors of the job market and promoting overall economic growth. This brief — developed at UNC-Chapel Hill's Global Research Institute under the "Making Scarce Water Work for All" theme— recommends policy initiatives to promote the creation and expansion of environmentally and ecologically-friendly water infrastructure in North Carolina in an effort to reap economic benefits, improve individual health status, and build resiliency in the face of the climate-change threat.

Charles D. Owen Park Lake, a designated water recreation area in Buncombe County, NC.

Credit: Kevin Schraer

Introduction

Historically a water-rich state, North Carolina is now confronting serious water challenges brought on by a growing population generating increased demand, as well as a failing infrastructure system for drinking water and wastewater. In contrast to some states in the U.S. and many other countries across the globe, North Carolina, fortunately, has not yet reached crisis conditions regarding water. State policy leaders and citizens have the opportunity to: engage in open dialogue about our current and projected water resources; address urgent issues regarding quality and availability; and make decisions to ensure that all North Carolinians have access to clean water for years to come before a crisis limits options. Creating a sustainable water infrastructure also opens up opportunities for job creation and economic development throughout our state (WFJ, 2014).

Both liberals and conservatives in North Carolina generally acknowledge the central role that investment in infrastructure, including water works (a system for supplying water to a city, town, or other administrative unit), plays in enhancing an area's economic competitiveness (NCBTC, 2011; Hood, 2012). Moreover, because the state's policymakers can draw upon the best ideas and practices developed in other states and countries that have already made improvements in this area, North Carolina will not have to reinvent

the (water) wheel in developing beneficial blue-green infrastructure (BGI) initiatives. That said, it must be acknowledged that federal and state funding is limited. As a result, governmental funding will—and must—focus on the most critical repairs, leaving very little funding for new and retrofit blue-green infrastructure projects. As a result, private investment in this sector must be encouraged to bridge the funding gaps, provide returns for investors, and create a nurturing environment for viable and efficient blue-green infrastructure (BGI) projects in North Carolina.

The Increasing Economic Importance of Water

For some time now, economic analysts have been referring to water as the oil of the twenty-first century (Coclanis, 2013). Not only is water essential to human existence, but also to our economic life. The fact that daily water withdrawals from groundwater and surface water sources in the U.S. amount to well over 400 billion gallons a day demonstrates the importance of water in the U.S (USGS, 2009). And it is water infrastructure of varying kinds that makes such withdrawals possible. Although we still lack the tools to quantify precisely the overall importance of H2O to the American economy—"green" accounting tools such as embedded-resource accounting, virtual-water content, and water foot-printing are still not widely used—a majority of public and private- sector leaders acknowledge the pervasive importance of water in our economy. Moreover, today almost everyone recognizes that the economic role of water is most profound in the extractive and processing sectors of the U.S. economy, which includes agriculture, forest industries, fishing, mining, manufacturing, construction, and utilities.

Tobacco, consistently one of the most profitable cash crops in North Carolina, is one very vulnerable to the negative effects of a potential water shortage. Credit: John Buie

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Although such a focus is understandable, the availability of water ultimately affects the entire economy, as the U.S. Environmental Protection Agency pointed out in a recent study (EPA, 2013). Another recent study by the U.S. Bureau of Labor Statistics provides further insight into the economic role of water in North Carolina specifically, which underscores the centrality of this resource to the state. Using 2011 data, this study estimates the number of "core" water-related jobs in North Carolina at 106,933 with another 479,442 jobs "water-enabled," for a total figure of 584,545 "water" jobs, which represents about 16 percent of the total number of jobs in the Tar Heel State (AEG, 2014).

The State of the Current Water Infrastructure

The current water-infrastructure systems in the U.S. are failing. In 2013, an annual report prepared by the American Society of Civil Engineers (ASCE) gave the country's general water infrastructure a grade of "D-"due to aging facilities in critical need of upgrade or replacement. The country's drinking water and wastewater infrastructure each received a grade of "D." The report cites an estimated 240,000 water main breaks per year throughout the U.S. By some estimates, at least 36 states will face increasingly severe water shortages within the next five years (ASCE, 2013).

The ASCE report also provided the status of infrastructural sectors by state. North Carolina's drinking water systems received a mediocre grade of "C+" due to the rising number of drinking-water systems deemed unsafe because of regulatory violations. With the state's *public* water systems alone projected to serve 9.8 million people by 2030—a number 70 percent higher than the current figure—North Carolina faces further troubles in the future (ASCE, 2013).

Charles Scaife, a graduate student in the UNC Chapel Hill Department of Geography, studies the hydrology of watersheds to better understand how they are impacted by changes in land use. Credit: Dan Sears

Clearly, it is imprudent, if not irresponsible, to ignore the need for a state-wide system overhaul (ASCE, 2011). Water-infrastructural improvements will not come at a small cost, however. According to the Congressional Budget Office, the funding gap to meet the nation's water needs is estimated at $3.0 to $19.4 billion annually when both drinking-water and wastewater systems are included (ASCE, 2013). After conducting its own assessment, North Carolina reported a need for $10 billion in drinking-water infrastructure and $6.6 billion in wastewater infrastructure improvements over the next 20 years (North Carolina Rural Economic Development Center, n.d.). A recent cost estimate by the U.S. EPA is even higher. The "Drinking Water Infrastructure" report presented to Congress documented a twenty-year infrastructure need of $10.06 billion for North Carolina's drinking-water facilities (EPA, 2013). These estimates do not include clean-up, remediation, and "lost-production" costs for episodic "events' resulting in part from inadequate infrastructure, which would include both "wet-weather" events such as hurricane-related flooding and emergency episodes such as Duke Energy's disastrous coal-ash spill into the Dan River earlier this year.

An Orange Water and Sewer Authority (OWASA) Operator checks the pumps at the Mason Farm Wastewater Treatment Plant in Orange County, NC. The plant delivers reclaimed water, or clean water repurposed from wastewater, to the UNC-Chapel Hill Campus, where it is used for purposes such as chilled water, landscaping irrigation, and more. Credit: Ed Kerwin

An approximately 50,000-gallon cistern stores rainwater from UNC Chapel Hill's FedEx Global Education Center's green roof, and the water is recycled for use in the building's restrooms.

Credit: Dan Sears

What is Blue-Green Infrastructure (BGI)?

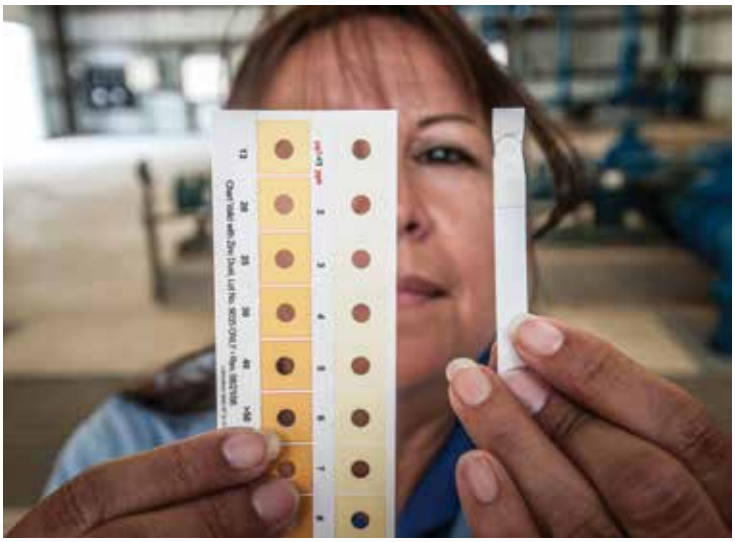
Whereas traditional infrastructural solutions (termed "gray") involve expanding the existing (and increasingly outdated) cement-and-pipe systems that convey rainwater away from where it falls, blue-green infrastructure transforms the natural and built environment to make it more feasible to manage and utilize storm water *onsite*. This can be done, for example, by reconfiguring the built environment so as to render it more compatible with the natural environment and repositioning (or in some cases removing) existing infrastructure for purposes of flooding attenuation. Blue-green infrastructure also makes it easier to manage stormwater onsite by introducing features such as permeable pavement, green roofs, roadside plantings, and rain barrels. Another blue-green option is the creation of man-made mechanisms that mimic natural hydrologic functions, such as water infiltration into soil and evapotranspiration into the air, or otherwise capturing water runoff onsite for productive usage such as purification and drinking (Green Infrastructure Foundation, 2013).

Smarter water practices such as those outlined above yield a variety of benefits. They often result in beautifying neighborhoods due to the reduction in unattractive cement-and-metal piping as well as the addition of rain gardens or green roofs. Community health also may move in a positive direction as a result of smarter water practices, as many features of these practices have the co-benefits of dispersing and reducing pollution, which leads to a reduction in asthma rates and other lung and

respiratory disorders (particularly in urban areas). Onsite water runoff can be used to mitigate heating and cooling costs or even be purified into potable drinking water. Environmental benefits are exponential: rain gardens and green roofs mitigate the "heat island" effect, which occurs in urban regions when high population concentration, dark reflective surfaces (such as asphalt), and impermeable surface areas form "islands" of higher temperatures. Mitigating heat islands will increase oxygen and decrease carbon dioxide levels in urban areas and will ensure greater U.S. resiliency in the face of the climate-change threat. Finally, an important benefit of blue-green infrastructure technologies will be job creation (The Johnson Foundation at Wingspread, 2012).

The Economic Potential of BGI

A number of states and foreign countries, along with various university research groups, technology centers, and think tanks, have recognized the potential of BGI and have begun to act on such recognition. In the U.S., the state of Michigan is especially active in promoting BGI, and internationally, the U.K., Sweden, and the Republic of Singapore have followed a similar path, with Singapore incorporating BGI concepts into virtually all of its national planning schemes going forward (European Environment Agency, 2011; Government Offices 2005, 2012; Newman, 2010; Rep. of Sing., 2014; Tortajada, et. al., 2013). In addition, some less developed countries are moving in this direction: Vietnam's "Living with Floods" (LWF) initiative in the environmentally threatened Mekong Delta is one such example (Vo Thanh Danh and Mushtaq, 2011). Not all of the blue-green initiatives promoted by the above governments have proven to be completely successful; however, the initiatives are generating a number of interesting ideas, strategies, and policies, and several can serve as good examples for study and consideration.



A water control and improvement district manager holds a test strip to a comparison chart to show that the tested water is less than one part per billion arsenic, meaning it is safe to drink. However, incidents such as the recent Duke Energy plant coal ash spill have raised water arsenic levels in many parts of the state. Credit: USDA

Currently over three million green jobs exist in the U.S. economy. Investment in the U.S. water-infrastructure system, which is clearly needed, shows significant potential for a large expansion of blue jobs

Although BGI, first and foremost, provides direct environmental benefits, its ancillary economic potential cannot be overlooked. Several recent studies suggest that BGI offers cost advantages *vis à vis* conventional infrastructure (Berg, 2012; EPI, 2012; Odefey, et. al. 2012) These studies make the case that greener industries grew faster than did the overall economy in recent years, and that, in the U.S., states with greater "green intensity" fared better overall than other states during and after the recent Great Recession (EPI, 2012). To be sure, it is not altogether surprising that the "green" sector of the economy—comprised largely of young, small firms—grew faster than the economy as a whole. In addition, the conclusions reported from the 2012 EPI report

Pictured above, the Tunnel and Reservoir Plan (TARP) in Chicago is one of the largest water infrastructure systems in the U.S. Tunnels like this one divert storm water and sewage into temporary holding reservoirs in order to reduce the harmful effects of flushing raw sewage into Lake Michigan.

Credit: Metropolitan Water Reclamation District of Greater Chicago

must be interpreted with some caution because "green intensity" in this case may in fact be rather more *effect* than cause. In other words, "green-intensity" locales are places, generally speaking, heavy with more educated, wealthier, "knowledge workers," which likely would have fared better than places less well positioned even in the absence of green industries. Nevertheless, if infrastructure, including water infrastructure, is to be repaired or rebuilt, it is fair to argue for the adoption of green practices, given the lack of compelling economic/efficiency reasons for *not* encouraging green growth.

Currently over three million green jobs exist in the U.S. economy. Investment in the U.S. water- infrastructure system, which is clearly needed, shows significant potential for a large expansion of blue jobs (Green for All, 2011). For example, the Rockefeller Foundation estimates that an investment equal to the amount the EPA projects will be needed for storm-water infrastructural improvements over the next five years would create almost 1.9 million jobs and generate $265.6 billion in economic activity (Green for All, 2011).

Another related benefit of such jobs is worth noting as well: these green jobs are often accessible to workers without college degrees, the employment sector generally most vulnerable to economic fluctuations. Indeed, green jobs differ and require varying levels of education, many, if not most, are appropriate for less-educated workers, the segment of the labor force hardest hit by the Great Recession and the weak recovery. This last

point is certainly true in North Carolina. An IPUMS (Integrated Public Use Microdata Series) sample from the U.S. Bureau of Labor Statistics' Current Population Survey for March 2013—the most recent unemployment data for North Carolina that are broken down by level of education—reveals that, as of March 2013, the unemployment rate in North Carolina for individuals with less than a high-school education was 70 percent higher than the unemployment rate for all workers in the state. The rate for those with a high-school education or GED was 28.6 percent higher than the state unemployment average (IPUMS Sample 2013).

Philadelphia offers an interesting case to better understand some of the implications of BGI for large cities in the state of North Carolina. Succinctly put, the City of Brotherly Love aggressively pushed BGI, and, as a result, is creating one of the top incentivizing programs in the country for encouraging investment in the water sector. It has been estimated that 250 additional people in the city are employed every year in green water-infrastructure projects (Philadelphia Water Department, 2011). Moreover, investment in the water sector creates jobs that require no prior experience and are suitable for individuals who might otherwise be unemployed and living in poverty. Thus, these new jobs result in reducing poverty-related costs, stabilizing neighborhoods, and transforming communities. The 2011 report from the Philadelphia Water Department also demonstrated an increase of up to 10 percent in recreational and stream-related visits to local parks due to increased water-sector BGI projects. In addition, the report projected that overall neighborhood improvements will result in an increase of up to $390 million in the property value of homes near parks and green areas over the next 45 years, as well as a reduction of up to 140 fatalities caused by excessive heat in the same period of time (Philadelphia Water Department, 2011).

Other U.S. cities are also pursuing job-intensive, blue-green infrastructure initiatives. Chicago has in recent years moved aggressively to invest in "green" water infrastructure, allocating considerable sums to permeable pavements, greenways, rain gardens, stormwater tree trenches, and bioswales, while continuing to invest heavily in conventional improvements to stormwater sewers and in the replacement of leaky water pipes, and pushing to complete a long-stalled Tunnel and Reservoir Plan (TARP)—"Deep Tunnel"—project (Circle of Blue 2012; City of Chicago 2014; EPA 2014). Because of that metropolitan region's aging infrastructure and high runoff characteristics, large storms frequently cause commingling of sanitary and storm sewer flows that exceed the system's ability to handle the load. The Deep Tunnel is designed to reduce and nearly eliminate the release of untreated water to streams, Lake Michigan, and people's basements. In so doing, the city, an innovator in urban water engineering through much of its early history, is in a sense returning to its roots (Smith 2013; City of Chicago 2014).

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Policy Reforms to Encourage BGI Investment in North Carolina

Though more cost-effective in the long run than traditional infrastructure methods, BGI does require significant initial financial investment. However, the potential financial return of green infrastructure practices provides the kinds of incentives that can induce individual or corporate private investment to underwrite much of this investment. And here the role of the state is important, and not always expensive. Policymakers in North Carolina can play an important role in encouraging private investors to finance the development of BGI technologies. Existing regulations and building codes often discourage private developers from incorporating BGI into buildings. Outmoded standards push developers towards traditional water-management practices in order to expedite approvals, rather than to pursue more innovative and ultimately more beneficial options.

For example, many states, including North Carolina's neighbors Georgia and Kentucky, maintain centralized databases of information on infrastructure needs in all sectors (ASCE, 2013). The creation of this type of database in North Carolina would be helpful to private individuals or corporate entities looking to invest in BGI. State government officials also could develop an annual process for cataloguing and tracking all existing water-infrastructure-project needs and funding patterns in the state. Such a database, at a minimum, should contain current and proposed infrastructure projects, system information (fiscal status, management practices), and information on funding sources and requirements (ASCE, 2013).

Research shows that making the change towards more widespread BGI usage will also help municipalities reduce their overall costs in the long term due to fewer maintenance responsibilities

Research shows that making the change towards more widespread BGI usage will also help municipalities reduce their overall costs in the long term due to fewer maintenance responsibilities (ASCE, 2013). Providing incentivizing mechanisms to encourage the retrofits of existing buildings for BGI will also encourage private retrofits. One incentivizing method is for communities with stormwater utility fees to offer private and corporate property owners the opportunity to reduce said fees in proportion to the amount of imperviousness on their land that they can eliminate with BGI technologies and additions. Fees are sometimes used to subsidize BGI improvements in places where potential benefits are high but property owners lack the funds to make improvements, such as older industrial or urban areas.

Again, using Philadelphia as an example, city officials there noted that the annual redevelopment rate was too slow to meet Clean Water Act goals or to address the flooding and water-shortage problems derived from current failing infrastructures. In 2011, Philadelphia's Water Department made a commitment to use BGI to address its drinking and storm-water runoff and infrastructure problems through an innovative

A worker repairing a culvert in central Idaho. Such structures allow water to flow under a road, railroad or trail, and are necessary to create safe and stable paths for water transport. However, many culverts in the U.S. are failing due to age or environmental pressure.

Credit: Laura Speck and Nils Ribi

plan named "Green City, Clean Waters" (Philadelphia Water Department, 2011). Philadelphia implemented a stormwater billing system that charges nonresidential customers a monthly stormwater fee based on the impervious area on their land. To encourage BGI adoption, the municipal government offers substantial fee discounts and waivers to land owners who "green" their property by reducing the amount of impervious area or by managing runoff in other ways (Philadelphia Water Department, 2011). In so doing, Philadelphia created an environment where an investment in BGI retrofits provides ongoing savings to nonresidential property owners.

Attracting large-scale investment in stormwater retrofits on private land parcels is another major challenge. Encouraging private capital to finance retrofit projects can be difficult because many of these projects tend to be small with high fixed and transaction costs. Project aggregation, whereby numerous projects are packaged as an aggregate portfolio, can help overcome this barrier. Aggregation can reduce project-development costs through economies of scale (for example, with respect to permitting, design, and acquisition of materials). Aggregation can also help investors manage risk by diversifying a stormwater investment portfolio. Municipal governments can serve as aggregating agencies, assisting private investors in taking on BGI water-investment portfolios. Because this strategy could possibly lead to similar types of problems that bundling and securitizing mortgages did in the run-up to the financial crisis of 2007-2008, the state must ensure that adequate regulatory safeguards are in place before moving forward.

Given North Carolina's current financial situation and political preferences, the state cannot realistically adopt and fund BGI initiatives in the same way, much less at the same level, as places such as the Milton Keynes/South Midlands Planning area in the U.K. and the entire city-state of Singapore. Therefore, other strategies must be devised to expand the opportunity for BGI initiatives in the state of North Carolina. Fortunately, many private-sector technology and research companies are attracted to the great economic potential of BGI development. As a leader in the technology field with hundreds of national and international companies located and headquartered within the state, North

Carolina is well positioned to develop this potential in mutually beneficial ways. The state government should build a relationship with the private sector in relation to green water infrastructure, to both encourage existing companies to further investment in the field and to bring new companies—and therefore new jobs—to the state.

Michigan has started encouraging private-sector investment and innovation in BGI development. The Michigan Economic Development Corporation reports that today over 350 emerging water-technology firms are located in the state with programs to discover, deploy, and manufacture clean-tech water products and to provide water engineering, cleanup, or ecosystem services (Austin, 2013). Government-funded academic initiatives are often the drivers of innovation in BGI technology. Michigan has nine University Water Research Centers spread across its public and private universities and community colleges. The University of Michigan recently opened a $9 million Water Center at the Graham Environmental Sustainability Institute. Other cities and states are active in similar ways. Milwaukee has attracted over 130 water-technology businesses by expanding its University of Wisconsin-Milwaukee and Marquette University water research and education programs. Cleveland has initiated an Alliance for Water Future to make the city home to freshwater innovation by turning its Great Lakes Science Center into a water education center (Austin, 2013). Similar initiatives are possible in North Carolina, a state with 16 public institutions of higher education. Ongoing work at UNC-Chapel Hill is being done in conjunction with the Global Research Institute, the Gillings School of Global Public Health's Water Institute, and the University's three-year "Water in Our World" theme, which represents the university's first pan-university theme (running from 2012-2015). The University's efforts are a start, but the state's efforts to enlist its large, diverse university system to develop and disseminate ideas regarding blue-green water infrastructure could be considerably expanded.

An excavation point crew installs downhill stormwater system components for the Lake Clay Stormwater Retrofit system on the West Coast of Central Florida. Credit: Highlands County Natural Resources Department

State and local political support is also crucial. In order to develop and commercialize new technologies more rapidly, Massachusetts recently initiated a New England Water Innovation Network to connect firms with laboratories to operating facilities, an idea originally presented at the 2013 Symposium on Water Innovation at Northeastern University in Boston. The water- technology sector already generates roughly $4 billion in revenue within Massachusetts and has the potential to grow larger, driving Massachusetts

Governor Deval Patrick to promise to push legislation to grow the industry and provide financial support (Ailworth, 2013). Massachusetts state policy-makers are also working through agencies such as the Massachusetts Clean Energy Center to help to identify what needs to happen to make the state's water cluster expand. Last year, for example, State Representative Carolyn Dykema proposed legislation to create incentives and pilot programs for water technologies (Ailworth, 2013). Stay tuned.

North Carolina, home to an even greater number of technology firms than Massachusetts, can follow this example by drafting and passing legislation to incentivize BGI research. As suggested earlier, the North Carolina state government or even county or city governments could begin modestly by developing databases identifying the costs of retrofits, informing interested parties of local opportunities, and providing landowners or potential investors with a clearer understanding of project costs and savings. This would improve information flows, streamline the process of converting gray infrastructure to BGI, and make it easier for firms to quantify tangible economic results for their upfront costs. In so doing, it would also enhance the government's ability to identify and prioritize the most critical financial and labor-intensive needs going forward. Other inexpensive steps the state could take are providing marketing assistance regarding BGI water projects and related opportunities, and finding ways to signal its support for public-private partnerships to grow the green water infrastructure cluster.

The Matter of Timing

The considerations discussed above take on greater moment because this is a particularly good time to invest in infrastructure. Long-term interest rates are at near-record lows; as we write, rates on inflation-protected bonds are about 0.4 percent, and earlier in the year they were lower still, sometimes even negative. Although recent studies have demonstrated that in such an investment environment borrowing to fund infrastructural improvements has a more positive economic effect than do so-called pay-go schemes, whereby such improvements are funded not by borrowing but via higher taxes or by reallocating public spending, the economic effects of public investment in infrastructure are positive however they are funded. North Carolinians, take heed (Krugman 2014; *The Economist*, 2014).

Conclusion

Let us conclude with some thoughts on the environmental and economic possibilities associated with BGI investment relating to water in North Carolina. Before doing so, let us be clear that we are cognizant of the fact that the appropriate roles of the public sector and the private sector need to be worked out, and that rigorous attention must be paid to the opportunity costs of all potential BGI investments. That said, there is a growing body of evidence that investment in blue-green infrastructure is worth careful consideration on both environmental and economic grounds. Moreover, the fact that such investment would have the additional advantage of putting numerous North Carolinians back to work—particularly hard-pressed segments of the state's population—suggests that in this case the state would be doing good while doing well. (Puentes and Katz, 2014)

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