SUSTAINING WATERSHEDS THROUGH PRESERVATION PRACTICE:

AN ANALYSIS OF THE ROLE OF HISTORIC PRESERVATION IN SUSTAINABLE WATERSHED MANAGEMENT

by

SEAN COLLINS STUCKER

(Under the Direction of James K Reap)

ABSTRACT

Advocates for historic preservation, such as Richard Moe and the National Trust for Historic Preservation, are currently engaged in a campaign to remake preservation as a leader in the sustainability movement. Sustainable watershed management is a major component of this movement, and it is also closely tied to historic preservation insomuch as watershed health and preservation are both primarily controlled by land-use issues. As such, this thesis will examine the intersection of historic preservation and watershed management through an analysis of the ways in which a variety of preservation practices relate to and contribute to healthy water systems. The goal of this research is to identify some of the partnerships between preservation and conservation, as concern watersheds, and to establish the importance of these partnerships for sustaining both communities and the planet as a whole.

INDEX WORDS: Watershed Management; Stormwater Management; Infiltration; Open Space Preservation; Natural Area Conservation; Teardowns; Brownfield and Greyfield Redevelopment; LID (Low Impact Development); Conservation Developments

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DEDICATION

This thesis is dedicated to my wife Jessica, who encouraged me to keep working and writing, and to my new daughter Lilah, who inspired me to get it done (mostly) before she got here. And to Tucker and Bean who kept me company during the long hours at the computer. Also to my mom Jan, who taught me everything I know about writing (and who edited this tome), and to my dad John, who taught me to finish a job that you start.

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INTRODUCTION

As Dan Nadenicek, Dean of the University of Georgia's College of Environment and Design, said in his *Dean's Message*: "The world is changing. Technological advancements, climate change, peak oil, demographic shifts, rapid urbanization, globalization, and other major forces assure that good design, planning and preservation practice will be valued commodities" now and in the future. A major aspect of this change has to do with how humans consume land and build their homes. For nearly three quarters of a century in the United States, Conventional Low-Density Development (CLDD) practices—typical suburban development—have been the template for residential land use, as well as for the commercial development, such as the strip malls and shopping centers, that inevitably follows.[1] In a country with seemingly unlimited space, this kind of expansive development might have continued for another 75 years, were it not for the intervention of a rapidly deteriorating planet Earth.

In response to the multitude of environmental alarm bells that have now been steadily sounding for several decades, humans have begun to fundamentally change the ways in which they use the planet and its resources. From hybrid automobiles, to local and organic farming, to green building, the concepts of sustainability and "less is more" have begun to supplant the American ideals of "bigger is better" and "more is better." Central to this movement of the changing nature of the relationship between people and resources is water—how we use it, how we treat it, how we make sure that it does not run out. Especially in the face of a changing global climate that can create both floods

[1]Berke, Philip R. "Greening Development to Protect Watersheds: Does New Urbanism Make a Difference." *Journal of the American Planning Association*, September, 2003.

and droughts of historic proportions, understanding the relationship between watersheds and human land use and settlement patterns is more important than ever.

It begs the question: what does historic preservation have to do with water management? Both practices are concerned with the management of the quantity and the quality of certain resources, and, when done properly, both practices are based on sound and sustainable planning. On the side of quantity, water management is concerned with conveying stormwater away from built resources in a manner that does not cause flooding or result in standing water; it also involves having enough water to support human and other life. From the standpoint of quality, water management involves ensuring that sewage, tainted stormwater and other runoff does not carry pollution into watersheds; because the rivers, lakes and aquifers that comprise our watersheds serve as water supplies for people and other living creatures, people are compelled to manage water with care and to be conscious of the effects of human actions on water resources.

Preservation is also concerned with resource management and "is first and foremost a land use issue."[2] Preservation is a broad term that can be applied to natural, cultural, tangible and intangible resources, but, in every case, the issues of quantity and quality are involved. Whether it involves open space or a neighborhood of early Ranch houses, the practice of preservation seeks to maintain both the amount (quantity) and integrity (quality) of the protected resources.

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[2] Tiller, DeTeel Patterson. "Subjectivity in Ethics," *Ethics in Preservation*, lectures presented at the Annual Meeting of the National Council for Preservation Education. Indianapolis, IN., 23 October 1993, p 6.

Before proceeding any further, it may be helpful to define some of the terms that will appear throughout this essay. *Preservation* is defined by Dictionary.com as "an occurrence of improvement by virtue of preventing loss or injury or other change"; listed as a synonym is *conservation*, which is defined as "the protection, preservation, management, or restoration of wildlife and of natural resources such as forests, soil, and water." According to these definitions, both conservation and preservation are concepts based on the practice of resource sustainability, yet the definitions draw a distinction between "conservation" of natural and "preservation" of other types of resources. In contrast to the European perspective and the UNESCO-sponsored concept of "heritage conservation"—which encompasses both cultural and natural heritage—the American view is one that often divides preservation and conservation into separate camps.

The irony of this separation is heightened by the fact that the National Park Service (NPS) is responsible for administering historic preservation policy at the national level. The "About Us" page on the NPS.gov website states that,

> Beyond national parks, the National Park Service helps communities across America preserve and enhance important local heritage and close-to-home recreational opportunities. Grants and assistance are offered to register, record and save historic places; create community parks and local recreation facilities; conserve rivers and streams, and develop trails and greenways.[3]

Despite these overlapping responsibilities and efforts, a disconnect remains between natural environment conservationists and built environment preservationists. Unfortunately, as long as this perception persists—that preservation is "backward looking" and that conservation includes "only the newest, greenest technologies"—both movements will suffer.

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[3] National Park Service website, various pages including "About Us." Retrieved online on 10 February 2009 at: http://www.nps.gov/.

Some other definitions: the terms *watershed* and *water system* appear throughout this thesis, and both terms refer to "a region or area bounded peripherally by a divide and draining ultimately to a particular watercourse or body of water." *Built environment* refers to the cultural and designed tangible resources that comprise the man-made landscape, in contrast to the *natural environment* that makes up the open spaces and undeveloped landscapes. Finally, the National Trust for Historic Preservation defines *teardown* as, "the practice of purchasing a home on a lot, demolishing it, and building a new, larger house in its place"[4]; *McMansion* is the colloquial term for this kind of house.

Returning to the question of where the fields of preservation and water management overlap, the most important connection is that "what happens on the land will ultimately end up in the river."[5] And it is a good bet that someone else will be using and affecting that water further downstream—and on and on. Thus, the preservation ethic of "do no harm," borrowed from the Hippocratic oath,[6] fits with the idea that "maintaining cleaner water and using intelligent water management practices are essential to [improving] . . . quality of life, livability and safety."[7]

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[4] National Trust for Historic Preservation. "Advocacy for Alternatives to Teardowns: Teardowns Resource Guide." Retrieved online on 14 January 2009 at: http://www.preservationnation.org/issues/teardowns/additional-resources/getting_started_with_advocacy_-_teardowns.pdf

[5] Sustainable Philadelphia. *Urban Sustainability Forum 2006, Notes from: Directing the Flow, Managing the City's Water*. Retrieved online on 13 January 2009 at: http://www.sustainablephiladelphia.com/pdf/Notes_Water_feb.pdf.

[6] Striner, Richard. "Historic Preservation and the Challenge of Ethical Coherence", *Ethics in Preservation*, lectures presented at the Annual Meeting of the National Council for Preservation Education. Indianapolis, IN., 23 October 1993, p 8.

[7] Sustainable Philadelphia. *Urban Sustainability Forum 2006, Notes from: Directing the Flow, Managing the City's Water*. Retrieved online on 13 January 2009 at: http://www.sustainablephiladelphia.com/pdf/Notes_Water_feb.pdf.

It is also worth noting that the main idea of this thesis—that our actions upon the land and the ways in which we build and manage our environments have great bearing on the health of our vital watersheds—is nothing new , and, in fact, it is a notion that may seem quite obvious. However, the fact remains that there is clearly a paucity of information or previous research available on this subject of where watershed management and historic preservation come together, despite what appears to be an obvious interest in the subject on the part of preservationists, planners and others, as is demonstrated by the following examples and case studies. Perhaps it is *because* the relationship seems so obvious that such concrete connections have rarely been made, but this research aims to demonstrate that preservation and conservation—often placed into different camps—are, in fact, players on the same team—Team Earth—and, as such, will more easily achieve their goals by working together.

This thesis, then, will examine the ways in which preservation contributes to healthy water management practices. The three-pronged examination will begin with the bigger picture, first making the case for the preservation of undeveloped land and open space by looking at the effects that development and the replacement of natural land with impervious surfaces have on water systems. Chapter 2 includes an investigation of the effects of teardowns on watersheds, and it will consider the benefits of preservation and the reuse of existing built resources on watersheds. Finally, this thesis will look at how innovative stormwater management technologies, including Low Impact Development (LID) and green roofs, are being used in both conservation developments and historic properties.

CHAPTER 1

Preservation of Natural Areas and Open Space

Direct environmental impacts of current development patterns include habitat loss and fragmentation, and degradation of water resources and water quality. Building on undeveloped land . . . [and] the construction of impervious surfaces such as roads and rooftops leads to the degradation of water quality by increasing runoff volume, altering regular stream flow and watershed hydrology, reducing groundwater recharge, and increasing stream sedimentation and water acidity.[8]
-US EPA

Waterworks

It has long been recognized that urbanization has negative impacts on watershed health, yet "solutions have been elusive because of the complexity of the problem, the evolution of still-imperfect analytical tools, and socio-economic forces with different and often incompatible interests."[9] In other words, we as humans have been hard pressed to figure out a way to balance cultural and material progress with stewardship of our natural resources. The alteration of the natural hydrology of an area during development creates a range of problems within a watershed, in terms of both the quantity and the quality of the resulting runoff.

Vegetation is the glue that holds the Earth together, and, when the glue is removed, soil systems begin to crumble. Soil layers are stripped away and the remaining land becomes unnaturally compacted, even when it is not covered with impervious materials. "In either situation . . . precipitation over a small watershed reaches [a] stream channel with a typical delay of just a few minutes, instead of what

[8] US Environmental Protection Agency. *Our Built and Natural Environments: A Technical Review of the Interactions Between Land Use, Transportation, and Environmental Quality*. Washington DC: US EPA, 2001, p 2.

[9] Booth, Derek B., et al. "Forest Cover, Impervious-Surface Area, and the Mitigation of Stormwater Impacts." *Journal of the American Water Resources Association*, 38(3): 835-845, June 2002, p 835.

had been a lag of hours, days or even weeks."[10] As previously noted, the changes to the landscape alter, not just the amount of water entering the watershed, but also the quality of that water, since the pollutants contained within it are not removed through the natural process of infiltration.

The hydrologic cycle demands explanation as part of analyzing the preservation of land resources. To begin, the hydrologic cycle in urban areas is drastically different from that of less urban and natural areas; it is a cycle that is characterized by "conveyance and detention". "The fundamental differences—vast areas of pavement and roofs, little open land, high pollutant levels, and higher temperatures—together create a different environment and require adaptive approaches to an urban hydrologic cycle."[11] These factors create an environment in which not only does stormwater run off at an accelerated pace, via storm drains and pipes that convey it to detention ponds or natural water bodies, but it also carries with it pollutants—including petroleum products and other organic compounds, heavy metals, pesticides, herbicides, fertilizers, bacteria, and suspended solids and other chemicals from construction sites—all of which negatively impact the water systems that supply our potable water.[12]

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[10] *Ibid*, p 836.

[11] Girling, Cynthia and Kellett, Ronald. *Skinny Streets & Green Neighborhoods: Design for Environment and Community*. Washington, DC: Island Press, 2005, p 123.

[12] Ferguson, Bruce K. and Debo, Thomas N. *On-Site Stormwater Management*. New York: Van Nostrand Reinhold, 1990, p 12.

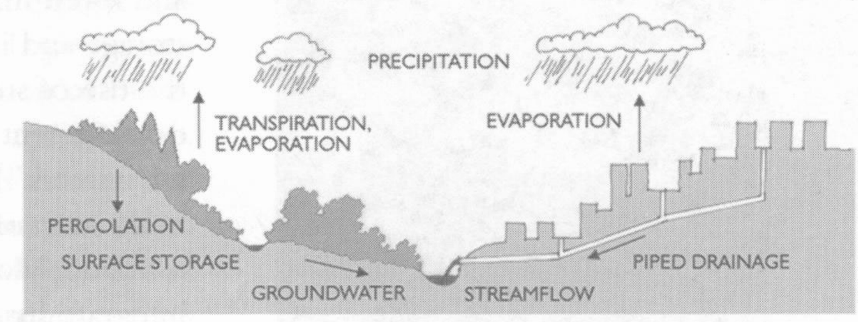

Figure 7.2 Comparison between the natural (left) and the urban (right) hydrologic cycles.

Figure 1: The Hydrologic Cycle [13]

By contrast, a more natural hydrologic cycle is characterized by the process of infiltration. Infiltration differs from the conveyance and detention scenario in that it sends "water to a different part of the environment, where it undergoes different types of processes."[14] As indicated in the figure above, the natural hydrologic process begins with condensation (clouds) and precipitation; rain "falls to the ground, makes its way across land and underground to rivers, lakes, and oceans, and evaporates into the atmosphere," where the cycle begins anew.[15]

A natural environment provides a multitude of paths for precipitation. Before it even reaches the ground, a significant portion of it is intercepted by the leaves of trees and other vegetation.[16] That which does not evaporate directly from the vegetation, travels down trunks and stems towards the ground where it is captured by layers of

[13] Girling, Cynthia and Kellett, Ronald. *Skinny Streets & Green Neighborhoods: Design for Environment and Community*. Washington, DC: Island Press, 2005, p 123.

[14] Ferguson, Bruce K. *Introduction to Stormwater*. New York: John Wiley & Sons, Inc., 1998, p 42-3.

[15] Girling, Cynthia and Kellett, Ronald. *Skinny Streets & Green Neighborhoods: Design for Environment and Community*. Washington, DC: Island Press, 2005, p 122.

[16] Wanielista, Martin P. *Stormwater Management: Quantity and Quality*. Ann Arbor, MI: Ann Arbor Science Publishers Inc., 1978, p 52.

duff—defined as: the organic matter in various stages of decomposition that covers the forest floor—that store the water for extended periods.[17] The water that is not absorbed by the roots of the vegetation infiltrates through the soil to join with underground sources of water, such as streams and aquifers. Infiltration that permeates to such underground water sources is referred to as "recharge" because it helps to replenish—or recharge—the underlying groundwater.[18] As indicated, infiltration occurs naturally in natural areas, but, as will be discussed later, engineered infiltration basins can also help to recharge groundwater sources.

Natural environments are capable of absorbing nearly 100 percent of precipitation in the form of either intercepted or infiltrated stormwater; on average, the leaves and roots of vegetation capture or absorb fully two-thirds of the rain that falls, while over 90 percent of the remaining one-third infiltrates the soil layers and is absorbed as groundwater. In contrast to urban environments, whose impervious surfaces can cause nearly 100 percent of stormwater to run off into storm drains, "only about 3.5 percent flows overland as surface runoff" in the average natural environment.[19] Additionally, depending on the composition of the soil (the sandier it is, the more it will absorb), the amount of vegetative ground cover, the volume of precipitation and other factors, "the intercepted water can be significant and potential evaporation high."[20]

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[17] Girling, Cynthia and Kellett, Ronald. *Skinny Streets & Green Neighborhoods: Design for Environment and Community*. Washington, DC: Island Press, 2005, p 122.

[18] Ferguson, Bruce K. *Introduction to Stormwater*. New York: John Wiley & Sons, Inc., 1998, p 43.

[19] Girling, Cynthia and Kellett, Ronald. *Skinny Streets & Green Neighborhoods: Design for Environment and Community*. Washington, DC: Island Press, 2005, p 122.

[20] Wanielista, Martin P. *Stormwater Management: Quantity and Quality*. Ann Arbor, MI: Ann Arbor Science Publishers Inc., 1978, p 53.

Puddles and Floods

This brings us to the problems caused by impervious surfaces—which can include asphalt, concrete, roofs and other non-porous surfaces. As previously noted, a major component of the natural hydrologic process is infiltration, and, as Professor Bruce Ferguson points out in his book *Introduction to Stormwater*, water that infiltrates and is stored as groundwater has a much greater potential to maintain the base flow of a watershed than does stormwater that is routed to surface sources that flow downstream and out of the local watershed[21]; *base flow* is defined as the "low flows" on a hydrograph that give an average level for a given water source.[22] In addition, groundwater also has several other benefits over surface water. For one, it is less susceptible to temperature fluctuations and the inevitable evaporation that occurs in surface sources. Moreover, infiltration is a natural treatment process that captures a great deal of the pollutants found in stormwater; "soil is a powerful filter and dynamic ecosystem that protects streams and aquifers from urban contaminants."[23]

Because of the vast amounts of impervious surfaces found in urban environments—ranging from 12 to more than 60 percent impervious cover for residential development and more than 95 percent for the average shopping center[24]—the majority of precipitation that falls in these areas is quickly conveyed to detention ponds and other surface water sources, through the method of stormwater management known as "pipes and ponds". As a result, "cities that utilize these conventional

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[21] Ferguson, Bruce K. *Introduction to Stormwater*. New York: John Wiley & Sons, Inc., 1998, p 194.

[22] Ferguson, Bruce K. and Debo, Thomas N. *On-Site Stormwater Management*. New York: Van Nostrand Reinhold, 1990, p 10.

[23] Ferguson, Bruce K. *Introduction to Stormwater*. New York: John Wiley & Sons, Inc., 1998, p 195.

[24] *Ibid*, p 4-5.

management systems deplete their groundwater resources."[25] What's more, not only does conventional stormwater management cause groundwater reserves to suffer in terms of quantity, but surface water sources also suffer in terms of quality, as the stormwater runoff carries with it the many pollutants that we humans deposit into our environment.

While the Federal Clean Water Act of 1972 was designed to regulate both point and non-point source pollution, the majority of "pollution problems [today] stem predominately from diffuse and minor point sources," or non-point source pollution.[26] To clarify, *point source pollution* is defined by the US Environmental Protection Agency as any pollutant discharge from a municipal or industrial facility, while *non-point source pollution* refers to the pollutants, or constituents, listed near the beginning of this chapter, such as organic compounds, metals, nutrients, suspended solids and so on. Nearly 70 percent of the urban water pollution in this country results from stormwater runoff, which carries with it non-point source pollutants.[27] Fortunately, the TMDL (Total Maximum Daily Load) program set up by the US Environmental Protection Agency is attempting to close the loopholes in the Clean Water Act by more strictly regulating non-point source pollutants, through constant surveillance of the quality of water bodies throughout the country.[28]

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[25] Girling, Cynthia and Kellett, Ronald. *Skinny Streets & Green Neighborhoods: Design for Environment and Community*. Washington, DC: Island Press, 2005, p 119.

[26] Water Environment Federation and (ASCE) American Society of Civil Engineers. *Urban Runoff Quality Management*, 1998, p 7.

[27] Ferguson, Bruce K. *Introduction to Stormwater*. New York: John Wiley & Sons, Inc., 1998, p 7.

[28] US EPA website, various pages. Retrieved online on 22 January 2009 at: http://www.epa.gov.

"The fact that we often get our drinking water from the same bodies of water into which our sewage goes is a sobering thought."[29] It is especially sobering when one considers that many municipalities employ a "combined sewer system," in which stormwater runoff combines with wastewater from drains and toilets en route to the sewage treatment plant. More sobering still is the concept of CSO, or "combined sewer overflow". CSO refers to the fact that combined sewer systems can be overwhelmed during heavy storms, resulting in an overflow discharge of raw sewage and other constituents directly into the receiving water body.[30] Some combined systems have storage tanks that hold the overflow until it can be treated, which is good from a water quality standpoint but does little to address the issue of runoff quantity unless the storage facility doubles as an infiltration basin.[31] Moreover, while all natural water contains a certain level of impurities, treatment processes rarely succeed in restoring storm and wastewater to the same level of purity as natural water.[32]

What Is Natural?

Having explored the different types of hydrologic processes and the contrasts between the effects of pervious and impervious environments on stormwater and water systems management, let us now examine in more detail the idea of a "natural" environment. While it is true that a grass-covered piece of agricultural land is bound to have fewer negative impacts on a watershed than its impervious urban counterpart, it is

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[29] Dobson, Clive and Beck, Gregor Gilpin. *Watersheds: a Practical Handbook for Healthy Water*. Buffalo, NY: Firefly Books, 1993, p 84.

[30] *Ibid*, p 84.

[31] Ferguson, Bruce K. *Porous Pavements*. Boca Raton, FL: Taylor & Francis, 2005, p 10.

[32] Girling, Cynthia and Kellett, Ronald. *Skinny Streets & Green Neighborhoods: Design for Environment and Community*. Washington, DC: Island Press, 2005, p 118.

important to draw a distinction between undeveloped and developed natural environments. An undeveloped natural area is exactly that—undeveloped and natural. This could include a mature native forest in the Pacific Northwest or a tall-grass prairie in Oklahoma. Whatever the specific environment is, the key concept is that its hydrology is preserved in its original state and, thus, conducts water in the manner in which nature intended.[33]

By contrast, a developed natural environment can refer to anything from a large open space that has been cleared for livestock grazing to a selectively-logged mountaintop to your local city park. In each of these cases, while impervious surfaces may not be present or may exist only in very small amounts, the alterations to the pre-development landscape can have devastating and sometimes irreversible effects on the hydrology of the area.[34] Consider the following:

> Although this [low-density rural development of one dwelling unit per five acres] generally did not create much imperviousness, the amount of forest clearing to create large lawns, pastures, or hobby farms could easily reach 60 percent of the landscape, with significant effects on watershed flow regime. Furthermore, many rural landowners were inclined to "manage" the streams on their property. This might include riparian forest clearing, removing woody debris from the channel, and hardening stream banks to protect property. Rural zoning, in and of itself, does not necessarily protect aquatic resources.[35]

These findings demonstrate that, even when the vast majority of the land in a watershed area remains "natural" and free from impervious surfaces, the mere act of clearing or altering the landscape or managing the flow of streams in that area can have a sizeable

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33 Dobson, Clive and Beck, Gregor Gilpin. *Watersheds: a Practical Handbook for Healthy Water*. Buffalo, NY: Firefly Books, 1993, p 112-17.

34 Booth, Derek B. and Jackson, C. Rhett. "Urbanization of Aquatic Systems--Degradation Thresholds, Stormwater Detention, and the Limits of Mitigation." *Journal of the American Water Resources Association*, 22(5): 1-19, October 1997, p 17.

35 Booth, Derek B., et al. "Forest Cover, Impervious-Surface Area, and the Mitigation of Stormwater Impacts." *Journal of the American Water Resources Association*, 38(3): 835-845, June 2002, p 840-1.

effect on the health of that watershed. In addition, these same data show that, unless the *effective impervious area* (EIA) in a given watershed area remains below 10 percent, physical degradation of that watershed becomes obvious and "ubiquitous".

While studies indicate that both forest preservation and the reduction of impervious surfaces are integral to watershed health, "hydrological analyses suggest that maintaining forest cover is more important than limiting impervious-area percentages."[36] Rural zoning codes can limit the number of residences and built structures in a given acreage, and they can even limit the amount of EIA, but the clearing of forests on private land is not something that is regulated under rural zoning restrictions. Clear cutting of forests and the creation of tree farms are common practices in rural areas across the country, and, while logging companies often reforest the areas they cut, "a tree farm is not the same as the native forest it replaced."[37]

Logging and agriculture provide fundamental goods for the human economy, and there is no arguing that they should and will continue to provide those goods. However, the data suggests that a conservative approach to our use of resources would be prudent. Furthermore, since it has already been established that the effectiveness of a "natural" area with regards to watershed health can vary according to the level of development that has taken place there, one could conclude that the wholesale preservation of natural areas—in the form of state or national parks, or waterfowl preserves or what have you—is the best way to contribute to healthy a watershed. In other words, our National Park

[36] *Ibid*, p 843.

[37] Dobson, Clive and Beck, Gregor Gilpin. *Watersheds: a Practical Handbook for Healthy Water*. Buffalo, NY: Firefly Books, 1993, p 112.

Service, steward of our preserved public lands and of many of our historic built resources, is also a primary provider of clean, healthy water.

Preserving the Land to Protect the Water

Considering the preservation ethic discussed earlier in this research—"do no harm"—historic preservationists appear perfectly poised to become valuable partners in the protection of our water resources. Chapter 2 will explore the contributions of preserved and reused built resources to, and the effects of "teardowns" on, water systems, but this final portion of Chapter 1 will look at some of the preservation-related land-use regulations that are beneficial for watershed protection, including conservation easements, transfer of development rights (TDRs), rural residential and agricultural zoning requirements and riparian buffer zones.

One of the most effective land-use regulations is the conservation easement. An easement is a permanent deed restriction that gives one party (the dominant estate) a non-possessory legal interest in the estate of another party (the servient estate), usually in perpetuity; in the case of conservation easements, they usually involve the requirement to maintain (positive) or refrain from alteration of (negative) some aspect of a property. If, for example, an easement requires that a particular piece of property remain undeveloped and in its natural state, such protections would be consistent with the kind of natural area preservation that is vital for healthy watersheds, as discussed in the last section.[38]

Easements are an excellent preservation tool because they usually grant the servient estate various federal, state and local tax credits, which may include charitable income tax deductions from the IRS, federal estate tax deductions, and a reduction in the assessed value for state and local property tax purposes. Despite the fact that easements usually reduce the value of a property, they also ensure that the property will remain under ownership that cares about its long-term future.[39] What's more, the fact that easements are held, monitored and enforced by outside parties can create a level of oversight that endures well beyond any individual or family ownership of a property. Considering that running out of water or allowing our water to become so contaminated as to become unusable are not viable options, it is important to have a system that protects resources for the long haul.

As to the legal life of easements, because it is almost always a requirement for being eligible to receive easement tax credits, such deed restrictions are usually granted in perpetuity. This makes sense, since the primary tax benefit for easements derives from a reduction in the property tax based on the reduced value of the property due to the deed restrictions. Other tax benefits are available and will be discussed further below, but the lasting economic benefit for the servient estate is the reduced annual assessment, while the benefit to the community is the assurance that an important

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[38] Booth, Derek B., et al. "Forest Cover, Impervious-Surface Area, and the Mitigation of Stormwater Impacts." *Journal of the American Water Resources Association*, 38(3): 835-845, June 2002, p 843.

[39] Historic Savannah Foundation website, various pages including "HSF Programs", "About Us", and "Green Pages." Retrieved online on 27 October 2008 at: http://www.historicsavannahfoundation.org/Default.asp.

cultural or natural resource will not be replaced by needless or thoughtless development that will categorically cause damage to the watershed.

Moving on to some other preservation tools, transfer of development rights (TDR) and purchase of development rights (PDR) are effective tools for preserving natural, historical, archaeological resources and for placing restrictions on rural open-space development. TDRs involve selling the development rights to areas that have been selected for preservation—known as "sending areas"—and diverting development to occur in more concentrated, already developed areas elsewhere—known as "receiving areas"; PDRs do not transfer development but, rather, provide grant money and tax incentives in exchange for the development rights.[40] The fact that TDRs are discussed as a component of water management in both government resource policy books and county comprehensive plans, suggests that they may also be an effective tool for protecting environmentally sensitive areas like watersheds.[41]

It is interesting to note that studies have shown that "individuals value permanent open space more than developable open space, as they are willing to pay more to live near permanent open space, all else being equal."[42] Because populations grow and expand so quickly, mature native forest and pristine farmland can suddenly be seen as the perfect place for development. As mechanisms for creating this "permanent" open space, PDR/TDR programs and conservation easements can "preserve environmental resources (e.g. groundwater resources, wildlife habitat, natural places,

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[40] Pruetz, Rick. *Beyond Takings and Givings: Saving Natural Areas, Farmland, and Historic Landmarks with Transfer of Development Rights and Density Transfer Charges*. Marina Del Rey, CA: Arje Press, 2003, p 29.

[41] National Research Council (U.S.). Committee on Watershed Management. *New Strategies for America's Watersheds*. Washington DC: National Academy Press, 1999, p 252.

[42] Geoghegan, Jacqueline. "The Value of Open Spaces in Residential Land Use." *Land Use Policy*, 19: 91-98, 2002, p 96.

rural character) and contribute to growth control efforts" and the preservation of natural lands by preserving certain designated areas while concentrating development in others.[43]

Also of note is that these same studies indicate certain pitfalls attached to such easements—pitfalls that can jeopardize the preservation of the protected resources. A *Washington Post* article that found that, "as easements have proliferated, so have problems and abuses."[44] Because preservationists are afraid of damaging the movement, they are often reluctant to recognize these problems, but

> surveys of land trusts around the nation . . . show that hundreds—perhaps thousands—of easements have been violated or altered at the request of landowners. Many of the owners have already pocketed the tax savings generated by the easement . . . an IRS program aimed at identifying inflated deductions taken for easements and other non-cash gifts to charities produced thousands of leads but, because of competing priorities at the agency, did not produce a single audit, according to the General Accounting Office.[45]

In addition, "statistics show that more than half of all new nonprofits fail in their first decade", which highlights the importance of reliable easement holders in creating a successful easement program that really can protect the chosen resource "in perpetuity."[46] If an easement-holding organization folds, who is left to enforce the restrictions? Moreover, if that organization allows the easement to be altered or intentionally violated without repercussions, the taxpayers who bear the burden of the

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[43] Nickerson, Cynthia J. and Lynch, Lori. "The Effect of Farmland Preservation Programs on Farmland Prices." *American Journal of Agricultural Economics*, 83(2) (May 2001), 341-51, p 342.

[44] Stephens, Joe and Ottaway, David B. "Developers Find Payoff in Preservation." *The Washington Post*, Sunday, 21 December 2003, 1-8. Retrieved online on 7 June 2008 at: http://www.catawbalands.org/pdf/articles/Article_Post_03Dec_Easements.pdf, p 1.

[45] *Ibid*, p 1.

[46] *Ibid*, p 7.

tax credit for the servient estate lose, not only tax dollars, but also the integrity of the resource that the easement is supposed to protect.

And it is not just "greedy developers" involved in the game, as the Nature Conservancy was caught participating in an easement for donations scandal—donations that the contributor could then take as a tax write-off.[47] However, such scandals are rare, and, although over 90% of easements are never violated, it is developers like Kenneth Hellings that are the primary violators of conservation easements; he received massive tax write-offs for "donating" open space—which contained a fully-developed golf course and 131 acres of steep hillsides and designated floodplains that Hellings had deemed "unusable space"—that either could not have been built on or that would have been required to be designated as open space anyway under township ordinances.[48]

As discussed in the last section, rural zoning is another land-use control that can be used to preserve open space, despite the drawbacks identified in that discussion. The *Georgia Stormwater Management Manual* posits that forested land absorbs 30 to 40 percent more stormwater runoff than its residential counterpart, and up to 90 percent more than urban land.[49] In addition, data suggest that, since low-density residential development (1 unit per 2-5 acres) averages an EIA of 4 percent versus an average EIA of 10 to 48 percent for medium to high-density residential development (ranging from 1 to 8 or more units per acre), cleared but mostly pervious rural open space is much better than no open space at all.[50]

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[47] *Ibid*, p 1.

[48] *Ibid*, p 7.

[49] *Georgia Stormwater Management Manual*, Volume 1 Stormwater Policy Guidebook. 1st Edition, August 2001, p 1•2.

[50] Booth, Derek B. and Jackson, C. Rhett. "Urbanization of Aquatic Systems--Degradation Thresholds, Stormwater Detention, and the Limits of Mitigation." *Journal of the American Water Resources Association*, 22(5): 1-19, October 1997, p 8.

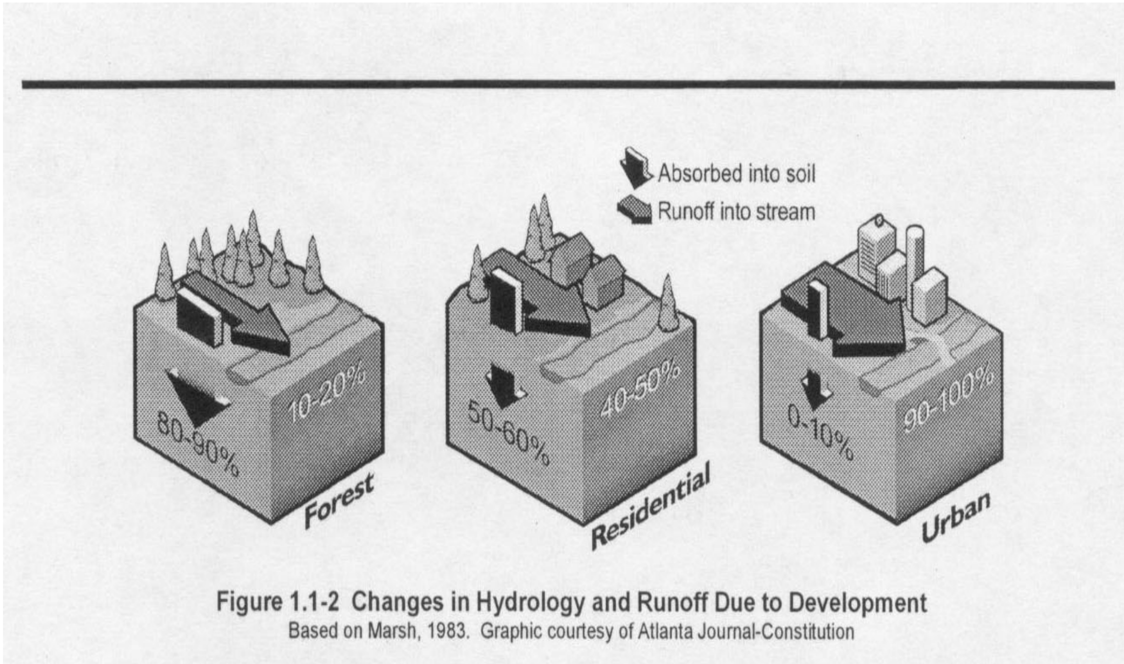

Figure 2: Pervious vs Impervious Surfaces[51]

The last tool to be examined in this section is a riparian buffer zone conservation ordinance. Riparian buffers are the vegetative lands adjacent to streams, lakes and other surface water bodies that help maintain stable banks and protect downstream and nearby property; "by slowing down floodwaters and rainwater runoff, the riparian vegetation allows water to soak into the ground and recharge groundwater."[52] Because riparian buffers are considered important for environmental protection, water resource management and the preservation of the built resources that border such water bodies, some municipalities go so far as to adopt ordinances that designate and protect Riparian

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[51] *Georgia Stormwater Management Manual*, Volume 1 Stormwater Policy Guidebook. 1st Edition, August 2001, p 1•2.

[52] "Riparian Buffers." *Stream Notes*, 1(3): 1-2. Retrieved online on 25 January 2009 at: http://www.bae.ncsu.edu/programs/extension/wqg/sri/riparian5.pdf, p 1.

Buffer Conservation Zones.[53] Unfortunately, even with such protections in place, a lack of controls upstream can negate preservation efforts downstream.

A Few Examples

Some real-world examples might help to illustrate how these tools and the overall process of land preservation contributes to watershed health. A farm in Walton County, Georgia provides an example of a conservation easement being used, in conjunction with two Purchase of Development Rights (PDR) grant programs, in an effort to permanently preserve a 200-acre cattle farm. This example comes from a Spring 2007 project carried out through the River Basin Center at the University of Georgia's School of Ecology that sought to assist the owner of this farm by helping him to put in place the proper legal protections, as well as to secure state and federal grant monies and tax benefits for the donation of future development rights.[54]

The authors of the study write that their project is intended to serve as a model framework for farmland conservation projects in the future; in addition, they note that, "due to the property's location within a regional drinking water sub-basin, the project also creates a model for conservation of critical lands that influence drinking water supplies in the Upper Altamaha river basin."[55] This study, then, clearly defines the watershed benefits that can be derived from legal preservation tools. Furthermore, the list of stakeholders involved in the project—"the farm owner, a local land trust (Athens

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[53] Passaic River Coalition & New Jersey Department of Environmental Protection, Division of Watershed Management. *Riparian Buffer Zone Conservation Model Ordinance*, March 2005. Retrieved online on 25 January 2009 at: http://www.marsh-friends.org/marsh/pdf/ordinance/StreamBufferOrdinance.pdf, 1.

[54] Ellis, Justin and Malone, Barrett. "Farmland Conservation Easement in Walton County," The Upper Altamaha Initiative: Spring 2007. Retrieved online on 29 November 2008 at: www.rivercenter.uga.edu/education/upper_altamaha/spring2007/farmland.htm.

[55] *Ibid.*

Land Trust), a local sponsor (Walton County), the Georgia Lands Conservation Program (GLCP), and the federal USDA Farm and Ranchland Protection Program (FRPP)"—indicates that such preservation efforts can create important partnerships and awareness on a variety of conservation issues.[56]

Charlotte County, Florida provides a good example of a Transfer of Development Rights (TDR) program that directly addresses the water resource benefits of the program. Located on the Gulf Coast, the county contains a wealth of cultural and natural resources, including archaeological sites, mangrove swamps, barrier islands, and estuary wetlands.[57] The "Transfer of Density Units Code," adopted in 1988, is a broad program aimed at protecting environmentally sensitive, historical, archaeological and agricultural resources by managing and directing growth in an efficient manner (Charlotte County, Florida).[58]

Additionally, receiving zones are prohibited from containing environmentally sensitive or historical resources unless these resources are preserved, and areas that are subject to storm surge are also ineligible as receiving zones (Charlotte County, Florida).[59] Taken together, such restrictions not only regulate and consolidate growth, but they also help to preserve the natural resources that protect both the built and natural environments; for example, barrier islands protect buildings from storm surge and wetlands help to filter pollutants from groundwater sources.

[56] *Ibid.*

[57] Pruetz, Rick. *Beyond Takings and Givings: Saving Natural Areas, Farmland, and Historic Landmarks with Transfer of Development Rights and Density Transfer Charges.* Marina Del Rey, CA: Arje Press, 2003, p 29.

[58] Charlotte County, Florida. "Transfer of Density Units Code," §3-5-432. Retrieved online on 25 January 2009 at: http://www.charlottefl.com/outreach/pzdocs/TDU/TransferOfDensityUnitsOrdinance.PDF.

[59] *Ibid.*

These cases provide tangible examples of how preservation tools contribute to healthy watersheds. Having established the case for preserving open space and natural, undeveloped land and having examined some of the tools used to achieve that end, Chapter 2 will look at how the preservation of built resources contributes to the protection of watershed systems.

CHAPTER 2

Preserving and Reusing

. . . the teardown /mansionization trend is not simply about historic preservation; it is about environmental health and protections, neighborhood conservation, and housing that can serve a diversity of people and incomes. The issue embraces buildings, streetscapes, trees, vegetation, open space, water quality, wildlife, and, of course, neighbors.[60]
-Teardown/Mansionization Bulletin

. . . brownfields redevelopment, when compared to greenfields development . . . improves water quality through reduced runoff, and generally accommodates growth in an environmentally responsible fashion.[61]
-Evans Paull

The relationship between water and the built environment is complex. As human developments affect watersheds, those same watersheds, in turn, affect our human developments. Our buildings and roads and cars cause rivers and oceans to fill with pollutants and sediments, and those rivers and oceans reciprocate by providing polluted drinking water and floods that drown and destroy entire cities.

For example, a BBC article from November 2005 reported that "the scale of the [Hurricane Katrina] disaster is increasingly being attributed to the disappearance of the region's swamps and marshes."[62] The loss of forest and wetlands—which help to limit the size and regularity of floods—through development that has drastically altered the hydrology of coastal areas, left New Orleans and the Gulf Coast vulnerable to the storm surge that accompanied the hurricane. The vegetation and soils found in wetlands and

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[60] Maryland-National Capital Park and Planning Commission and Montgomery County Department of Planning Historic Preservation Section. *Teardown/Mansionization Bulletin: Protecting Older Neighborhoods with Newer Tools*, August 2006. Retrieved online on 27 January 2009 at: http://www.mc-mncppc.org/historic/pdfs/teardown.pdf.

[61] Paull, Evans. *The Environmental and Economic Impacts of Brownfields Redevelopment*. Northeast-Midwest Institute, July 2008. Retrieved online on 28 January 2009 at: http://www.nemw.org/EnvironEconImpactsBFRedev.pdf.

[62] Hirsch, Tim. "Katrina damage blamed on wetlands loss", 1 November 2005. BBC News. Retrieved online on 29 January 2009 at: http://news.bbc.co.uk/2/hi/americas/4393852.stm.

forests serve as sponges to soak up and greatly reduce the amount of water that enters a watershed, and, as our often impervious human developments encroach on these natural sponges, we destroy areas that both provide us with natural beauty and help regulate environmental quality and effects.[63]

While it is not the focus of this study, it is worth noting that the vast majority of building material conservation (BMC) challenges arise from water problems. Water is the single most damaging element to all historic building materials, be they wood, metal or masonry. What's more, when that water contains the many constituents and pollutants already discussed, it does even greater damage to historic resources and the larger environment. After standing for centuries in the African desert, it took only a few decades of exposure to acid rain and other pollutants in New York's Central Park to cause irreparable damage to Cleopatra's Obelisk; likewise, the Katrina scenario described above creates a vicious cycle, wherein the destruction of natural areas causes destruction of built resources, which, in turn, causes more damage to the natural environment and to other built resources.

Since it has already been established that development inherently alters the hydrology of the areas where it occurs, it is a given that the current buildings and cities are already affecting the watersheds in which they are located. This chapter, then, seeks to explore how the preservation of existing built resources and the reuse of developed-but-underutilized areas contributes to maintaining a healthy watershed. More specifically, it will examine how teardowns negatively affect stormwater runoff and how

[63] Dobson, Clive and Beck, Gregor Gilpin. *Watersheds: a Practical Handbook for Healthy Water*. Buffalo, NY: Firefly Books, 1993, p 58-9.

the reuse and redevelopment of greyfields and brownfields positively affects watershed health.

Before discussing the "tearing down" of buildings, it is important to first look at the "building out" of the human environment. Urban areas have historically had problems with water and other pollution, even to the point of their rivers catching fire from the amount of flammable pollutants they contain—like the Cuyahoga River in Ohio. Since concentrated development was a mostly urban phenomenon, the vast majority of development-induced environmental problems have historically remained relatively concentrated. However, the era of suburban expansion that began during World War II promoted a type of growth and land use that now affects watersheds across the country in areas both urban and rural.

Prior to World War II, development was confined primarily to urban city centers, and the majority of this country's population still lived in rural areas. Only the largest metropolitan areas saw significant development outside of the urban core, and this growth was usually a result of a natural expansion of a city's limits or the construction of isolated country estates. However, the economic boom of post-war America—fueled by the rise of the automobile and the entitlement that accompanies being the world's only Capitalist superpower—ushered in the start of the suburban development movement as we know it today. "By 1950, the population distribution had shifted more heavily to metropolitan areas . . . by 2000, suburbs had become home for roughly half the U.S. population."[64]

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[64] Girling, Cynthia and Kellett, Ronald. *Skinny Streets & Green Neighborhoods: Design for Environment and Community*. Washington, DC: Island Press, 2005, p 1.

Traditional suburbanism, otherwise known as Conventional Low-Density Development (CLDD), is characterized by low-density residential and commercial development that *always* occurs outside of the urban core and *usually* occurs in greenfields. *Greenfield* is defined by Dictionary.com as "a piece of usually semirural property that is undeveloped except for agricultural use, especially one considered as a site for expanding urban development." Hearkening back to the Chapter 1 discussion of the contributions of undeveloped areas to watershed health, it would appear that the sprawling development that typifies the suburbs has done a great disservice to our water and our environment.

While it may appear that the grassy lawns of the suburbs are more sympathetic to natural hydrology than are the mostly-paved streets of the cities, traditional suburban development does create a great many impervious surfaces, including wide streets and long Ranch-house roofs. Suburban neighborhoods do not follow the grid pattern found in many urban areas and often feature dead-end streets without sidewalks, connected only by a single main "artery" street; the result is that these neighborhoods encourage more automobile use and less walking. In addition to increased impervious areas are "chemically managed lawns or landscape[s] that, together with greater concentrations of automobiles, contributes to erosion, pollution, and reduced ground water."[65]

In terms of their negative contributions to watershed health, traditional suburbs fail both to maintain pre-development hydrology and to limit impervious-area percentages. Yet, since the wholesale removal of the suburbs is an impractical and impossible course of action, the next best strategy is to apply preservation planning principles to both the existing and future built resources.

[65] *Ibid*, p 4.

Teardowns

Teardowns—"the practice of purchasing a home on a lot, demolishing it, and building a new, larger house in its place"[66]—cause even more damage to an already damaged watershed. Although proponents of teardowns often argue that they embody smart growth ideals since they direct growth to already developed areas, increase density and prevent suburban sprawl, the fact is that teardowns mostly just add built square footage and increase impervious surfaces, while doing very little to boost population density.[67] In addition to the massive amounts of embodied energy and building materials that are sent to the landfill as a result of this process, "teardown critics [argue] that the new homes often appear out of place in their neighborhood, cause stormwater problems and strain infrastructure, and damage our architectural heritage."[68]

As this country's leading preservation advocate, the National Trust for Historic Preservation believes that it is important to encourage the revitalization of existing neighborhoods because it promotes efficient land use planning and makes use of already developed public and private infrastructure. As such, a research agenda published by the National Trust recognizes that preventing teardowns should be a primary component of Smart Growth and comprehensive planning; this same agenda states that

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[66] National Trust for Historic Preservation. "Advocacy for Alternatives to Teardowns: Teardowns Resource Guide." Retrieved online on 14 January 2009 at: http://www.preservationnation.org/issues/teardowns/additional-resources/getting_started_with_advocacy_-_teardowns.pdf, p 1.

[67] Fine, Adrian Scott and Lindberg, Jim. "Taming the Teardown Trend". National Trust for Historic Preservation's *Forum News*, July/August 2002. Retrieved online on 15 January 2009 at: http://www.preservationnation.org/issues/teardowns/additional-resources/teardowns_executive_summary.pdf, p 2.

[68] Chicago Metropolitan Agency for Planning. *Teardown Strategy Report*, June 2008. Retrieved online on 26 January 2009 at: http://www.goto2040.org/ideazone/forum.aspx?id=634, p 3.

"the environmental costs of teardowns have not been well explored, and the impacts of teardowns in terms of energy use, water use, etc, is not well known,"[69] but also goes on to stress the importance of, and pledge support for, studying the environmental and cultural impacts of a teardown epidemic whose effects can be seen nationwide.

And it is not just the National Trust that recognizes teardown prevention as an integral part of comprehensive planning. Montgomery County, Maryland's Department of Planning (MCMDP) and the Chicago Metropolitan Agency for Planning (CMAP) are both examples of local planning departments that have included teardown prevention in their comprehensive plans; both agencies cited stormwater management problems and other environmental impacts alongside loss of "quality of life" and "sense of place" as primary reasons for pursuing teardown prevention policies. Moreover, some municipalities have enacted stormwater ordinances that are directly tied to preservation and teardown prevention.

For example, in August 2006, MCMDP published *Teardown/Mansionization Bulletin: Protecting Older Neighborhoods with Newer Tools*, which details the planners' struggle against mansionization and explores the tools that they are using to combat the practice. In general, all of the tools discussed are preservation oriented, ranging from neighborhood conservation districts to a demolition moratorium to an urban forest conservation law—all of which are preservation strategies that help foster a healthy watershed. More directly connected to this thesis, however, the preservation

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[69] National Trust for Historic Preservation. "Prioritized Research Agenda National Trust for Historic Preservation Sustainability Initiative." Retrieved online on 14 January 2009 at: http://74.125.47.132/search?q=cache:F0UoielpMWQJ:www.aia.org/SiteObjects/files/NTHP%2520Draft%2520Research%2520Agenda%25202008%252004-21.pdf+DRAFT+Prioritized+Research+Agenda+National+Trust+for+Historic+Preservation+Sustainability+Initiative&hl=en&ct=clnk&cd=1&gl=us&client=firefox-a, p 3-4.

plan calls for a legislative amendment in the form of a stormwater management ordinance.

"If trees are the first environmental issue to be noticed with infill development, stormwater runoff is the second,"[70] and, since Chapter 1 already established the importance of trees and other vegetation in the hydrologic process, one can easily argue that these two issues are fundamentally connected. While buildings and structures *can* be sited with a certain sensitivity to the existing landscape—a practice exemplified by the designs and site plans of architects like Thomas Church and Robert Marvin—the majority of development, or re-development, projects begin with the wholesale clearing of vegetation and the extensive alteration of topography, otherwise known as grading and leveling. In the case of teardowns, such practices are causing older neighborhoods with extensive numbers of mature trees to disappear, as trees and houses alike must make room for the McMansions.

[70] Maryland-National Capital Park and Planning Commission and Montgomery County Department of Planning Historic Preservation Section. *Teardown/Mansionization Bulletin: Protecting Older Neighborhoods with Newer Tools*, August 2006. Retrieved online on 27 January 2009 at: http://www.mc-mncppc.org/historic/pdfs/teardown.pdf, p 11.

Figure 3: Scene of a Teardown: *A neighborhood with mature trees (left) and a teardown in progress* (right)[71]

The "Stormwater Management Amendment" section of MCMDP's *Teardown Bulletin* lists several factors related to teardowns that negatively impact stormwater systems, including:

> 1) bigger house footprints and massing, 2) the possibility of an artificially raised grade (at least prior to the height amendment to stop the practice), and 3) an expansion in impervious surface area and loss of soil cover. The result is larger houses that sometimes tower over neighboring houses set at a lower grade, with stormwater runoff trailing onto other people's property (and into their homes) and damaging the County's important stream systems.[72]

The first point is supported by data demonstrating that, between 1950 and 2000, the footprint and overall size of the average American house increased from two bedroom, one bathroom houses of 1,000 square feet or less to three or more bedroom, two-and-a-half bath houses of 2,250 square feet or more.[73] These numbers, of course, are averages; teardowns are often much larger. A few examples include: Dallas, TX,

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[71] *Ibid*, p 11.
[72] *Ibid*, p 11.
[73] Girling, Cynthia and Kellett, Ronald. *Skinny Streets & Green Neighborhoods: Design for Environment and Community*. Washington, DC: Island Press, 2005, p 2.

where 1,000 historic early 20th-century homes were demolished to make way for luxury homes of up to 10,000 square feet each; Denver, CO, where nearly 200 homes—most of them Craftsmen bungalows—were torn down and replaced in 2001 with houses three times their size; even Frank Lloyd Wright's work was endangered when a spacious home he designed in the Bannockburn suburb of Chicago was threatened with demolition and replacement—a fate that was avoided through public outcry.[74] In general, teardowns are much larger than historic homes and are even considerably larger than the average new home, measuring between 3,000 and 10,000 square feet, and rarely, if ever, do they increase population density.[75]

The second and third points refer to the grading and leveling as well as the added pavement and roof surfaces that accompany teardowns. The report posits that teardowns result in stormwater problems that include damage to the remaining historic homes that sit at a lower grade from increased storm discharges and damage to the watershed from pollutants and erosion that sends sediment into streams and rivers. Moreover, absent a surface drainage grading ordinance, stormwater runoff regulations usually do not apply to runoff on individual lots; as a result, the heavily altered topography and the increases in impervious area cause serious problems for stormwater systems.[76] These problems are magnified when teardowns become an epidemic in a

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[74] Fine, Adrian Scott and Lindberg, Jim. "Taming the Teardown Trend". National Trust for Historic Preservation's *Forum News*, July/August 2002. Retrieved online on 15 January 2009 at: http://www.preservationnation.org/issues/teardowns/additional-resources/teardowns_executive_summary.pdf, p 1.

[75] Fine, Adrian Scott. "New Help for Teardowns," 18 August 2008. Retrieved online on 23 January 2009 at: http://blogs.nationaltrust.org/preservationnation/?cat=9, p 2.

[76] Maryland-National Capital Park and Planning Commission and Montgomery County Department of Planning Historic Preservation Section. *Teardown/Mansionization Bulletin: Protecting Older Neighborhoods with Newer Tools*, August 2006. Retrieved online on 27 January 2009 at: http://www.mc-mncppc.org/historic/pdfs/teardown.pdf, p 11.

neighborhood or an entire city, as is the case in places like Atlanta, Denver and Los Angeles.[77]

The Chicago Metropolitan Agency for Planning (CMAP), specifically the Village of Downers Grove, has taken similar steps by "trying to balance the needs of newcomers while also addressing a reduction in affordable 'starter' housing, storm water drainage impacts caused in part due to teardowns, and the overall loss of original community character."[78] In other words, Downers Grove is tackling a variety of issues that include preserving the built and natural environments, while also providing affordable communities that maintain a sense of place.

Interviews conducted with municipal officials revealed that stormwater flows are their main environmental concern. Officials complained that during replacement construction, developers rarely excavate to the depth of the previous buildings, which results in the previously discussed problem of "creat[ing] a steeper grade around the edge of the teardown property, and a greater likelihood of flooding nearby parcels" and filling storm sewer systems with increased levels of silt and sediment runoff.[79] The CMAP report also refers to the "extensive paved connectors such as streets and driveways" that accompany conventional suburban developments and points out that

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77 National Trust for Historic Preservation. "Managing Teardowns: Preserving Community Character and Livability." Retrieved online on 14 January 2009 at: http://www.preservationnation.org/issues/teardowns/additional-resources/Teardown-Tools-on-the-Web-1.pdf, p 22.

78 Fine, Adrian Scott. "New Help for Teardowns," 18 August 2008. Retrieved online on 23 January 2009 at: http://blogs.nationaltrust.org/preservationnation/?cat=9, p 2.

79 Chicago Metropolitan Agency for Planning. *Teardown Strategy Report*, June 2008. Retrieved online on 26 January 2009 at: http://www.goto2040.org/ideazone/forum.aspx?id=634, p 4.

"current zoning, especially when applied to the redevelopment of teardowns, often facilitates the type[s] of stormwater problems" already discussed.[80]

In their efforts to manage teardowns, both Downers Grove and Montgomery County have passed amendments to their stormwater ordinances that seek to reduce the negative impacts of redevelopment. Montgomery County's Stormwater Ordinance, for example, is aimed specifically at controlling runoff on small lots and puts tight restrictions on the amount of land that can be graded or covered with impervious surfaces unless the plans "provide for safe conveyance or control of any increased water runoff." The passage of both a Demolition Moratorium and a Forest Conservation Law also help to control stormwater problems in Montgomery County; some of the other methods used—which involve LID stormwater technologies—will be discussed in Chapter 3. Downers Grove published a Stormwater Master Plan in 2006 which identified an understanding of "Redevelopment Issues" as important to the sustainable management of their stormwater system; in the summer of 2006, the Village passed an amendment to their stormwater ordinance that placed tighter controls on redevelopment.[81]

In addition to these examples of government regulation as a means for teardown prevention, PreserveMidtown is an example of a citizen neighborhood group that is working to promote preservation of built resources as a path to healthy water. PreserveMidtown "is a grassroots, non-partisan, volunteer community-based

[80] *Ibid*, p 4.

[81] Downers Grove, Village of. *Stormwater Master Plan 2006*. Retrieved online on 28 January 2009 at: http://www.downers.us/page/view/201, p 16.

organization" that advocates for historic preservation in Tulsa, OK.[82] In addition to the commonly cited teardown problems that include the loss of historic homes and neighborhood character, PreserveMidtown recognizes that teardowns have very damaging effects on both stormwater systems and watershed health.

From a citizen perspective, PreserveMidtown argues that the increased stormwater volumes that result from increased amounts of impervious surfaces and extensive grading of land costs taxpayers and homeowners money.[83] More stormwater, and more *polluted* stormwater, means more infrastructure maintenance and costlier water treatment processes that will, ultimately, be billed to the taxpayer. Moreover, increased stormwater flows—especially in the flashflood-prone areas of the Midwestern and Mountains/Plains regions of the United States[84]—can result in floods that damage and destroy large numbers of properties and that cost homeowners and insurance companies millions of dollars in repairs and lawsuits.[85] It is hard to imagine that one solitary McMansion can create conditions for more damaging floods and polluted drinking water, but evidence suggests that the seemingly unchecked proliferation of the

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[82] PreserveMidtown website, various pages. Retrieved online on 15 January 2009 at: http://www.preservemidtown.com/.

[83] Southmayd, Patty, PreserveMidtown Board Member. "Our Neighborhoods: Everyone's Environment," a presentation and PowerPoint given at the National Trust Conference in Tulsa, OK on 24 October 2008.

[84] National Trust for Historic Preservation. "Prioritized Research Agenda National Trust for Historic Preservation Sustainability Initiative." Retrieved online on 14 January 2009 at: http://74.125.47.132/search?q=cache:F0UoielpMWQJ:www.aia.org/SiteObjects/files/NTHP%2520Draft%2520Research%2520Agenda%25202008%252004-21.pdf+DRAFT+Prioritized+Research+Agenda+National+Trust+for+Historic+Preservation+Sustainability+Initiative&hl=en&ct=clnk&cd=1&gl=us&client=firefox-a, p 3.

[85] Southmayd, Patty, PreserveMidtown Board Member. "Our Neighborhoods: Everyone's Environment," a presentation and PowerPoint given at the National Trust Conference in Tulsa, OK on 24 October 2008.

unsustainable building and re-building practices that are common in this country is doing just that.

As well as identifying problems caused by increases in quantity of stormwater as a result of teardowns, PreserveMidtown is interested in uncovering some of the water quality effects that have never received much attention before. Specifically, the group has hired an environmental consultant named Guy DeVerges, who is in the preliminary stages of conducting research to measure the levels of chlordane that is present in the runoff from teardown sites. *Chlordane* is defined by Dictionary.com as "A colorless, odorless, viscous liquid, $C_{10}H_6Cl_8$, used as an insecticide [that] may be toxic to humans and wildlife as a result of its effect on the nervous system." Before being banned in 1988, chlordane was the standard chemical used to treat buildings for termites.

One of chlordane's properties is that it bonds with soil particles, and another is that it lingers as an environmental toxin for many years after it is applied.[86] According to DeVerges' research, as long as it is left undisturbed and under a house, chlordane is relatively inert. When that building is torn down, however, the chlordane-tainted soil is exposed and left subject to erosion. If proper construction site erosion controls are not implemented, the result is that both sediment *and* toxic chemicals enter the watershed—in this case, the Arkansas River.[87]

DeVerges research method involves locating houses that are slated for demolition and then taking stormwater samples where runoff leaves a property, both before and after it is demolished. Despite the city of Tulsa's unwillingness to provide information on pending demolition permits, PreserveMidtown's vigilant members keep a watchful

[86] *Ibid.*
[87] *Ibid.*

eye out for potential research subjects—future teardowns. The stormwater samples are taken on the public right of way, after the runoff has left the subject property; eventually, DeVerges hopes to get permission to take soil samples from some of the actual private parcels, but it is unclear, as of yet, whether the homeowners or developers involved with these teardowns will be willing to provide access to this information. Nevertheless, PreserveMidtown and DeVerges are optimistic that this research will contribute to greater public awareness and stronger public policy to prevent teardowns.[88]

Other instances of historic preservation as a means for sustainable water management surely exist, though the relative scarcity of examples confirms the National Trust's view that "the environmental costs of teardowns have not been well explored."[89] Nevertheless, the existing examples likewise confirm the need for the Trust "to undertake a study of the environmental impacts of teardowns" and to advocate for a greater public awareness of the relationship that exists between the built and natural environments and of the important role that historic preservation can play in fostering a healthy planet.[90]

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[88] *Ibid.*

[89] National Trust for Historic Preservation. "Prioritized Research Agenda National Trust for Historic Preservation Sustainability Initiative." Retrieved online on 14 January 2009 at: http://74.125.47.132/search?q=cache:F0UoielpMWQJ:www.aia.org/SiteObjects/files/NTHP%2520Draft%2520Research%2520Agenda%25202008%252004-21.pdf+DRAFT+Prioritized+Research+Agenda+National+Trust+for+Historic+Preservation+Sustainability+Initiative&hl=en&ct=clnk&cd=1&gl=us&client=firefox-a, p 3.

[90] *Ibid*, p 3.

Filling In to Keep From Filling Out

"Regional efforts to encourage development in strategic areas are one of the strongest approaches to coordinating growth and resource protection in a watershed."[91] To that end, another preservation practice that contributes to a healthy watershed is infill development—specifically, brownfield and greyfield redevelopment. The National Brownfield Associations website gives the following breakdown for *brownfield*:

> Most states have their own definition of a brownfield. The U.S. EPA defines brownfields as "real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant." Brownfield sites can be found in every state. Common examples are abandoned gas stations and dry cleaners, railroad properties, factories and closed military bases.[92]

Greyfields are similar, but they "differ from brownfields in that they are not contaminated or perceived to be contaminated"[93]; both brownfields and greyfields often retain functional stormwater infrastructure.[94] The National Association of Home Builders defines *greyfield* as "a Regional or Super-Regional Mall with a minimum of 35 stores and . . . [an] Average size of 45.96 Acres"; conservative estimates put the number of such abandoned malls and accompanying massive parking lots at over 200 as of

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[91] Nisenson, Lisa, et al; US EPA Development, Community and Environment Division. *Using Smart Growth Techniques as Stormwater Best Management Practices*. Washington, DC: US EPA, December 2005. Retrieved online on 28 January 2009 at: http://www.epa.gov/smartgrowth/pdf/sg_stormwater_BMP.pdf, p 29.

[92] National Brownfield Associations website, various pages. Retrieved online on 10 February 2009 at: http://www.brownfieldassociation.org/.

[93] Nisenson, Lisa, et al; US EPA Development, Community and Environment Division. *Using Smart Growth Techniques as Stormwater Best Management Practices*. Washington, DC: US EPA, December 2005. Retrieved online on 28 January 2009 at: http://www.epa.gov/smartgrowth/pdf/sg_stormwater_BMP.pdf, p 49.

[94] Greenberg, Michael; Lowrie, Karen; Mayer, Henry; Miller, K.; Solitaire, Laura. "Brownfield Redevelopment as a Smart Growth Option in the United States," *The Environmentalist*, 21(1), June 2001. Recovered online on 18 September 2008 at: http://www.springerlink.com.proxy-remote.galib.uga.edu:2048/content/k321161452537tm5/.

2004.[95] Conflicting estimates on the number of brownfields approximate that between 400,000 and over 1 million such sites exist in the United States alone.[96] The clean-up and re-use of these contaminated and already-developed areas can have significant positive environmental, economic and social impacts on areas that are blighted by abandoned and underused buildings and infrastructure.

These types of infill development garner many of the same watershed health benefits that were discussed in association with teardown prevention—just on a larger scale. The National Vacant Properties Campaign estimates that previously developed "vacant and abandoned properties occupy about 15 percent of the area of a typical large city."[97] Because these properties are almost always covered with compacted or impervious surfaces, they have a high potential for causing negative stormwater runoff impacts. In the case of brownfields, the negative impacts may be heightened by the presence of hazardous materials and by the costs associated with their remediation.[98]

On the other hand, considering the long-term costs associated with sprawling development and environmental contamination, brownfield reuse is probably the better investment. This stance is supported by a 2002 Johns Hopkins University School of Public Health study that showed "a spatial and statistical relationship between

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[95] National Association of Home Builders. "Turning Smart Growth Into Reality: How to Implement Infill and Mixed-Use Developments," PowerPoint, 18 February 2005. Retrieved online on 17 February 2009 at: http://www.nahb.org/fileUpload_details.aspx?contentID=36061.

[96] National Brownfield Associations website, various pages. Retrieved online on 10 February 2009 at: http://www.brownfieldassociation.org/.

[97] Nisenson, Lisa, et al; US EPA Development, Community and Environment Division. *Using Smart Growth Techniques as Stormwater Best Management Practices*. Washington, DC: US EPA, December 2005. Retrieved online on 28 January 2009 at: http://www.epa.gov/smartgrowth/pdf/sg_stormwater_BMP.pdf, p 48.

[98] Paull, Evans. *The Environmental and Economic Impacts of Brownfields Redevelopment*. Northeast-Midwest Institute, July 2008. Retrieved online on 28 January 2009 at: http://www.nemw.org/EnvironEconImpactsBFRedev.pdf, p 10.

environmentally-degraded brownfields area[s] and at-risk communities."[99] The study went on to suggest that brownfields cleanup "should be part of any strategy to reduce public health disparities," and it also warned that these strategies must account for the new sites that are added to the list every time an industrial complex or gas station goes out of business; in light of the current economy, the need for brownfield reuse strategies is more important than ever.

Tying infill back to the concept of open space preservation discussed in Chapter 1, it is estimated that 1 acre of brownfield redevelopment preserves 4.5 acres of open space, since infill development makes use of existing infrastructure and avoids damage to undeveloped greenfields.[100] Moreover, infill is more sustainable than greenfield development because it uses land that has already been developed and infrastructure that is already in place, and it avoids the widespread development patterns associated with Conventional Low-Density Development.[101] EPA studies have shown that higher-density development over a smaller area has significant water quality benefits. As such, it follows that infill development—which tends to be higher density and which confines development to an overall smaller area of a watershed—contributes to water quality improvement (Paull 20).[102] An additional connection between open-space preservation and brownfields relates to the preservation tool of Transfer of Development Rights

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[99] *Ibid*, p 16.

[100] Nisenson, Lisa, et al; US EPA Development, Community and Environment Division. *Using Smart Growth Techniques as Stormwater Best Management Practices*. Washington, DC: US EPA, December 2005. Retrieved online on 28 January 2009 at: http://www.epa.gov/smartgrowth/pdf/sg_stormwater_BMP.pdf, p 53.

[101] Paull, Evans. *The Environmental and Economic Impacts of Brownfields Redevelopment*. Northeast-Midwest Institute, July 2008. Retrieved online on 28 January 2009 at: http://www.nemw.org/EnvironEconImpactsBFRedev.pdf, p 20.

[102] *Ibid*, p 20.

(TDRs) that was discussed in Chapter 1, since brownfields are often seen as ideal candidates for "receiving zones."[103]

Another benefit of infill development relates to impervious surfaces, as illustrated through the example of an abandoned shopping mall. Because a greyfield shopping mall already contains 95% impervious surfaces, it already creates heavy stormwater runoff volumes; such high impervious surface percentages mean that redevelopment of the shopping mall is likely to cause zero net runoff increase, and, "in many cases, redevelopment of these properties breaks up or removes some portion of the impervious cover, converting it to pervious cover and allowing for some stormwater infiltration."[104] Brownfield and greyfield redevelopment reduces overall land consumption and can increase an area's stormwater infiltration capacity with the end result of improving overall regional water quality.

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[103] Nisenson, Lisa, et al; US EPA Development, Community and Environment Division. *Using Smart Growth Techniques as Stormwater Best Management Practices*. Washington, DC: US EPA, December 2005. Retrieved online on 28 January 2009 at: http://www.epa.gov/smartgrowth/pdf/sg_stormwater_BMP.pdf, p 30.

[104] Richards, Lynn, et al; US EPA Development, Community and Environment Division. *Protecting Water Resources With Higher-Density Development*. Washington, DC: US EPA, January 2006. Retrieved online on 27 January 2009 at: http://www.epa.gov/smartgrowth/pdf/protect_water_higher_density.pdf, p 29.

Figure 4: Greyfield Redevelopment: *reduces impervious areas and runoff*[105]

Most brownfield and greyfield redevelopments follow the principles of smart growth.[106] The details of smart growth may vary from one community to another, but, "in general, smart growth invests time, attention, and resources in restoring community and vitality to city centers and older suburbs;" these aims and community contributions are essentially identical to those of historic preservation practices.[107] This makes sense, though, when one considers that the neighborhood planning principles championed by New Urbanist founders Duany and Plater Zyberk "show extensive agreement" with the historic neighborhood design concepts of such urban theorists as Ebenezer Howard and Clarence Perry.[108] Perry's designs, which "borrowed many themes from Howard," called

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[105] *Ibid*, p 30.

[106] Greenberg, Michael; Lowrie, Karen; Mayer, Henry; Miller, K.; Solitaire, Laura. "Brownfield Redevelopment as a Smart Growth Option in the United States," *The Environmentalist*, 21(1), June 2001. Recovered online on 18 September 2008 at: http://www.springerlink.com.proxy-remote.galib.uga.edu:2048/content/k321161452537tm5/.

[107] Smart Growth Online website. Retrieved online on 19 February 2009 at: http://www.smartgrowth.org/.

[108] Girling, Cynthia and Kellett, Ronald. *Skinny Streets & Green Neighborhoods: Design for Environment and Community*. Washington, DC: Island Press, 2005, p 12-13.

for neighborhood streets to be narrower in order to limit both automobile traffic and impervious surface percentages, thereby reducing stormwater runoff quantities and improving stormwater runoff quality.[109]

It would appear, then, that smart growth is an ally of historic preservation. In fact, the *Charter of the New Urbanism* specifically states that "preservation and renewal of historic buildings, districts, and landscapes affirm the continuity and evolution of urban society"; elsewhere it says that "the development and redevelopment of towns and cities should respect historical patterns, precedents, and boundaries."[110] To clarify, "historical patterns" refers to patterns of narrow, gridded streets and concentrated development, in contrast to the wide, curving streets and sprawling development patterns associated with traditional suburbanism.

Of course, many critics of New Urbanism argue that it does not promote preservation principles because it just creates new suburbs, even if they *are* better planned ones. However, listed by the EPA as a type of smart growth under the "special development districts" subheading, brownfield and greyfield redevelopment is not subject to such criticism, since it inherently involves recapturing already developed but underutilized property.[111] Moreover, as evidenced by the hundreds of mills across the country that have been converted into condominiums and mixed-use development, it is often the case with brownfields that there are reusable buildings on the property—in

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[109] *Ibid*, p 12.

[110] Congress for the New Urbanism, The. *Charter of the New Urbanism*, ratified in 1996. Retrieved online on 15 February 2009 at: http://www.cnu.org/charter.

[111] Nisenson, Lisa, et al; US EPA Development, Community and Environment Division. *Using Smart Growth Techniques as Stormwater Best Management Practices*. Washington, DC: US EPA, December 2005. Retrieved online on 28 January 2009 at: http://www.epa.gov/smartgrowth/pdf/sg_stormwater_BMP.pdf, p 25.

which case the adaptive reuse of such buildings reduces the impact to the land during development which, in turn, reduces hydrological impacts.

The Smart Growth Network's webpage provides further support for the contributions that brownfield redevelopment makes to both historic preservation and water management. The website features links to brownfield programs in both the city of Portland, OR and the state of Florida, and it provides information on "Brownfields Training, Research and Technical Assistance Grants" as well as "Historic Preservation Funding." Several of the projects on the Portland Bureau of Environmental Services brownfield program website involve adaptively reused buildings, including a former service station that was listed on the Oregon Department of Environmental Quality's Leaky Underground Storage Tank list and a former battery recycling plant that now houses a non-profit that provides life skills training and employment opportunities for developmentally disabled adults.[112] Of course, many brownfield buildings are poorly constructed and should not be rehabilitated anyway, yet reuse of the pre-developed site alone preserves undeveloped land elsewhere and avoids damage to the watershed.

Finally, it is worth noting the National Trust for Historic Preservation is a partner in the Smart Growth Network and is a resource of both information and funding for nonprofit organizations and federal, state, or local government agencies that are involved in brownfield redevelopment and other infill development. Because brownfield redevelopment often involves the adaptive reuse of large, commercial buildings, these projects are often eligible for historic rehabilitation tax incentives. The Trust maintains a page on its website with links to both educational information sources and funding

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[112] Portland Brownfield Program (Portland Bureau of Environmental Services) website, various pages. Retrieved online on 24 February 2009 at: http://www.portlandonline.com/bes/index.cfm?c=35008.

sources, including public and private grants, for preservation projects under the heading "Nonprofit Organization and Public Agency Funding."

This chapter has explored some of the ways in which the preservation of existing built resources contributes to healthy water systems. Building on the facts that were established in Chapter 1, an analysis of teardowns and brownfield redevelopment reveals that historic preservation practices can have significant positive impacts on watersheds. Brownfield redevelopment preserves open space by encouraging growth in strategic areas, and teardown prevention preserves both built and natural resources by reducing the erosion and increased impervious surface runoff that can cause damage to buildings and rivers alike. This kind of preservation is passive, in that the watershed benefits derive from not causing any additional damage to the land. The last chapter will explore more active examples of water management vis-à-vis preservation, by looking at how modern stormwater technologies and techniques are being used in conjunction with historic resources.

CHAPTER 3

Conservation and Preservation: A Partnership

. . . improved energy efficiency and an increase in the use of renewable sources of energy at the Capitol Complex . . . has the opportunity to demonstrate to the American public the important role our older and historic buildings play in reducing carbon emissions. . . [and] the flat roofs and even sloped roofs of many historic buildings often easily accept planted or green roofs which reduce storm water run-off, increase building insulation and lower the summer air temperature.

- Jean Carroon (FAIA, Principal with Goody Clancy Architects and member of the National Trust's Sustainable Preservation Coalition) in testimony before Congress[113]

Chapters 1 and 2 looked at how preservation tools and practices can have significant benefits for watershed health. This chapter will examine the water/preservation connection from a different angle, by identifying some of the stormwater management technologies that are beginning to replace the traditional conveyance and detention systems discussed in Chapter 1 and by showing how these are being used in conjunction with both historic resources and new development that follows preservation planning principles. The analysis begins with definitions and descriptions for such stormwater-related terms as LID (Low Impact Development) and green roofs and then moves on to a variety of case study examples of the described technologies.

What is LID?: and Other Definitions

As urban and suburban populations continue to grow, more and more land is developed, resulting in a nation-wide, and even world-wide, disruption to the natural hydrologic cycle. Starting in the mid-1980s, Prince George's County, Maryland began to

[113] PreservationNJorg. "National Trust to Senate Panel: Green & Historic Are Compatible", 7 July 2008, from PreserveNJ website. Retrieved online on 10 March 2009 at: http://preservationnj.wordpress.com/2008/07/07/national-trust-to-senate-panel-green-historic-are-compatible/.

develop the bioretention technologies that would serve as the foundation for LID, in an effort to offer alternatives to the region's failing conventional stormwater facilities. *Bioretention* is a stormwater management technique that combines retention with infiltration by providing storage for the excess stormwater that does not initially infiltrate, in order that much more of the water will eventually provide groundwater recharge rather than storm-sewer runoff.[114]

Over time, LID's repertoire has expanded from bioretention alone to include, among other things, permeable pavers and disconnected downspouts, all of which help to reduce pollution and control runoff.[115] "LID allows for greater development potential with [fewer] environmental impacts through the use of smarter designs and advanced technologies that achieve a better balance between conservation, growth, ecosystem protection, and public health/quality of life."[116] Like historic preservation, LID looks to the past—attempting to recreate pre-development hydrologic conditions—in order to develop technologies and techniques that help plan for the future.

[114] Northern Virginia Soil and Water Conservation District and ATR Associates, Inc. *The Workhouse Arts Center at Lorton Low-Impact Development Design Report*, January 2005, p 9.

[115] Urban Design Tools website. "Introduction to LID," 1-8. Retrieved online on 6 October 2008 at: http://www.lid-stormwater.net/background.htm, p 2.

[116] *Ibid*, p 2.

Figure 5: Pervious Pavement: *Water is allowed to pass through porous pavement, thus increasing stormwater infiltration*[117]

The Low Impact Development Center defines LID as "a new, comprehensive land planning and engineering design approach with a goal of maintaining and enhancing the pre-development hydrologic regime of urban and developing watersheds."[118] Although certain details are different—preservation is not new and is not generally focused on pre-development watershed hydrology—historic preservation is similar in that it is *also* a comprehensive land planning and design approach, with a general goal of maintaining and enhancing built and cultural environments. This similarity is another indication of the analogous relationship between conservation and preservation.

One of the reasons why LID works as well as it does is that it is "an approach with a basic principle that is modeled after nature: manage rainfall at the source using

[117] Appropedia website. Retrieved online on 12 March 2009 at: http://www.appropedia.org/Reducing_runoff.
[118] Low Impact Development Center, Inc. website, various pages. Retrieved online on 11 November 2008 at: http://www.lowimpactdevelopment.org/.

uniformly distributed decentralized micro-scale technologies."[119] This is in contrast to the "pipes and ponds" approach of conventional stormwater management strategies, which use highly efficient drainage systems to quickly move water to a centralized treatment device. LID technologies promote fewer paved areas and more green space and encourage aesthetically pleasing drainage in the form of fountains or streams, in an attempt to approximate the natural watershed hydrology of the area and allow for greater levels of infiltration and groundwater recharge.[120] This kind of sustainable development contributes to the creation of healthier communities and helps to protect water and other resources.

A similar comparison exists between preservation planning and traditional Post WWII urban planning. The latter uses a network of roads and as much space as possible to segregate the places where people work from the places where they live, in the process creating decentralized networks of roads, parking lots and low-density mediocre architecture. This is in contrast to the preservation planning principles that promote the maintenance and use of historic buildings and traditional mixed-use neighborhoods. Comparing it to LID, historic preservation is essentially an "on-site treatment" for neighborhoods and historic resources. Just as treating stormwater on site by allowing for infiltration improves watershed health, preserving the buildings and neighborhoods that have proven their steel can have lasting positive impacts on community health.

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[119] Urban Design Tools website. "Introduction to LID," 1-8. Retrieved online on 6 October 2008 at: http://www.lid-stormwater.net/background.htm, p 1.

[120] Coffman, Larry S; Associate Director, Department of Environmental Resources Programs and Planning Division, Prince George's County, Maryland. "Low Impact Development: Smart Technology for Clean Water," 1-11. Retrieved online on 19 September 2008 at: http://www.wsud.org/downloads/Info%20Exchange%20&%20Lit/Larry%20Coffman%20Low%20Impact%20Development.pdf, p 2.

Returning to the description of LID, it employs landscape features known as Integrated Management Practices (IMPs) or Best Management Practices (BMPs). Because "almost all components of the urban environment have the potential to serve as an IMP," everything from open spaces to rooftops and parking lots to street medians can be incorporated into LID designs.[121] Moreover, while LID is most often associated with greenfield development through new design and construction, it can apply equally to redevelopment and retrofits, including brownfield and urban revitalization projects.[122] As the case studies will demonstrate, LID technologies can be employed over an entire conservation development or an individual historic home or building.

Similar to the economic comparison between historic preservation and new construction, case studies have shown that, in addition to its environmental benefits, LID can save 25 to 30% over conventional approaches in terms of infrastructure and site preparation costs; this minimized infrastructure—in the form of fewer pipes and mechanical components—also requires less maintenance over the long term.[123] On the scale of a conservation development neighborhood, less pavement, fewer curbs, and reductions in clearing and grading all add up to cost-savings, and more green space leads to healthier water and higher property values.[124]

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[121] Urban Design Tools website. "Introduction to LID," 1-8. Retrieved online on 6 October 2008 at: http://www.lid-stormwater.net/background.htm, p 1.

[122] Coffman, Larry S; Associate Director, Department of Environmental Resources Programs and Planning Division, Prince George's County, Maryland. "Low Impact Development: Smart Technology for Clean Water," 1-11. Retrieved online on 19 September 2008 at: http://www.wsud.org/downloads/Info%20Exchange%20&%20Lit/Larry%20Coffman%20Low%20Impact%20Development.pdf, p 3.

[123] Urban Design Tools website. "Introduction to LID," 1-8. Retrieved online on 6 October 2008 at: http://www.lid-stormwater.net/background.htm, p 3-4.

[124] Coffman, Larry S; Associate Director, Department of Environmental Resources Programs and Planning Division, Prince George's County, Maryland. "Low Impact Development: Smart Technology for Clean Water," 1-11. Retrieved online on 19 September

On the individual lot level, green roofs, disconnected downspouts, cisterns and the like are easy ways to integrate LID into existing buildings, and the wide-ranging benefits of such integration can include a building that contributes to its neighborhood's historic character *and* to its environmental integrity; green roofs that can reduce heating and cooling costs as well as stormwater runoff fees, especially for large public buildings like Chicago's City Hall; and rainwater captured in cisterns that can reduce water-usage costs, especially for large spaces like the Founders Memorial Garden that require extensive watering. Many technologies can be applied unobtrusively, so as not to damage a historic resource's integrity.

Moving from the general facts of LID to its specific components, the descriptions of the following technologies are important for understanding the case studies in the second half of this chapter. Many of the concepts associated with LID were discussed in Chapter 1, including: infiltration to increase groundwater recharge and limiting impermeable surfaces to decrease stormwater runoff. The technologies associated with LID embrace these concepts in order to achieve their goals.

As previously described, bioretention involves storing water for purposes of infiltration; this is in contrast to the detention ponds and storage tanks used in conventional stormwater management, which simply store the overflow from storm sewers until it can be processed by a treatment plant.[125] In other words, bioretention encourages infiltration "rather than efficient hydraulic conveyance, thereby promoting sedimentation, filtration, and other pollutant removal mechanisms," while conventional

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2008 at: http://www.wsud.org/downloads/Info%20Exchange%20&%20Lit/Larry%20Coffman%20Low%20Impact%20Development.pdf, p 3.

[125] Dobson, Clive and Beck, Gregor Gilpin. *Watersheds: a Practical Handbook for Healthy Water*. Buffalo, NY: Firefly Books, 1993, p 84.

stormwater detention only returns the storm runoff that is still full of constituents to surface water systems.[126]

Bioretention can be achieved in a number of different ways and can be implemented at a variety of scales, from individual lots to entire communities. At the most basic level, a swale can serve as a natural bioretention device. Defined as "open channels with unobstructed flow," swales, or bioswales, are shallow depressions—in the shape of a "v" or a "u"—that facilitate stormwater and snowmelt drainage.[127] "In vegetated swales, unlike paved gutters or structural pipes, vegetated soil infiltrates and stores rainfall, treats it, and discharges it gradually to streams weeks after storms are past."[128] As discussed in Chapter 1, this kind of infiltration helps to maintain groundwater and surface water base flows.

Figure 6: Bioswale: *This bioswale is designed to look like a creek, adding both beauty and functionality to the landscape*[129]

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[126] Water Environment Federation and (ASCE) American Society of Civil Engineers. *Urban Runoff Quality Management*, 1998, p 193.

[127] Ferguson, Bruce K. *Introduction to Stormwater*. New York: John Wiley & Sons, Inc., 1998, p 113-19.

[128] *Ibid*, p 2.

[129] Girling, Cynthia and Kellett, Ronald. *Skinny Streets & Green Neighborhoods: Design for Environment and Community*. Washington, DC: Island Press, 2005, p 50.

Not only do swales allow more stormwater to infiltrate, but they can also protect built resources. When placed between a building and a hill that slopes down towards that building, a swale will prevent water from pooling at the foundation and, thus, prevent water, mold and termite damage. As it turns out, swales can be more than just stormwater management tools; they can also be tools for preservation.

On a larger scale, bioretention units can be used to store and infiltrate the runoff from a collection of buildings—say, a new subdivision or a campus. Some specifics of this kind of bioretention will be examined in the case study portion of this chapter, but, in general, it involves grading paved areas and directing downspouts so as to send stormwater into natural grassy areas or "natural" areas that are specially engineered to accommodate storage and infiltration; the engineered areas are called "connected" units, while the actual natural areas are referred to as "disconnected" bioretention units.[130] In fact, the disconnected units might also be considered "engineered," since such natural areas are often home to *rain gardens*, which are gardens that make use of plants that can withstand extremes—usually, this means native plants, which are commonly a part of many historic landscapes.[131]

Finally, similar to bioretention is a practice referred to as Alternative Sewage Treatment, often represented through wetlands or stormwater-retention ponds.[132] Venice, Italy has for centuries used the surrounding wetlands as a method of wastewater treatment, and constructed wetlands are more and more common in planned

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[130] Northern Virginia Soil and Water Conservation District and ATR Associates, Inc. *The Workhouse Arts Center at Lorton Low-Impact Development Design Report*, January 2005, p 9-10.

[131] Low Impact Development Center, Inc. website, various pages. Retrieved online on 11 November 2008 at: http://www.lowimpactdevelopment.org/.

[132] Dobson, Clive and Beck, Gregor Gilpin. *Watersheds: a Practical Handbook for Healthy Water*. Buffalo, NY: Firefly Books, 1993, p 86.

neighborhoods and neighborhood redevelopments in this country.[133] "In addition to breaking down wastes and absorbing excess nutrients, these artificial wetlands mimic natural processes and help to filter the water and remove sediments, [leaving the water] much cleaner and also much clearer."[134] What's more, wetlands not only clean wastewater, but they also provide habitat for wildlife and help preserve built resources by absorbing excess stormwater during flood events.[135]

Other LID technologies include: permeable pavers/pervious pavements, tree box planters, subsurface infiltration units, rain gardens, rain barrels/cisterns, and so on.[136] What follows are short descriptions of some of the aforementioned tools, since examples of these technologies in action will fill the case study portion of this chapter.

Chapter 1 delineated the effects of impervious surfaces on watersheds, and permeable pavers/pervious pavements are happy mediums that simultaneously allow for urban development and infiltration. The permeability of porous pavers and pavement, unfortunately, makes them unable to support high-traffic volumes, and, thus, the technology can only be employed in certain areas; pavers are often used in sidewalks and patio areas, while porous pavement is a good option for "low-volume parking and service areas."[137] The structure of a porous pavement system is similar to the

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[133] Girling, Cynthia and Kellett, Ronald. *Skinny Streets & Green Neighborhoods: Design for Environment and Community*. Washington, DC: Island Press, 2005, p 19-50.

[134] Dobson, Clive and Beck, Gregor Gilpin. *Watersheds: a Practical Handbook for Healthy Water*. Buffalo, NY: Firefly Books, 1993, p 87.

[135] Hirsch, Tim. "Katrina damage blamed on wetlands loss", 1 November 2005. BBC News. Retrieved online on 29 January 2009 at: http://news.bbc.co.uk/2/hi/americas/4393852.stm.

[136] Urban Design Tools website. "Introduction to LID," 1-8. Retrieved online on 6 October 2008 at: http://www.lid-stormwater.net/background.htm, p 2.

[137] Northern Virginia Soil and Water Conservation District and ATR Associates, Inc. *The Workhouse Arts Center at Lorton Low-Impact Development Design Report*, January 2005, p 117-125.

bioretention units, except that the surface layer is paved rather than vegetative. The function— to increase infiltration—is identical.

Another option when no natural areas are available for drainage, is subsurface infiltration. As the Workhouse Arts Center at Lorton case study will demonstrate, this involves connecting building downspouts and storm drains to underground storage areas that allow for infiltration.[138] This is a great option for historic buildings because, once installed, the underground system is invisible and does not interfere with the aesthetic of the resource or its landscape.

A historic practice that has found new life in the "green revolution" is the use of cisterns and rain barrels for capturing runoff. Used by civilizations for thousands of years, cisterns mostly disappeared in modern society with the advent of public water systems and the introduction of a seemingly endless supply of water. However, the recent droughts and the move towards a "green" planet have put household rainwater catchment back in vogue. Ranging from 55-gallon drums that connect to a single downspout to 1000+ gallon cisterns that connect to multiple downspouts, rain barrels can supply water for household plants and car washing, while cisterns can supply enough water for larger jobs like watering the Founders Memorial Garden.

The final tool to touch on before moving into the case study examples is the green roof. Because they attempt to restore infiltration to and reduce runoff in urbanized areas, green roofs technically fall under the rubric of LID, though they are essentially a category unto themselves. The general public is much more likely to be familiar with the idea of green roofs than with LID, yet green roofs actually employ a number of LID

[138] *Ibid*, p 109-110.

technologies at the same time and, as such, can serve as a good entry point for introducing people to the technologies and concepts associated with LID.

"Green roofs, also known as vegetated roof covers, eco-roofs or nature roofs, are multi-beneficial structural components that help to mitigate the effects of urbanization on water quality by filtering, absorbing or detaining rainfall."[139] They are usually installed on flat roofs and, thus, are ideal for commercial, public, and urban buildings. A green roof consists of a series of layers built above the roofing membrane that include root barriers, insulation, drainage and aeration, growing medium and the vegetative cover itself.

Green roofs are generally considered compatible with historic buildings because they do not alter the appearance—though this is debatable since, in the example of an urban area like Chicago, they can be seen from the taller surrounding buildings. This compatibility is evidenced by the green roof on Chicago's century-old City Hall and by the citywide Chicago initiative to install green roofs on all public buildings and to provide grants for their installation to both commercial and residential property owners.[140] Green roofs decrease stormwater runoff, reduce building temperatures, and can provide a peaceful garden space for people and urban wildlife like birds and butterflies. It is also worth noting that many of the conservation practices—including green roofs—that are promoted by LID are similar to those recognized and promoted by the US Green Building Council (USGBC) in its LEED (Leadership in Energy and

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[139] *Ibid.*

[140] City of Chicago Department of Environment website. Retrieved online on 28 August 2008 at: http://egov.cityofchicago.org/city/webportal/portalDeptCategoryAction.do?BV_SessionID=@@@@0116461400.1236886891@@@@&BV_EngineID=cccfadegjlhmelkcefecelldffhdfho.0&deptCategoryOID=-536889313&contentType=COC_EDITORIAL&topChannelName=Dept&entityName=Environment&deptMainCategoryOID=-536887205.

Environmental Design) rating system; buildings attempting to receive LEED certification can obtain up to 2 credits for stormwater-related retrofits.[141]

Figure 7: Chicago City Hall – Green Roof: *The 20,000- square-foot green roof on Chicago's City Hall "can retain 75% of a 1- inch rainfall before there is stormwater runoff into the sewers"*[142]

Having explored and defined many of the different technologies associated with LID, it is important to note that, "the more techniques that are applied, the closer to natural hydrologic function one gets."[143] Traditional stormwater management systems are designed to handle the maximum capacity loads of a 100-year flood or storm, which means that they are designed to move water along as quickly as possible. Unfortunately, during the more frequent and moderate precipitation events, this efficiency tends to over drain and degrade the watershed "by rapidly transporting pollutants through the

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[141] US Green Building Council website, various pages. Retrieved online on 23 June 2009 at: http://www.usgbc.org/DisplayPage.aspx?CategoryID=19.

[142] City of Chicago Department of Environment website.

[143] Urban Design Tools website. "Introduction to LID," 1-8. Retrieved online on 6 October 2008 at: http://www.lid-stormwater.net/background.htm, p 5.

urban area and into the receiving waters" from which the water supply is drawn.[144] As the following case study examples will illustrate, LID not only uses a variety of decentralized site-based source controls to efficiently manage stormwater, but it also uses this runoff to manage existing and create additional water resources.

Case Studies

Beginning with some examples that are located in Athens, Georgia, this case study analysis will then move on to a few examples from other areas, whose incorporation of multiple LID technologies has resulted in up to 100% stormwater runoff capture. The first example, located on UGA's North Campus, is the Lumpkin House at the Founders Memorial Garden. Several of the gutters and downspouts on the rear of the 1850s Greek Revival house are designed to terminate in a 540-gallon cistern, located on the house's south façade.

Figure 8: The Lumpkin House: *The Lumpkin House at the Founders Memorial Garden* (photo by S Stucker)

[144] *Ibid*, p 5.

The gutter and downspout that is directly connected to the cistern runs along the east façade of the house that borders the courtyard and is a collector for runoff that is directed into it from several of the roof surfaces; because it must handle larger volumes than the average gutter, the collector has a diameter of 9 inches, versus 6 inches for the regular gutters. However, because the Lumpkin House is an important historic resource and a symbol for both the Historic Preservation program and the University as a whole, the faculty and staff that were involved in this retrofit applied strict scrutiny to the selection of a historically compatible gutter. A barrel gutter design with a plain white color was selected, and, as such, the oversized collector gutter does not stand out. Similarly, the cistern is hidden behind an existing lattice screen on the least trafficked side of the house and, thus, does not detract from the integrity of the resource.

Figures 9 and 10: The Lumpkin House – Gutters and Downspouts: *The gutters and downspouts for nearly half of the roof surfaces tie together (left), directing water into the larger collector gutter (right), which terminates in the cistern* (photos by S Stucker)

Currently, the gutters and downspouts for the rear of the second story and the gutters that service the courtyard façades of the house all direct their rainwater loads into the cistern. Before entering the tank, the water must pass through a first-flush filtration system that removes leaves and other debris that would clog the tank and muddy the water. When the cistern has filled to capacity, water can overflow through a pipe projecting from the top of the cistern—similar to the pressure release valve on a water heater. The cistern is connected to a system of pipes and pumps that can distribute the water to areas of the garden that are hundreds of feet from the cistern, and the stormwater that is captured is used as a backup source for the drip hoses during periods of water restrictions, which have been quite frequent during the past few years. Future plans call for a second cistern to which the gutters and downspouts on the front of the house could be connected, thus doubling catchment capacity to 1080 gallons.


Figures 11 and 12: The Lumpkin House – Cistern: *Water from the collector gutter passes through a filter (left), that removes leaves and other debris, before settling in the 540-gallon cistern (right)* (photos by S Stucker/Kim Kooles)

While the amount captured is just a fraction of the water needed to maintain the garden—UGA Founders Garden Estimated Applied Irrigation Water Use Calculation figures that three days of watering per week in the peak month of July requires 37,000 gallons of water per week—UGA *does* have a campus policy that "every drop counts."[145] As such, a second cistern would double the benefits. Even better would be to follow through with one or both of the feasibility studies conducted by Bob Scott Irrigation Consultant Services in 2007.

Published in January 2007, the first study evaluated a proposal to harvest condensation water from Caldwell, Denmark and Brooks Halls, as well as rooftop and condensate water from the Lumpkin House; the study found that this amount of captured runoff—4,770 "gallons per day during the summer cooling season"—would be sufficient to support the Founders Memorial Garden irrigation system.[146] Not only would this system fulfill the garden's watering needs, but it would also give water that would otherwise run off into storm drains an opportunity to infiltrate and replenish groundwater sources.

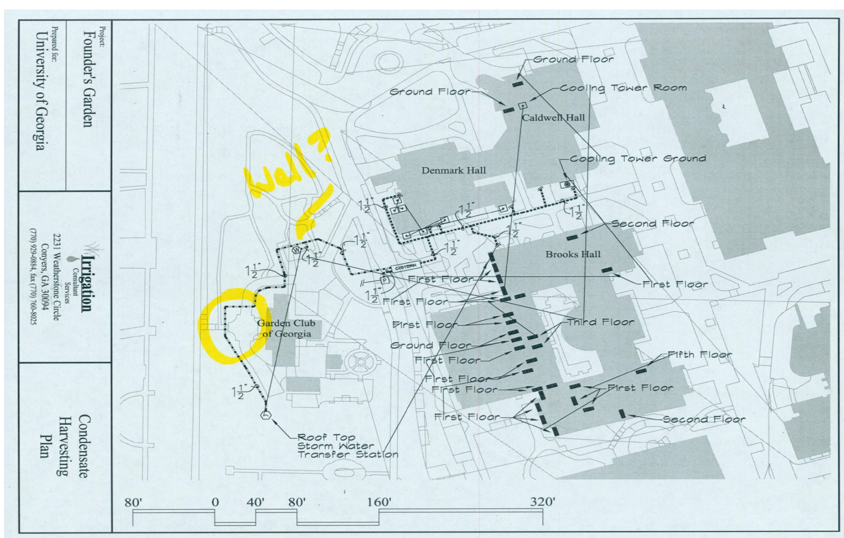

Figure 13: Condensate Harvesting Plan – UGA: *The condensation from HVAC systems for UGA buildings could supply enough water to support the Founders Memorial Garden*[147]

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[145] Bob Scott Irrigation and Consultant Services, Inc. *Landscape Irrigation Water Harvesting Evaluation: Founders Garden*, 31 October 2007, p 6.

[146] Bob Scott Irrigation and Consultant Services, Inc. Landscape Irrigation Surrounding Building Condensation Water Harvesting Evaluation: Founders Garden, 10 January 2007.

[147] *Ibid*, p 22.

The details of the system are quite complicated, but they essentially involve a maze of pipes connecting the HVAC components from all four buildings and the gutters from the Lumpkin House to a cistern located below the Brooks Hall Administration Parking lot. The cistern would have a capacity of 30,000 gallons, or "just below one week water cycle", and could also be connected to an irrigation well that would supplement the cistern during cooler months.[148] The entire project was estimated to cost in the $200,000 range, but, since current Athens-Clarke County water rates for non-residential users that use more than 25% over the annual average are $7.68 per 1,000 gallons, the University would recoup its investment through the money it saves on garden-watering costs in under two years (this is based on calculations done by the author using the project cost, the water rate and the gallons-per-week watering amount listed above; even at lower-tier rates, the investment could be recouped within 4 years). In addition, such a system would divert current runoff towards more beneficial uses for both the University and the environment.

The other study was published in October of 2007, and it evaluated the more modest proposal of harvesting rooftop and condensate water only from the Lumpkin House.[149] The details of the system are similar to the one discussed above, though the cistern would be located nearer the Lumpkin House and the cost would be under $70,000. In addition, the amount of water captured would be far less than in the other proposal, and, despite the water that would be available from the back-up well, the time it would take to recoup the investment could be considerably longer. However, the

[148] *Ibid*, p 5.

[149] [149] Bob Scott Irrigation and Consultant Services, Inc. *Landscape Irrigation Water Harvesting Evaluation: Founders Garden*, 31 October 2007, p 4.

University and the garden intend to remain for some time, and, as has already been established, the benefits of stormwater harvesting go beyond just money savings. Unfortunately, the current economic climate makes it unlikely that the University will act on these proposals any time soon, but at least the proposals are there for the future.

Further hope for such proposals exists since there is already a cistern installed and in use less than a thousand feet away at the Military Science Building (ROTC). The downspouts from the roof of the ROTC building are tied together in pipes underground and directed to the 5,100-gallon cistern, which is actually three 1,700-gallon tanks piped together to save costs; the cistern supplies water for the irrigation system for the Memorial Garden that sits between the ROTC building and the Student Learning Center.[150] "The Memorial Garden was the first implementation of both a cistern for rainwater harvesting and sub-surface drip irrigation in turf areas."[151]

Figures 14 and 15: Military/ROTC Building: *Built in 1941, the ROTC Building's (left) down-spouts and gutters terminate underground (right) in a cistern* (photos by S Stucker)

[150] Kirsche, Kevin. "Military Science Bldg / Memorial Garden Cistern," informational email from UGA Office of University Architects project files. Received on 19 March 2009.

[151] University of Georgia Office of University Architects. *University of Georgia Memorial Garden: PDF #2 Submittal*, 2009, p 10.

When the cistern fills to capacity, the overflow spills back into the storm drainage network underground. Like the Lumpkin House cistern, there are filters installed to catch leaves and debris from the roof. Essentially, these are screened boxes—through which water can pass but debris cannot—that must be shaken out by hand every few months, especially in the Fall when leaves are dropping.[152] This pilot project has helped pave the way for three other cisterns on campus (not counting the Lumpkin House), and it has also helped to encourage "planting native, sustainable plants on campus which require little to no irrigation."[153] Unfortunately, since the cisterns are buried or otherwise hidden, public knowledge of them is minimal; perhaps the university could advocate these projects through some form of subtle signage or an online tour of innovative stormwater management tools and techniques, linked to the "Virtual tour" on the "Campus" page of the UGA website.

Figures 16 and 17: Military/ROTC Building – Cistern/Aerial View: *Three 1700-gallon tanks linked together (left) are buried behind the ROTC building and are used to irrigate the Memorial Garden, shown under construction (right)*[154]

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[152] Kirsche, Kevin. "Military Science Bldg / Memorial Garden Cistern," informational email from UGA Office of University Architects project files. Received on 19 March 2009.

[153] University of Georgia Office of University Architects. *University of Georgia Memorial Garden: PDF #2 Submittal*, 2009, p 10.

[154] Kirsche, Kevin. "Military Science Bldg / Memorial Garden Cistern," informational email from UGA Office of University Architects project files. Received on 19 March 2009.

In addition to these examples of historic campus buildings incorporating stormwater capture technologies, the cistern at the Paul Coverdell Center (built 2005) and the green roof on the newly constructed Lamar Dodd School of Art (built 2008) are both proof that the University has a commitment to employing environmentally sensitive designs and technologies in the future. As a major landholder and stakeholder in Athens and Georgia as a whole, UGA's promotion of LID and green design in general could have far-reaching and long-lasting positive effects.

Another local example is found just a few blocks north of campus at the Athens Welcome Center, which has a pervious parking lot. Located in the circa 1820s Church-Waddel-Brumby House, the Athens Welcome Center is a first stop for many tourists that visit Athens, and, as such, the parking lot could serve as an educational example for teaching the public about LID technologies. Of course, while a parking lot obviously detracts from the aesthetic of a historic resource, the Welcome Center *must* have parking, and at least the parking lot in question is doing its part to contribute to infiltration and reduce stormwater runoff. Other pervious parking areas exist around Athens, and, thanks to the expertise of such people as Professor Bruce Ferguson and Professor Alfie Vick at UGA's College of Environment and Design, there is a continued awareness of the benefits of this and other stormwater management technologies.

A final local example is another case of a feasibility study that has not yet been actualized. The local government commissioned a study in the spring of 2007 to evaluate the proposal to install a green roof on the east balcony of ACC City Hall.[155] The

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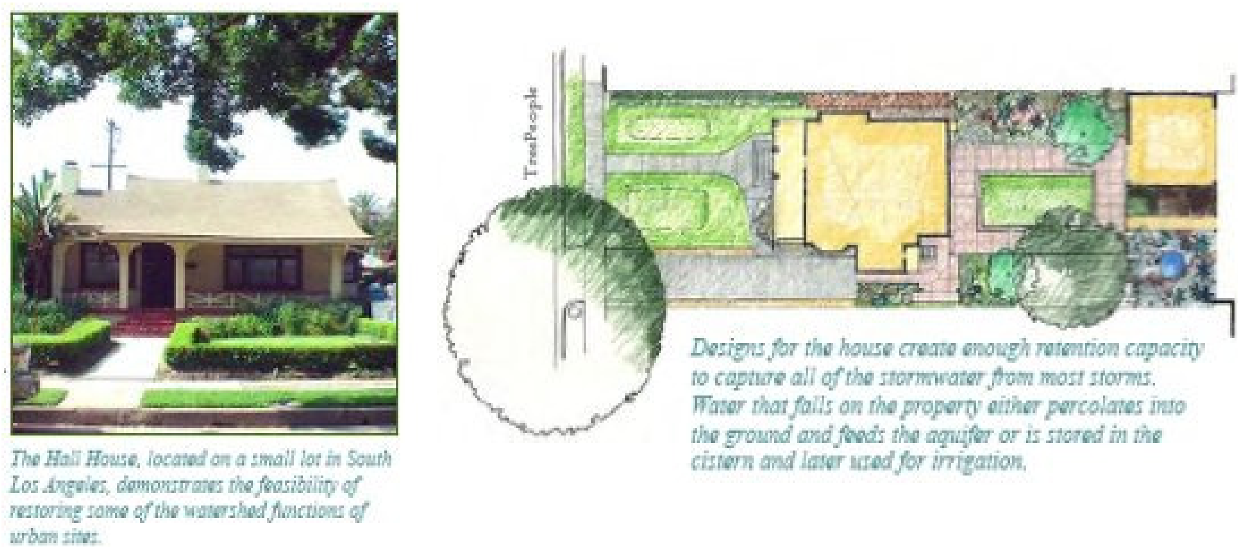
[155] Andros, Tammy and Maclin, Ted. *Green Roof Proposal and Guide: Athens-Clarke County City Hall*, a Spring 2007 project of the UGA Environmental Practicum for the UGA

unified government intended this to be a pilot project that would spur improvement in other stormwater management practices in the downtown Athens area, provide an opportunity for public education about stormwater management, and serve as a guide for evaluating future green roof projects.

A comprehensive report was produced and is available on the UGA River Basin Center's website; in addition to the design and budget details, the report even addresses the fact that City Hall is located within the nationally and locally designated Downtown Historic District, and, as such, the green roof would be subject to design restrictions and Historic Preservation Commission review.[156] As with the Founders Memorial Garden proposals, this plan is not yet a reality, but the study *is* a foundation for a future project.



Figures 18 and 19: The Hall House – Stormwater Retrofit Design [157]

River Basin Center. Retrieved online on 11 September 2008 at: http://www.rivercenter.uga.edu/education/upper_altamaha/pdf/greenroof_acc_spring2007.pdf.

[156] *Ibid*, p 24-7.

[157] Ben-Horin, Edith. *Rainwater as a Resource: A Report on Three Sites Demonstrating Sustainable Stormwater Management,* 2007. Retrieved online on 25 October 2008 at: http://www.treepeople.org/files/Rainwater_as_a_Resource.pdf, p 6.

Moving on to some non-local examples, the first stop is the Hall House in Los Angeles. Identified as an "early twentieth century . . . Craftsman-style bungalow house," the TreePeople organization selected this site as a demonstration project that would use "a variety of BMPs that illustrate some of the greening options available to homeowners or developers interested in managing their properties as miniature watersheds."[158] Because restricted financial resources limited TreePeople to a single charrette design test project, the organization was intent upon executing a design with the greatest potential for replication and for inspiring policy shifts towards greater sustainability; considering the predominance of single-family homes in Los Angeles and in the United States as a whole, the Hall House was a logical choice.[159]

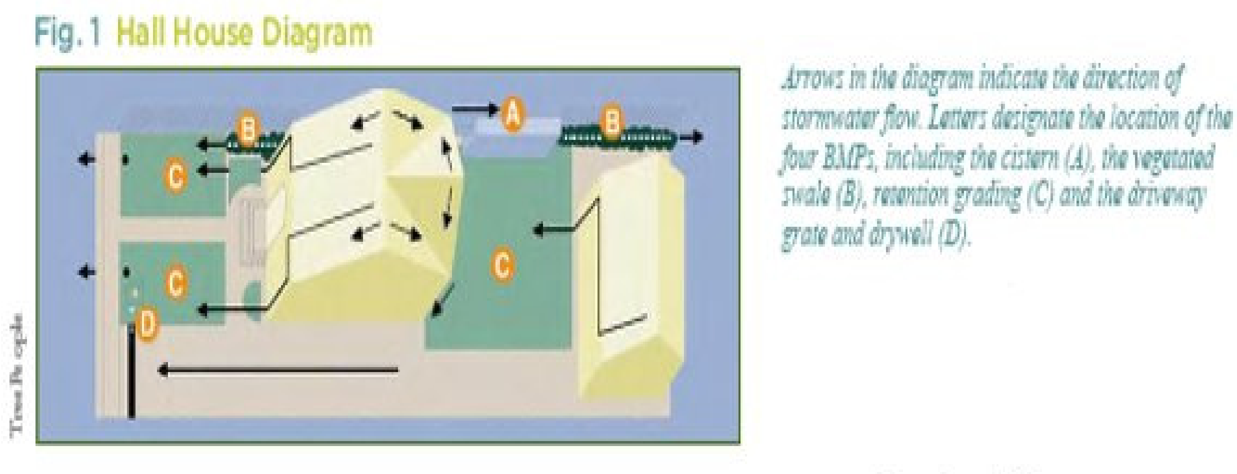


Figure 20: The Hall House – Technologies Diagram[160]

A test of the system following its installation demonstrated that the "combination of technologies . . . used at the site, including retention grading, *swales* and a *cistern*," ultimately resulted in on-site management of 100% of the stormwater that fell on the

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[158] *Ibid*, p 6.
[159] *Ibid*, p 5.
[160] *Ibid*, p 8.

property.[161] The retention grading, the swale and the driveway grate with its bioretention drywell all promote infiltration and prevent water from leaving the property; the swale also collects yard clippings that help to slow the flow of stormwater and filter pollutants from it, while also reducing the amount of yard waste that goes to the landfill. In addition, "a roof-wash unit collects the first-flush water that falls during the first part of a storm and sequesters it long enough so that gravity can settle out the buildup of" constituents before filling the two 1,800 gallon cisterns with clean water for the irrigation system.[162]

The sunken lawn panels, elevated at the perimeter to ensure retention capacity, provide temporary storage for up to 5,800 gallons and allow water to infiltrate into the ground and replenish the aquifer.

The driveway grate, an unobtrusive addition to the property, directs stormwater down into the underground drywell.

Once water passes through the driveway grate, it flows underground through sand and crushed rock. The system filters water and retains it until it can be absorbed by the ground below.

Figures 21 and 22: The Hall House – Bioswale and Driveway Grate/Biofiltration Unit[163]

[161] *Ibid*, p 5-13.
[162] *Ibid*, p 8.
[163] *Ibid*, p 9.

As the diagrams and photos illustrate, the stormwater management technologies that were applied at the Hall House are unobtrusive, highly effective and easy to replicate. The biggest impediment to replication, though, would probably be cost, since the price tag on the project was close to $30,000.[164] However, as with any new technology, increased demand for these kinds of retrofits will drive down their cost, as will the incentive of reduced stormwater utility fees. Moreover, these retrofits could easily become standard practice for new construction, and—in terms of retrofitting historic houses—they are the kinds of modifications that are unlikely to cause problems for a historic preservation commission, since they don't damage the integrity of the resource.

This case study is now over 10 years old, and it is obviously still a unique example, since the number of retrofits that are as comprehensive as the Hall House is still very few. However, the TreePeople report that this project has helped to educate the general public, "city leaders and agency representatives, fostering support and enthusiasm that has helped shift policy around the region."[165] The University of Georgia and Athens could follow a similar path by continuing to implement innovative designs—like a green roof atop City Hall—and by using the existing examples as tools for public education and advocacy—like a display about pervious pavements in the Welcome Center parking lot.

Returning to the eastern United States, the next example is the Guildford Farm Conservation Development (GFCD), a 250-acre farm located in southern Greene County, Virginia. The site contains a circa 1790 farmhouse, a historic cemetery and a

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[164] *Ibid*, p 10.
[165] *Ibid*, p 13.

variety of scenic views, and, after purchasing the land to develop a new subdivision, the project developer became enamored with the beauty and the history of the site and, subsequently, sought help from the Blue Ridge Foothills Conservancy (BRFC) "to explore something better than a conventional development on an old farm."[166] The result is a 35-lot conservation development—with a 150-acre wildlife preserve and over a mile of stream buffers along important waterways—that makes use of a variety "of LID practices on roads and house lots to manage storm water runoff and maintain current hydrology."[167]

Figure 23: Guildford Farm Conservation Development - Aerial View: *The developer of GFCD wanted to preserve the area's natural beauty and its historic resources*[168]

Because the context of southern Greene County is one that is defined by the area's rural character and its scenic nature, the preservation of both the farm house and

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[166] *Guildford Farm Conservation Development: Cooperative Conservation Case Study*. Retrieved online on 6 October 2008 at: http://www.cooperativeconservationamerica.org/viewproject.asp?pid=648.

[167] *Ibid.*

[168] Guildford Farm website, various pages. Retrieved online 9 October 2008 at: http://www.guildfordfarm.com/.

over 150 acres of natural land was seen as integral to a successful development. The farm house is now the residence of the project developer, and, despite its having been remodeled to an extent, it remains standing, and it remains standing in its original rural context. Moreover, the LID Integrated Management Practices (IMPs) used on the roads and house lots—which includes pervious roads absent traditional curbs and gutter systems and "infiltration trenches and biofilters to manage driveway and roof runoff"—contribute to conserving the natural hydrology of the site.[169]

Figure 24: GFCD – LID Design Components: *LID and preservation working together*[170]

The conservation ethic of GFCD is plainly stated on the Guildford Farm website, and the Landowner's Manual is designed "to ensure continued maintenance of LID and

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[169] *Guildford Farm Conservation Development: Cooperative Conservation Case Study*. Retrieved online on 6 October 2008 at: http://www.cooperativeconservationamerica.org/viewproject.asp?pid=648.

[170] Culpeper Soil & Water Conservation District website, various pages. Retrieved online on 6 October 2008 at: http://culpeper.vaswcd.org/.

conservation practices."[171] The introduction on the homepage of the website is, in fact, a short lesson in rural preservation and the important role that proper stormwater management plays in protecting water resources. GFCD sells itself on its "Views Views Views," its "proximity to a 140-acre fully functioning farm graced by the Guildford Farm Manor House," and its adherence to Low Impact Development IMPs for both roads and homes; in other words, Guildford's sales pitch, as well as its success, is based on preservation and conservation planning.[172]

Remaining in Virginia for the final case study, the Workhouse Arts Center at Lorton (WACL), located in Fairfax County, Virginia, is a historic site rehabilitation that is dedicated to employing LID practices in every way possible. In 1910, the US Government acquired land along the Occoquan River and built the Occoquan Workhouse. In 1913, the workhouse became the Lorton Reformatory, housing around 60 inmates; by the 1930's, after expanding to house over 7,000 inmates, it became known as the Lorton Penitentiary, serving Washington D.C.[173] The Workhouse, and the Lorton site as it expanded, was placed in a rural setting and organized like a college campus with large classically styled brick dormitory buildings situated around a work yard that resembled a university-style quad. "The belief was that a prisoner's hard physical work, learned skills and fresh air would transform him into a model citizen."[174]

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[171] *Guildford Farm Conservation Development: Cooperative Conservation Case Study*. Retrieved online on 6 October 2008 at: http://www.cooperativeconservationamerica.org/viewproject.asp?pid=648.

[172] Guildford Farm website, various pages. Retrieved online 9 October 2008 at: http://www.guildfordfarm.com/.

[173] "History of the Lorton Complex," Lorton Arts Foundation website. Retrieved online on 24 March 2009 at: http://www.lortonarts.org/the_workhouse.htm.

[174] *Ibid.*

Figure 25: Workhouse Arts Center at Lorton – Historic Photo: *Historic photo of the Lorton Reformatory grounds, situated around the "quad"*[175]

Over time, the prison was filled to overcapacity, and many buildings became badly deteriorated. The Balanced Budget Act of 1997 mandated that the District of Columbia close the facility by December 31, 2001, and, in "July 2002, Fairfax County received title to 2,440 acres of the Lorton Complex and was tasked with the challeng[e]" of how best to use the asset.[176] The first phase of the redevelopment was completed in September 2008 with the opening of the WACL, which is comprised of the aforementioned "brick [dormitory] buildings that will be artists' studios, office space and the exhibit gallery."[177]

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175 Virginia Department of Historic Resources website; image retrieved online on 24 March 2009 at: http://www.dhr.virginia.gov/registers/Counties/Fairfax/DCworkhouseHD_photos.htm

176 "History of the Lorton Complex," Lorton Arts Foundation website. Retrieved online on 24 March 2009 at: http://www.lortonarts.org/the_workhouse.htm.

177 Gowen, Annie. "Lorton Prison Reformed Into Arts Center," *The Washington Post*, August 23, 2007, Page PW10. Retrieved online on 24 March 2009 at: http://www.washingtonpost.com/wp-dyn/content/article/2007/08/21/AR2007082101853.html.

Figure 26: WACL - Aerial View: *An aerial view of the site shows the layout of the buildings*[178]

While the entire Lorton Complex spans over 2,000 acres and consists of over 500 buildings, the 55-acre WACL is the subject of this case study. Not only was the project dedicated to adaptively reusing 234,000 square feet of building space and preserving 40 of the 55 acres as open space, but the Comprehensive Plan also identified the application of LID site design techniques as a primary objective and recognized the opportunity to establish "a demonstrated process for actually assessing, designing, and implementing LID (in [the] case of a redevelopment site) along with quantifying and publicizing its cost and environmental benefits."[179] In other words, this project is a vehicle for preservation and conservation advocacy and education.

The plan, furthermore, promised to "pursue commitments to reduce stormwater runoff volumes and peak flows, to increase groundwater recharge, and to increase preservation of undisturbed areas" through practices that include: minimizing

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[178] Lorton Arts Foundation website, various pages. Retrieved online 7 October 2008 at: http://www.lortonarts.org.

[179] Northern Virginia Soil and Water Conservation District and ATR Associates, Inc. *The Workhouse Arts Center at Lorton Low-Impact Development Design Report*, January 2005, Appendix 10 and Attachment A.

impervious surface areas, conveying drainage from impervious to pervious areas, encouraging tree preservation rather than replanting to fulfill tree cover requirements, using conservation easements, and employing a range of LID IMPs.[180] If any more proof of the project's dedication to preservation is needed, the top 3 issues listed under the "Analysis and Recommendations" section of the plan are the Laurel Hill Greenway, Cultural Resources and Stormwater Management.

The "Executive Summary" of the *Low-Impact Development Design Report* states:

> It is anticipated that with the implementation of the structural IMPs presented in this Design Report, as well as the other IMPs that must be developed as the final grading plan is prepared, approximately 90% of the pre-development hydrologic character of the area will be restored.[181]

This 90% restoration is made possible with the use of 3 main IMPs—bioretention facilities, infiltration galleries and porous pavers and pavement.[182] The remainder of this case study will briefly examine how these technologies are employed at the Workhouse Arts Center.

Prior to the implementation of LID IMPs, an extensive "Environmental Setting" study was undertaken to determine the "the most important environmental aspects"—precipitation amounts and soil specifics.[183] The rates of precipitation and the types of soils on site are used to determine the types of IMPs used. For example, studies found that "in order to restore the natural hydrology of the site, the initial 2.66 inches of runoff from each storm should be infiltrated into the soil," while the rest should be allowed to

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[180] *Ibid*, Appendix 10.
[181] *Ibid*, Executive Summary.
[182] *Ibid*, Executive Summary.
[183] *Ibid*, p 1.

run off naturally or into traditional stormwater conveyance systems.[184] In addition, initial tests suggested that the soils on site were "urban soils" and were not amenable to infiltration; however, soil tests taken in the general area of the WACL confirm that the upper native soils had been removed over the years of development and that the original hydrology would have supported greater levels of infiltration.[185]

The primary IMP used at the WACL is bioretention, and the site features both "connected" and "disconnected" bioretention units.[186] The "connected" units serve the parking areas and are designed as 10-foot median strips that receive the runoff from the parking lots. The medians contain a 2-foot grass buffer on each side and a depressed central planting area that allows for "ponding" of the runoff as it awaits infiltration. The diagram also shows the piping system that connects the bioretention units to the traditional stormwater system for draining "runoff volumes in excess of the target infiltration amount."[187]

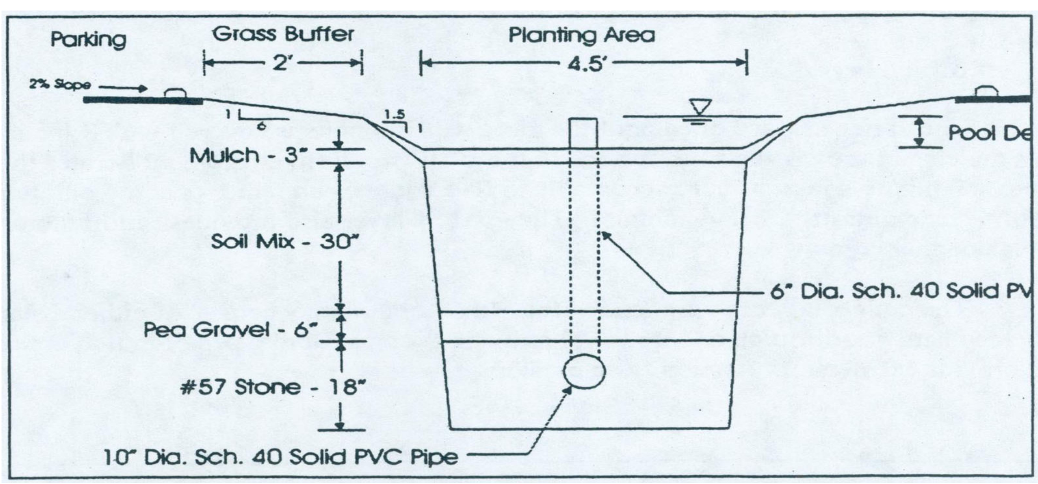

Figure 27: WACL – Biofiltration Unit: *Diagram showing a cross-section of a connected bioretention unit*[188]

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[184] *Ibid*, p 4.
[185] *Ibid*, p 7.
[186] *Ibid*, p 9.
[187] *Ibid*, p 9-12.
[188] *Ibid*, p 9.

More directly connected to the historic buildings are the thirteen "disconnected" bioretention areas, which serve various out-buildings at the WACL.[189] This IMP is proposed for buildings "that are not adjacent to large grassy areas where the roof runoff can be distributed" or where other factors hinder runoff distribution; the primary difference between these units and those in the parking lots is that these do not have drain piping, and excess water is conveyed to a surface water source through a grass-lined swale that slows the runoff and allows for additional infiltration.[190]

Because the historic buildings in the central building area are so closely spaced, the alleys between the buildings will not support grassy areas for infiltration. Instead, subsurface infiltration galleries—as discussed in the first part of this chapter—are located between the buildings and are connected to the downspouts. Water is received in the collection box and then sent at a measured pace into the infiltration chamber; as with the "connected" bioretention units, when the water level overtops the collection box, the excess is discharged into the storm sewer system.[191] These units are invisible from the surface and the alleys are simply sidewalks that serve as corridors "into and out of the central courtyard."[192]

Finally, in instances where bioretention and subsurface infiltration units were not feasible, porous pavers and pavements were sometimes used. For certain sidewalk and patio areas "interlocking block pavers that incorporate small openings or spaces between the pavers, which are filled with coarse sand to promote drainage" were used,

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[189] *Ibid*, p 106.
[190] *Ibid*, p 106-7.
[191] *Ibid*, p 109-111.
[192] *Ibid*, p 109.

while porous pavement was used in locations that were expected to be low-volume parking and service areas.[193] Of course, as was already discussed, because porous pavers and pavement cannot support the full loads that regular roads can carry, these IMPs were only employed in selected areas.

In total, the Workhouse Arts Center serves as an ideal example of historic preservation and Low Impact Development working together. "The closing of the penal complex and the region's overall development boom fostered a blossoming in Lorton, a part of the county some residents thought had long been neglected."[194] What is even better is that this development boom has so far been guided by preservation planning principles and has paid a great deal of attention to adaptive reuse of historic buildings and restoration of natural areas and the natural hydrology of the WACL site. One hopes that other developments on the 2,400-acre Lorton site might follow the lead of the WACL and help make Fairfax County, Virginia, a place where preservation and conservation are all part of the same plan.

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[193] *Ibid*, p 117-23.

[194] Gowen, Annie. "Lorton Prison Reformed Into Arts Center," *The Washington Post*, August 23, 2007, Page PW10. Retrieved online on 24 March 2009 at: http://www.washingtonpost.com/wp-dyn/content/article/2007/08/21/AR2007082101853.html, p 1.

CONCLUSION

Our goal is to educate policy makers and the public about the importance of reusing existing buildings as part of our overall efforts to address climate change. We want to quantify the adverse impacts that occur when sound older buildings are abandoned or demolished—and state those impacts in terms that are readily understandable.
-Richard Moe, National Trust President[195]

Richard Moe's statement is supported by the National Trust agenda mentioned in the "Teardown" section of Chapter 2, which states that "the National Trust proposes to undertake a study of the environmental impacts of teardowns."[196] This idea that preservation and conservation should be part of the same plan is a thread that runs throughout this thesis, and it is the concept that guides these concluding remarks.

Built and cultural resources are only as strong as the foundation on which they stand; without proper stewardship of the land, the water and the other natural resources that are vital to the survival of *all* life, there will be no avenue left for cultural or economic advances, nor a planet to support them. Moreover, the "WalMart-ization" of the built environment—bigbox-steel-and-stucco stores and snout houses that are exactly like the next and the next and the next—threatens to erase traditional commercial and residential forms and cultures. If all that is left are polluted parking lots and buildings that are destined for the landfill or abandonment within 20 to 30 years, then what is the point?

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[195] Young, Dwight. "Building on What We've Built," *Preservation: the Magazine of the National Trust for Historic Preservation*, January/February 2008, p 7.

[196] National Trust for Historic Preservation. "Prioritized Research Agenda National Trust for Historic Preservation Sustainability Initiative." Retrieved online on 14 January 2009 at: http://74.125.47.132/search?q=cache:F0UoielpMWQJ:www.aia.org/SiteObjects/files/NTHP%2520Draft%2520Research%2520Agenda%25202008%252004-21.pdf+DRAFT+Prioritized+Research+Agenda+National+Trust+for+Historic+Preservation+Sustainability+Initiative&hl=en&ct=clnk&cd=1&gl=us&client=firefox-a, p 4.

Figure 28: Snout Houses!: *The aforementioned snout houses prominently feature their garages*[197]

Fortunately, certain segments of society recognize the importance of preservation- and conservation-based planning, and, fortunately, many of these people and organizations are working to inform politicians and the public of the significance of preservation planning. For example, the National Trust prominently features sustainability on its website, and, in fact, as of March 2009, preservationnation.org features green-colored hyperlinks and banners, and the first image in the slideshow advertises the Preservation Green Lab. "As a key component of the National Trust for Historic Preservation's Sustainability Program, the Preservation Green Lab will focus on" promoting the development and implementation of policies that support green retrofits and adaptive reuse, and it will also provide support to groups looking to go green, both by launching green retrofit pilot projects across the country and by serving as

[197] "Snout house," *Wikipedia: the Free Encyclopedia.* Image retrieved on 26 March 2009 at: http://en.wikipedia.org/wiki/File:Snouthouses.jpg.

a clearinghouse for information that "navigat[es] the intersection of historic preservation and sustainability."[198]

Not only does preservationnation.org teem with sustainability resources for its visitors, but the Trust's broad range of partnerships gives the conservation of built and natural resources a powerful voice and a place at the decision-making table from "state historic preservation offices to local Main Street programs, from citywide preservation organizations to national environmental groups to corporate America."[199] All of the information contained in the preceding pages does not amount to much if there is no public or policy to support it. Of course, anyone can install a rain barrel, but taming a local teardown epidemic or successfully completing a rehab project like the Workhouse Arts Center does not happen without policies and a comprehensive plan based on sustainable asset management and community preservation.

For a more local example, Chip Wright, Historic Preservation Planner for the Georgia Mountains Regional Development Center, has lectured on the idea that regional preservation planning requires that attention be paid to much more than just historic resources.[200] "Y'all probably aren't familiar with TMDL reports," Wright said during one lecture. "TMDL, that's Total Maximum Daily Load; they're reports that measure the amount of pollutants in waterways. I end up writing those things all the time." He stresses that it is difficult to talk about regional preservation planning without talking about planning at the larger level, which includes growth and economic development, cultural and environmental resources (like water), housing and community,

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[198] National Trust for Historic Preservation website, various pages including "Sustainability" and "Find Funding". Retrieved online on 17 November 2008 at: http://www.preservationnation.org.

[199] *Ibid.*

[200] Wright, Chip. Lectures for HIPR 6850: Historic Preservation Planning Studio, Spring 2009.

transportation and so on; furthermore, he emphasizes the importance of considering conservation and preservation as part of the same plan—preferably as the foundation of the plan.

For a region like North Georgia, it is imperative that water resources be properly managed. Rivers, streams, and lakes bring millions of tourism dollars a year to the region, and the water that flows from its mountains provides a potable source for tens of millions of people that live downstream. When comprehensive plans and public policies approach growth from a sustainable perspective, these important resources are given greater attention and protections.

Since this thesis focuses more on identifying the intersection between preservation and water management and defining the terms associated with this overlap, a next step in the research might include a closer look at the kinds of plans and policies identified above. How are regional planners incorporating these kinds of issues into their comprehensive plans? How are local governments addressing them in their ordinances and policies? Are there any policy examples at the state or federal level?

Another possibility for further research would be to explore in more detail the contributions of historic building methods and historic neighborhoods. For example, historic buildings were usually sited *within* their landscape, taking into account trees and topography, and were built using hand tools and light machinery; their modern counterparts, on the other hand, are sited *upon* their landscapes, on flat pieces of clear-cut land, and are built using heavy machinery that compacts the earth, drastically disrupting infiltration processes and the hydrologic cycle. Older streets tend to be narrower than newer streets; this means less pavement and more pervious surfaces, and older neighborhoods have simply had more time to heal from the damage done by past development. Further research could identify and quantify the ways in which historic neighborhoods contribute to stormwater management.

Finally, despite the fact that this thesis is dedicated to linking preservation and conservation as synonymous with one another, it would be amiss to suggest that historic preservation, as a practice, has a perfect record when it comes to conservation. The fact that a historic landscape like the Founders Memorial Garden on UGA's North Campus can require up to 37,000 gallons of water per week during peak season, suggests that perhaps we as preservationists must reconsider what is important and what should be preserved. The garden as a whole is important, but could it contain more native plants that might require less water? This is just one example, but it highlights the larger issue of preservation priorities. Historic preservation *is* a multi-disciplinary field, and preservation educators and advocates need to do a better job of recognizing the field's responsibilities towards conservation and of educating its own and the public about the role that preservation plays in the greater sustainability movement.

Whether or not these avenues for further research are pursued, it is essential that planners, politicians and the general public recognize the benefits of preservation and conservation and understand that sustainable communities are realized through plans and actions that are based on heritage conservation. From the headwaters of a river in a National Forest to the storm sewer drains on a residential street, proper care of the natural and built environment is essential to maintaining healthy watersheds.

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