WATERSCAPING: RECONFIGURING THE SAVANNAH RIVER

by

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(Under the Direction of Jon Calabria)

ABSTRACT

The term “Waterscape” and related concepts suggest hybrid systems comprised of infrastructure and natural processes. The concept is a useful one for landscape architects and planners who are increasingly investigating rivers and other aquatic spaces. Waterscape is a potential member of a growing family of contemporary site typologies in design discourse that emphasize inherent processes as well as well as physical form. Identification of this site as a distinct element in the landscape could contribute to the development of a specific sustainable design agenda to address modern issues facing rivers. With the idea of a sustainable design approach for rivers in mind, this thesis asks how designers mobilize those critical conceptions of rivers to reconnect the Savannah River.

INDEX WORDS: Rivers, dams, dam removal, ecological restoration, sustainability, landscape architecture, waterscape, infrastructure

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CHAPTER 1

UP THE CREEK

This thesis begins on the Chattooga River, a rocky rivulet that spills out of the Blue Ridge Mountains, through boulders and over granite ledges, with Georgia and South Carolina looming overhead to the right and left. The river has become known throughout the world for its whitewater rapids, attracting expert paddlers to the rural region as well as novices, who are led down the river by professional guides, an economic boon for Rabun and Oconee Counties, in Georgia and South Carolina respectively. This border river, as it progresses southward toward

Figure 1. A raft approaches a rapid on the Chattooga. (Source: Author)

the sea, becoming the Tugaloo and then the Savannah along the way, is a fascinating transect of the region's physical and ecological, political and economic landscapes.

Designated a Wild and Scenic river in 1974, the Chattooga is an anomaly in the Savannah River basin (US Forest Service, n.d.). Much of the river has been parceled out into various hydraulic infrastructures, with dams and reservoirs where rapids and rivers once flowed. But these dams may no longer be necessary, or may not be the best technology to accomplish what we ask of rivers. Changing needs mean that some of those contained rivers could one day be a little more wild, and a little more scenic once again.

The Five Falls are the Chattooga's signature rapids, the wildest and most intimidating part of the river. In quick succession, paddlers must navigate a narrow gorge dominated by a series of formidable Class V drops, the most severe ranking for whitewater. Should they survive the raging Five Falls, paddlers are delivered onto the placid waters of Lake Tugaloo, a quiet hydroelectric reservoir ringed by sugarloaf Appalachian hilltops. This point is the last time this water will flow freely for hundreds of miles. From here on down to the Atlantic Coastal Plain—where the river is by then known as the Savannah—this water is checked in a series of nine dams. These impoundments entirely mask the river's original contours, save for a few short stretches peeking through below these dams, a bitter reminder of how much has been lost.

After a calm paddle across Lake Tugaloo, paddlers disembark at a boat ramp, where Old Bull Sluice Road touches the lakeshore. The road was named for a mighty rapid, known as Bull Sluice, but today paddlers (and fishermen who bring their jonboats to the lake) see only calm water. Old Bull now lies submerged beneath silt and still water, well below the surface of Lake Tugaloo. But could Old Bull breathe again?

Dams are coming down across the country, especially in the Pacific Northwest, where public support for restoring wild salmon runs has helped to steer government and energy company officials toward restoring a number of rivers. It gives hope that the Savannah watershed's own anadromous fishes—American shad, Atlantic and shortnose sturgeon—could return to their old spawning grounds, as their Pacific cousins do. Could American shad one day swim freely all the way up to Old Bull? Maybe, but the river they swim through won't be the same, and they will be sharing it with a variety of human users and structures. This journey up and down the river, from the Chattooga to the Savannah, is a transect by which this thesis will evaluate the infrastructure of the Savannah River Basin, and explore alternative futures for the river system.

RATIONALE

Rivers provide a variety of ecosystem services that benefit human communities. They provide drinking water for nearby communities, and also carry away treated wastewater. Buffers along river corridors contribute to the quality of that water. In addition, they provide habitat and contribute to the health of fisheries, even impacting ecosystems hundreds of miles downstream in estuaries. This is the case with the Apalachicola Bay oysters, an important industry for the region which is heavily dependent on fresh water from the Chattahoochee upstream (Pillon 2014).

The Savannah is an important corridor, not only for aquatic and riparian organisms and nearby communities, but also in a more regional context. It benefits terrestrial and avian species, which in turn provide their own ecosystem services. The Southeastern Ecological Framework, a document developed by the Environmental Protection Agency that aids in conservation planning, identifies the Savannah as an important component for linking existing habitat nodes (Carr, Hoctor et al. 2002). The report draws heavily on methods for large-scale habitat protection developed in the interdisciplinary field of Conservation Biology, which calls for networks of core habitat reserves connected by protected corridors. The Southern Appalachians, where the Savannah's headwaters are located, are part of the most biodiverse region in the Eastern United States, identified as one of six biodiversity hotspots in the US by the Nature Conservancy (Stein, Kutner et al. 2000).

Several areas along the Savannah River and its tributaries could contribute to the development of such a network. Significant sites include the Chattahoochee National Forest, the Andrew Pickens and Long Cane Ranger Districts of Sumter National Forest, Fort Gordon, the Savannah River Site, and the Savannah National Wildlife Refuge. The Savannah River connects all of these sites, but its viability as a corridor is severely impacted by the lakes that have replaced the river and its floodplains. One of the great challenges of implementing the kinds of corridors that conservation biologists call for is stitching back together a fragmented landscape owned by potentially thousands of individuals and corporations. The unique opportunity offered on the Savannah is that there are so few owners along the montane and piedmont sections of the river. The Federal Government owns the majority of the corridor between the headwaters and Augusta, including over 275,000 acres of open water and buffers surrounding three USACE reservoirs (US Army Corps of Engineers 2013). If those dams came down, not only would a great deal of connectivity be restored, but a massive footprint--a little over half the size of the Great Smoky Mountains National Park (US National Park Service, n.d.)-would become available for habitat reestablishment and restoration.

Beyond these ecological functions, rivers play a broader role for the landscapes they pass through. They are vectors for infrastructure and transportation system, and the economic capital that travels through those systems. They also provide important social functions, from providing recreational and scenic amenities. Just as there are ecological opportunities in the reconnection of rivers, there are also other kinds of benefits that are less often quantified. This thesis will explore the possibilities that arise when those ecological goals are aligned with social and economic opportunities that river reconnection offers.

RETHINKING RIVERS: WATERSCAPES

Environmental restoration is a powerful vision for any site, but especially so for rivers. In spaces like the Savannah, infrastructure, economics, and ecology are so entangled that true restoration is likely impossible. The dams and other projects that have changed these spaces are often significant not only locally, but across large regions. Each of these dams was created for a reason. Hydropower, flood control, and navigation were several of the predominant concerns along the Savannah. More than that, the dams are part of an infrastructure much more expansive than the turbines and spillways. Along the Tugaloo and Tallulah, the Georgia Railway & Power Company (now Georgia Power) built six dams, their associated reservoirs, and 800 miles of transmission lines to light Atlanta and other communities around the state. A company historian described the system as the most developed such infrastructure in the country when it was completed (Manganiello 2010, p 107). In South Carolina, Duke Energy operates a similar but more recently constructed hydroelectric landscape on the tributary Seneca River.

Likewise, the Army Corps of Engineers (USACE) manages its three reservoirs as part of an interconnected system, dubbed the Savannah River Basin, with each reservoir only a constituent “project.” Lake Russell, for instance, currently serves as a pump storage reservoir for Thurmond (known by the State of Georgia, and for the rest of this thesis, as Clarks Hill) downstream (US Army Corps of Engineers 2013, p 6). The Diversion Dam above Augusta captured water for the city's mills, feeding water down a seven mile long canal to a network of waterways weaving through the city (Augusta Canal Authority, n.d.). New Savannah Bluff provided for commercial navigation to Augusta in conjunction with channelization and dredging between Augusta and Savannah (Hale and Jackson 2003).

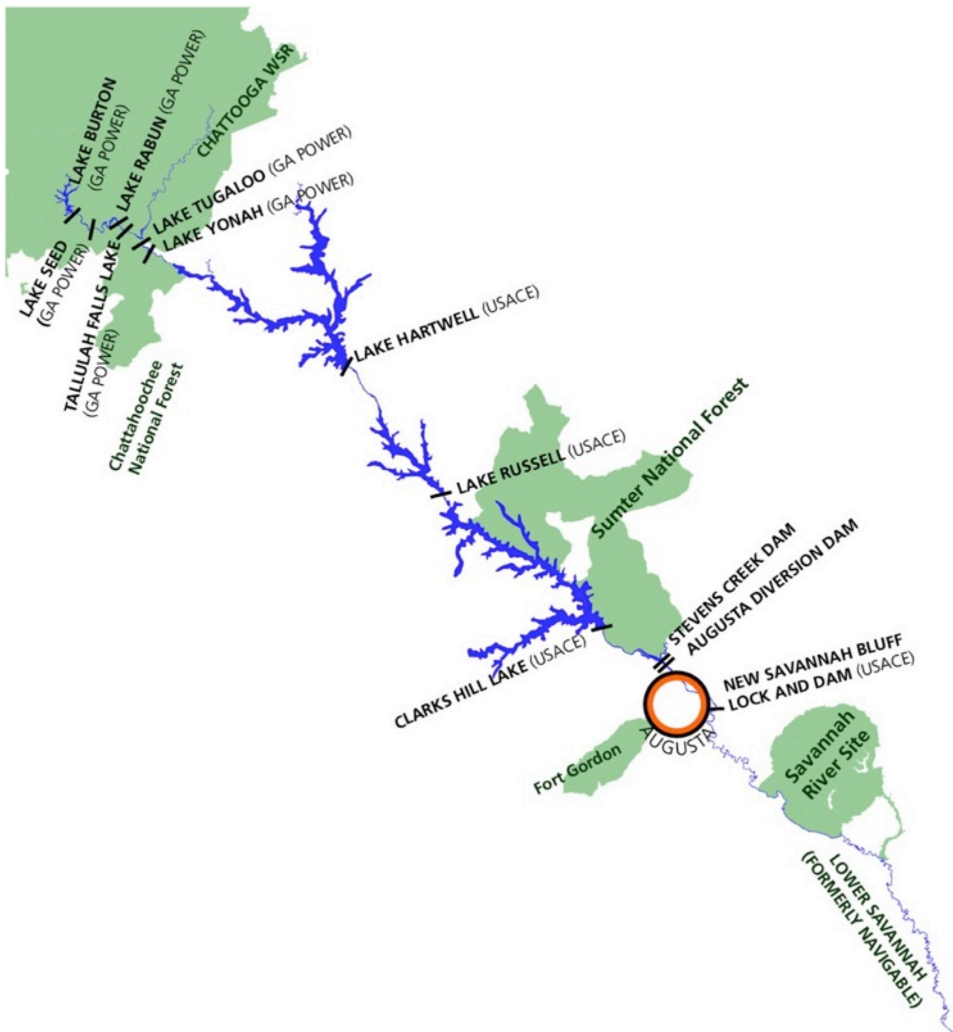

Figure 2. Major Reservoirs and Habitat Areas along the Chattooga-Tugaloo-Savannah Transect (Source: Author)

Even the most comprehensive river management projects, like those of USACE's efforts on the Savannah, which almost completely harness the river's energy, are still beholden to its natural and unpredictable flow. Just last year, in the face of an extremely wet year, USACE opened the floodgates at Clarks Hill, sending water cascading over the dam, and into the front yards of homes in North Augusta, South Carolina. Likewise, when the lakes dry up, there isn't much to be done by public officials, other than to pray (Green 2007).

The vision of a reconnected Savannah isn't new. Advocates like the Savannah Riverkeeper have long pushed for better management of the river, and the removal of dams, with some success. The river between Augusta's shoals and the ocean will largely be reconnected, as part of a legal settlement for disturbances related to the Savannah Harbor Expansion Project. The Savannah Riverkeeper led the suit. The New Savannah Bluff Lock and Dam severed this portion of the river decades ago, as part of a project that included miles of river channelization downstream. The settlement calls for delisting the river as a route for ships above the container port. Once delisted, the river will be left undredged. Its natural patterns of meandering and sediment transport restored. Straightened channels will be removed and oxbows restored, adding miles of habitat back to the river (Sullivan 2013). The upper end of the mitigation effort will reach around the New Savannah Bluff Lock and Dam, which has long restricted fish migration, with an artificial "rock ramp" (Framatome ANP DE&S 2002).

The end result will be a continuous free-flowing river system, reaching from the ocean all the way through the Augusta shoals, and ending at the base of the Augusta Canal Diversion Dam, the first major structure built on the river nearly 150 years ago. That structure, which is in poor health, will also need to be updated with environmental improvements, such as a fish ladder (Pavey 2012). Stevens Creek, just upstream, will also be required to construct a fish passage structure (Robillard 2013).

As the agenda of a reconnected Savannah unfolds, engineers, planners, landscape architects, and other professionals will be called in to redesign the physical infrastructure of the river. Increasingly, these professions have adopted the values of sustainability to guide their work. But rivers are complicated spaces, and the sustainability agenda--as implemented through various design schools and methodologies--isn't fully ready for the complexities that rivers present. Those design approaches are often more focused on cities and terrestrial ecosystems. Rivers are unique, hybrid spaces for which current sustainable design methodologies aren't currently equipped. Part of the challenge may be that conventional site typologies don't often capture river systems in a holistic fashion, and often focus on landscapes or urban environments through which rivers pass, without an appropriate emphasis on the riverine space itself.

Several historians and human geographers have produced a critical dialogue about rivers that defines them as a unique type of space, presenting them as hybrid artifacts of infrastructural and natural processes. Richard White, in his history of the Columbia River, describes that waterway as an "organic machine." White argues that the river and the dams that now manage the Columbia's flow have become a hybrid entity, with both natural and man-made components (White 1995). Christopher Manganiello, in *Southern Water, Southern Power*, an analysis of the history and politics of the Savannah's dams, refers to the spaces they create as "hydraulic waterscapes," comprised of "the hydroelectric dams, transmission lines, and reservoirs with their associated leisure economies" (Manganiello 2015).

The hybrid character and fuzzy scale of these concepts is analogous to how landscape architects think about the idea of "landscape," which is often presented as a space where the relationship between man and nature is mediated. White and Manganiello have used their terms in a critical context, but the concepts are just as relevant to those who are producing, maintaining, and occasionally removing the physical components of waterscapes.

Though landscape architects have yet to claim the term "waterscape," the body of work they are creating with planners, ecologists, engineers, and other practitioners hints at the concept's potential. In California, a plan for the Los Angeles River, a 51 mile urban river corridor, has been developed that would revive that waterway through a series of hybrid park-floodplains (City of Los Angeles 2007). In England, the Thames Gateway Plan focuses on a 40-mile estuary between London and the English Channel. The project marries restoration and climate change adaptation with ecologically minded economic development (BBC News 2007). Louisiana's Coastal Master Plan operates in a similar paradigm, aiming to better protect the region with softer and more naturally oriented coastal defenses (Coastal Protection and Restoration Authority 2011). And a design competition looking at the mouth of the Don River in Toronto focused on balancing port infrastructure, urban development, and naturalization of the river's mouth (Waterfront Toronto 2007). These contemporary planning efforts, which bring ecological performance to the forefront, are greener descendants of the more narrowly programmed dams and infrastructures of the last two centuries. Those dams could be seen as the Industrial Revolution and Modern era iterations of a long tradition of hydraulic manipulation and organization, going back to the first agricultural canals and fish weirs (Cosgrove and Petts 1990, pp 2-3). Collectively, the contemporary projects and their predecessors suggest a distinct typology of landscape intervention.

This thesis will build upon the ideas of rivers as "organic machines" and river-related infrastructures as "waterscapes," and consider their relevance to the design of those spaces. It will ask how sustainable design can mobilize those critical conceptions of rivers to address contemporary design challenges on the Savannah River. These challenges include recent droughts (Pavey 2013), flooding (WRDW 2013), and even earthquakes (Highfield 2014) that have brought attention to the state of this infrastructure. If the river is a machine, as White suggests, then the parts that constitute it have the potential to be modified and replaced. The following chapters will explore how the ideas of sustainable design and waterscape might work together, and contribute to a richer future for the machine created out of, within, and along the Savannah.

This thesis also puts that notion of waterscape into a broader context, situating waterscape as part of a broader class of contemporary site typologies that designers are currently working to address in the landscape. The complex problem of rivers is similar in many ways to other challenging sites, and the frames that describe those sites provide good analogs for describing rivers and suggesting solutions.

FEASIBILITY

The vision of a reconnected river system wouldn't be realized in one grand project, but over time. Each impediment and impoundment will be considered on its own merits, with larger habitat concerns only one of many that determine the future of these hydroelectric infrastructures. Though regional connectivity of habitat is a component of relicensing conversations related to these dams, moves in this direction are often comprises that modify individual structures, rather than wholesale re-envisionings.

Complex histories and patterns of infrastructure ownership ensure that any approach to planning river habitat will be fragmented. Obsolescence is often a more substantial factor in the removal of many dams, especially old hydroelectric dams like the one creating Lake Tugaloo, which generates a negligible amount of power as compared to the vast generating capacity of the nuclear reactors downstream at Plant Vogtle, below Augusta. On the other hand, the intensity of development surrounding a reservoir is a major factor in their persistence. Many reservoirs in Georgia have become magnets for suburban-styled development, with reservoir operators granting permission to owners of surrounding properties to build docks or even leasing land for home sites.

Figure 3. Proposed Rock Ramp Fish Passage structure at New Savannah Bluff.

(Source: http://balancingthebasin.armylive.dodlive.mil/files/2013/05/Fish-Bypass-Rendering.jpg)

New Savannah Bluff Lock and Dam, the last of the nine dams between the Chattooga and the sea, provides an illustration of these competing interests. USACE, which owns and operates the structure, has proposed removing it, resulting in complaints from surrounding municipalities (Pavey 2011). Built for moving ships from the coast up to Augusta, it hasn't been used in decades, and provides an opportunity for mitigation in relation to the Savannah Harbor Expansion Project. However, that dam's reservoir contributes to a stable water level in Downtown Augusta. With concerns from businesses and homeowners who abut the river, USACE relented on its plan to demolish the structure, instead turning the dam over to the City of Augusta. USACE will instead build a fish passage around the dam (Pavey 2012).

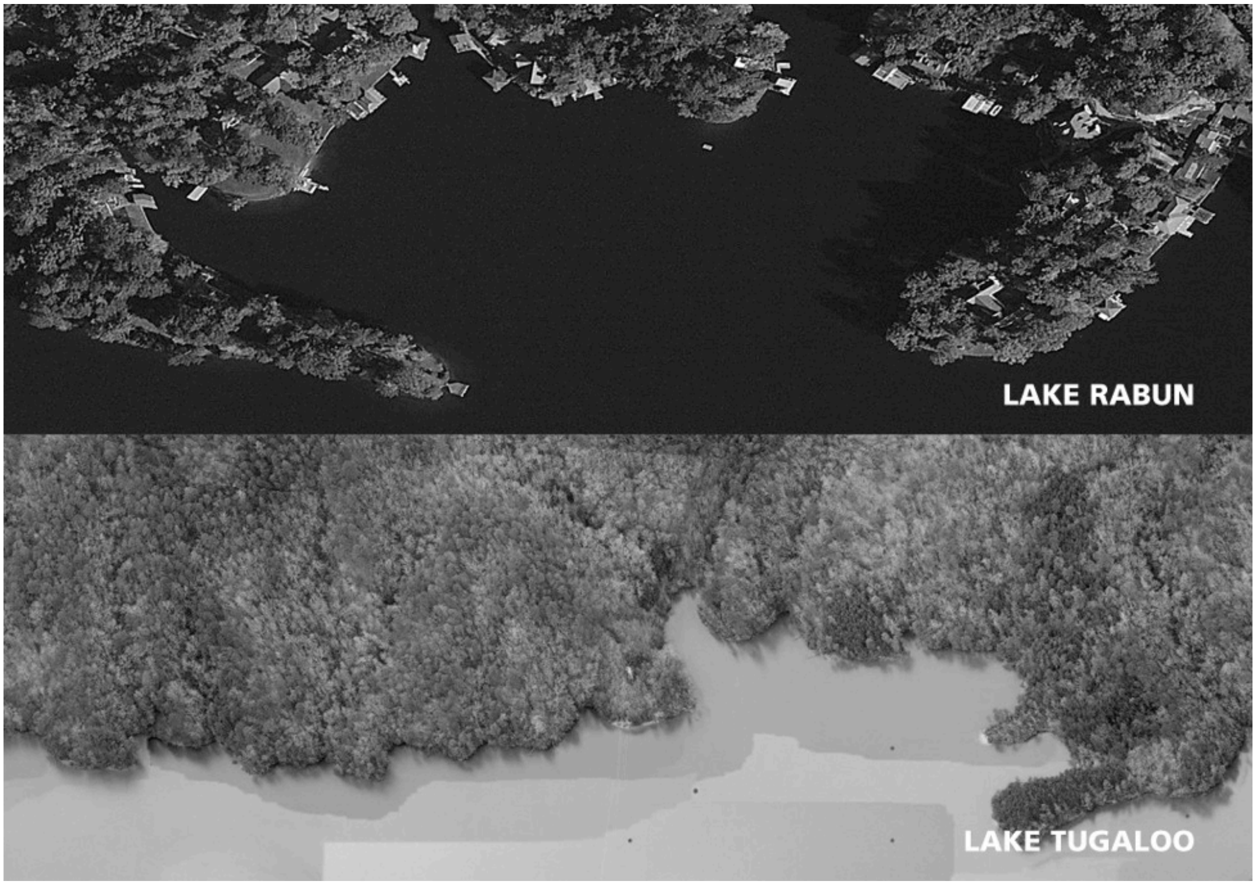

Figure 4. Developed and undeveloped lake shorelines (Image Source: maps.bing.com)

Obsolescence and development are major factors in determining the future of New Savannah Bluff. They also serve as powerful tools for evaluating which dams to target first in the quest for a wild Savannah. Working downstream from the Five Falls, the first reservoir is Tugaloo, which captures the Chattooga and her sister the Tallulah River. Next is Yonah, which along with Tugaloo and four other reservoirs comprises part of a hundred-year-old system of small hydroelectric reservoirs. Georgia Power built and owns this system. The reservoirs on the Tallulah River are surrounded by residential development, especially Lakes Rabun, Seed, and Burton, but Lakes Yonah, Tugaloo, and Tallulah are quite undeveloped by comparison. The latter three are also surrounded by a great deal of state and federal lands, including Tallulah Gorge State Park, which brings hikers as well as kayakers to the region. For instance, boating on the Chattooga alone generates an estimated $2.6 million economic impact in 2002 (Moore and Siderelis 2003, p 75). The economic role that adventure-based tourism plays in the region, combined with the structures' age, minimal generating capacity, and low numbers of homeowners to object over lost lakefront means that Lakes Tallulah Falls, Yonah, and Tugaloo could be ideal candidates for removal.

SITE	BUILT / AGE	SURROUNDING DEVELOPMENT	DESIGNED PURPOSES
LAKE BURTON GEORGIA POWER	1919 **(95)**	**HIGH**	**POWER**
LAKE SEED GEORGIA POWER	1927 **(87)**	**HIGH**	**POWER**
LAKE RABUN GEORGIA POWER	1915 **(101)**	**HIGH**	**POWER**
TALLULAH FALLS LAKE GEORGIA POWER	1914 **(100)**	**LOW**	**POWER**
LAKE TUGALOO GEORGIA POWER	1923 **(91)**	**LOW**	**POWER**
LAKE YONAH GEORGIA POWER	1925 **(89)**	**LOW**	**POWER**
LAKE HARTWELL USACE	1962 **(52)**	**HIGH**	**POWER, WATER SUPPLY, FLOOD CONTROL RECREATION, DOWNSTREAM NAVIGATION**
LAKE RUSSELL USACE	1984 **(30)**	**LOW**	**POWER, WATER SUPPLY, FLOOD CONTROL RECREATION**
CLARKS HILL LAKE USACE	1953 **(61)**	**HIGH**	**POWER, WATER SUPPLY, FLOOD CONTROL RECREATION, DOWNSTREAM NAVIGATION**
STEVENS CREEK DAM SCE&G	1912 **(102)**	**LOW**	**POWER**
AUGUSTA DIVERSION DAM CITY OF AUGUSTA	1845 **(169)**	**LOW**	**WATER SUPPLY**
NEW SAVANNAH BLUFF USACE	1937 **(77)**	**HIGH**	**NAVIGATION**

Figure 5. Analysis of Dam Sites (Sources: (Manganiello 2010, p 23) and (US Army Corps of Engineers 2013))

These structures, in their history, design, and the topography they inhabit, quite resemble the dams being removed in the Pacific Northwest. Two dams have been removed on the Elwha River, Washington State's Olympic National Park. These two structures, the Elwha and Glines Canyon Dams, date to 1913 and 1927(US National Park Service 2013), with 340 and 438 acre reservoirs respectively (Chenoweth, Acker et al. 2011). Tallulah Falls, Tugaloo, and Yonah are 63, 597, and 325 acres in area respectively (Georgia Power, n.d.).

Next come USACE's three flood control reservoirs, collectively known as the Savannah River Project. Moving downstream come Hartwell, then Richard B. Russell, and finally Clarks Hill. These massive reservoirs, each well over a hundred feet tall, cover tens of thousands of acres of bottomland, and over 100 miles of river channel. The USACE built them primarily to protect Augusta from catastrophic flooding, as well as for hydropower generation. The first, Clarks Hill, finished construction in 1954. Hartwell opened in 1962, and Russell, the smallest of the three, in 1985 (US Army Corps of Engineers 2013, p 2). These aging dams mirror a general trend across the USACE's portfolio: "approximately 95 percent of the dams managed by USACE are more than 30 years old, and 52 percent have reached or exceeded the 50-year service lives for which they were designed" (US Army Corps of Engineers, n.d.).

Development surrounds Hartwell and Clarks Hill, but Russell's periphery is largely undeveloped. Changes in federal law after the first two dams were built result in a much larger buffer around the reservoir, and a ban on private docks on the public lake shore (US Army Corps of Engineers 2013, p 10). These reservoirs do appear to compete with one another for visitors (Allen, Carey et al. 2010). With no homeowners invested in the lake's presence, and two comparable reservoirs offering the same recreational amenities nearby, Russell may be the best candidate of the three for removal, although the scale and cost of the project, combined with its "dam-locked" position between Hartwell and Clarks Hill yielding negligible benefits for regional habitat connectivity, may mean that such a project is highly unlikely to occur.

The idea of removing reservoirs like these raises questions, not only about the engineering and hydrology of the river channel itself, but of the entire landscape. Converting Lake Russell's 26,650 acres of land from muddy lakebed into a stable Piedmont floodplain ecosystem would be a massive challenge. But efforts like the Civilian Conservation Corps, which planted 22 million trees in Georgia during the Great Depression, as part of reforestation efforts in places like Chattahoochee National Forest (which includes some of the Savannah's headwaters) show that this kind of work is possible (Davis 2013). Such a project would require drawing upon many disciplines including ecology, forestry, agriculture, and landscape architecture.

But these challenges do not mean that the idea should be written off. Dams of this scale, many built by the United States Army Corps of Engineers in the middle portion of the last century, are rapidly passing 50 years in age, their designed lifespan. In other cases, changing conditions are rendering them obsolete. Lake Mead in the Southwest is an extreme example of the problems that many dams face. Due to extreme drought induced by climate change, the dam may never be filled again; downstream flows to Mead are being reduced by drought and climate change, and infrastructure such as water intakes must be (Wines 2014). And many dams in the region are rapidly filling with sediment (Powell 2010). Congress authorized large dam projects across the country for a variety of purposes, including hydropower, flood control, navigation, and recreation, some of which may no longer apply. These projects will require expensive repairs and rebuilding as they age. Whether they are still meeting their authorized needs effectively will be an important consideration in determining their future. If the dams are no longer able to meet those needs, or costs of repair or replacement are too high, alternative infrastructures may become not just desirable, but unavoidable.

Figure 6. Lake Mead's "bath rub" ring illustrates the reservoir's full pool. (Source: Author)

Downstream from Clarks Hill is the Stevens Creek Dam, a hydroelectric structure dating to 1914 (South Carolina Electric & Gas,p 15). Barely a mile further downstream is the Augusta Canal Diversion Dam, dating back to the 1840s. In many ways, the short stretch of river that these two dams bookend is a microcosm of the issues that the Savannah presently faces. The Augusta Canal, which is fed by the diversion dam, provides drinking water to the city. The dam, however, is showing its age, and is a significant ecological barrier. Stevens Creek, just upstream, covers several miles of shoal habitat in addition to important archaeological sites. “Dilution of pollution” from industrial users around Augusta is another competing use of the river’s water.

These uses are monitored for Total Maximum Daily Loads (TMDLs) to maintain water quality (US Environmental Protection Agency 2013). The corridor has both substantial residential development and significant conservation opportunities. There are also pending requirements for fish passage around the two structures. Developing a plan for this reach that balances these many competing demands on the river will be a significant challenge. But through the lens of waterscape, a solution that successfully balances ecological, social, and economic concerns could be discovered.

These infrastructure systems are fragile ones, rapidly aging, and in some cases already obsolete. A more sustainable approach to managing the Savannah is needed that accounts for the kinds of concerns outlined above. This means a resilient infrastructure that is designed with life-cycle costs in mind. It means a more multi-functional approach that allows for other kinds of human and non-human uses. And it means avoiding or minimizing the negative externalities--social and ecological--that can come with infrastructure development.

CONCLUSION

There’s an old saying that you can never put your foot in the same river twice. Time, like a river, only flows in one direction. Restoration is therefore something of a misnomer. The sites can never be returned to exactly what they were in a pre-European or pre-development state. That river is gone. The history of these sites informs and limits the possibilities for their futures, and the contemporary relationships between the manmade and natural components of the organic machine that is the Savannah River system cannot be untangled. Landscape Architects, who have long managed spaces where human and ecological systems interface, are well suited to design and modify these machines to achieve a more sustainable future.

The next portion of the thesis will be devoted to developing the concept of waterscape. Chapter Two will investigate a number of sustainable design approaches, and consider their respective emphases, sites of focus, and relevance to the design of waterscapes. Chapter Three will investigate the critical language of waterscape, consider its relationship to scholarly conceptions of landscape, and propose a narrower definition for waterscape, distinct from its critical usage, that could be of use to designers: waterscapes form part a unique typology of site within our understanding of landscape. Several prominent projects that are representative of waterscape will be explored in Chapter Four. Each of the sites identified above--the Georgia Power dams, Lake Russell, and the Augusta dams--provides an opportunity for exploring a different approach to the concept of sustainable waterscapes. These sites will be considered in greater detail in Chapter Five, using them as distinct lenses through which to analyze the intertwined relationships that constitute the "organic machine" of the Savannah, and to consider how river infrastructures might be made more sustainable, resilient, and responsive. Each site's purpose, history, current conditions, as well as the ecological and social factors present at the site will inform a proposal for the site's future.

CHAPTER 2

SUSTAINABLE DESIGN & RIVERS

The vision of reconnected rivers is an inherently normative one, with certain values implied regarding what our relationship to natural systems ought to be. But even within the environmentally minded sustainable design dialogue, there are many competing ideologies and approaches that offer sometimes-conflicting suggestions regarding our relationship to natural systems. Which are most appropriate to the challenge of river corridors? In framing his comprehensive analysis of approaches to ecological planning, Forster Ndubisi notes a "proliferation of approaches..." "employed at a variety of scales and in a spectrum of urban to rural settings" (Ndubisi 2002, p 3). The broad field of sustainable design (which overlaps with ecological planning) exhibits a similar range of distinct approaches. Each design approach has its own focus, which may be more or less easily adapted to the idea of waterscape. These approaches address and produce particular categories of sites and spatial typologies. And there are certain principles that can be borrowed from among these approaches that are particularly suitable to the design of waterscapes.

The sustainability agenda has particular relevance in considering the varied social and ecological demands put upon riverine corridors. A commonly accepted definition, from the United Nations report *Our Common Future,* states that sustainable development "meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1987, p 16). Elaborating upon that sentiment, "three pillars" of sustainability are often referred to, by which sustainable development is achieved (United Nations, n.d.). These are ecological, economic, and social sustainability.

Resilience, an emerging line of thinking within this discourse, is an especially important consideration when thinking about water if events like Superstorm Sandy are any indication (Zolli 2012). Resilience thinking is focused on systems' ability to recover from disturbance events (Fridolin and Jax 2007). This is essential for dynamic stream and river sites, where disturbance events like flooding and meandering channels are common. Many sustainable design approaches have begun incorporating aspects of resilience theory into their thinking. For instance, the Congress for the New Urbanism made it the theme of their 2014 conference (Congress for the New Urbanism 2014).

Sustainable design approaches, such as New Urbanism and Green Infrastructure, offer form and method to the broad goals of sustainability, proposing unique relationships between the social, economic, and ecological aspects of places. However, not all are equally effective in addressing the challenges facing river corridors. Each sets its own weight for those goals, not only balancing them between one another, but also prioritizing certain sites over others. When considering how to proceed in improving river corridors, it is worth evaluating how effectively each of these approaches responds to the ecological, economic, and social aspects of rivers. River spaces are distinct from other landscapes, and have a unique set of attributes within the realms that the three pillars of sustainability address. The design approaches considered later in this chapter each offer many compelling ideas that are applicable to rivers generally and the Savannah specifically, but none completely addresses the unique relationships present in rivers, as outlined below. However, they may be useful for operationalizing the waterscape concept and developing strategies for sustainable river infrastructure.

CHARACTERISTICS OF RIVERS

Ecologically, economically, and socially, rivers are especially vibrant places, and often provide key links in each of these areas. The ecological significance of river corridors is well known. Riparian corridors "are some of the most diverse, dynamic, and complex biophysical habitats on the terrestrial portion of the planet" (Naiman and Decamps 1997, p 622). Hydrologic connectivity is an important service provided by rivers and streams, connecting aquatic habitats across regions (Pringle 2003). River corridors also provide key linkages when planning for wildlife connectivity (Rudnick, Ryan et al. 2012). This can include not only migration of aquatic species within the channel, but terrestrial species using rivers as corridors, and birds who incorporate rivers into migratory flyways. Rivers' roles and relationships operate across many scales. Riverine landscapes are "complex mosaics of habitat types and environmental gradients, characterized by high connectivity and spatial complexity," that are increasingly " viewed as 'riverscapes,'" a fuzzy unit that allows for investigation of these spaces at a variety of scales (Allan 2004, p 258).

Less apparent is the important role that rivers play for human interests. Teasing out the many relationships that occur within waterscapes is an especially compelling contribution from historians. Part of what their investigations reveal is that many of these ecological and social elements have been sacrificed for particular economic goals. Further, particular kinds of economic development have been favored over others. The richness of rivers as outlined below is what sustainable design of those spaces should aspire to produce.

Rivers have long been spaces of commerce, whether as fisheries or as transportation corridors. Whether across rivers via ferries, or along them via barges, movement across the water has a long history. Bridges, as well as the gentle grades of river valleys, have also made rivers important components of land-based transportation systems. Municipal infrastructures such as sewer and stormwater lines often take advantage of stream and river valleys to move waste or runoff. Water gaps and narrow valleys also provide key linkages in regional infrastructure, level routes in otherwise steep topography. The Columbia River Gorge in Oregon is an example of this infrastructural landscape, with many infrastructure corridors of regional and national significance converging in a small footprint. There, railroads, highways, power and gas easements line the narrow banks, framing a river occasionally interpreted by locks and bridges (Wang and Chaker 2005). In addition to these variables, there are also a number of other demands, including water withdrawal and discharge, and electricity generation.

Figure 7. Highways and railroads (far bank) crowd the narrow banks of the Columbia River. (Source: Author)

Culturally, rivers are often important sites for recreation, providing space for fishing, boating, and swimming. They also display a richness of place names that illustrates their significance. At Celico Falls, on the Columbia, a significant site for Native Americans who fished there, “nearly every rock and island in the falls suitable for fishing acquired a name” (White 1995, p 22). Access to these fishing places, often only a few feet apart, was highly programmed. This richness of place in riverine environments isn’t just a historical artifact of Native American societies. Modern fishermen, on lakes and open water as well as rivers, often inhabit a similarly precise landscape, with personal secret fishing spots jealously guarded, their location often aided by consumer level GPS devices. The modern territoriality and specificity of seemingly undifferentiated water is especially well known in Maine, where lobstermen control access to fishing territories (Acheson 1975), hearkening back to traditional patterns at Celico Falls.

Likewise, historical records and charts on the Savannah show a densely named series of rapids and spaces between Augusta and Petersburg (Carter 1889). Crews of five to six men poled the flat-bottomed “Petersburg” boats down the river to Augusta, a distance of sixty miles (Ouzts 2013). Present-day whitewater paddlers and raft guides maintain a similarly rich level of place knowledge of the river, with individual rocks and rapids, like those of Celico Falls, all earning unique names. Experienced paddlers likewise have knowledge of each rapid and rock’s performance at varying levels of flow. That informal knowledge has increasingly been collated, first through guidebooks and more recently through websites like American Whitewater (American Whitewater 2014).

These concerns, which could broadly be categorized in terms of tangible outcomes as infrastructure, habitat, and place, align with the sustainability literature’s three pillars. The pillars form a conceptual lens, through which the effectiveness of current and potential approaches to managing river systems can be evaluated. That lens will be employed in greater detail in Chapters 4 and 5.

Critiques of current approaches to managing rivers often point to a sacrifice of one or two of these components at the expense of the others, even when not explicitly referencing sustainability. River designers should aspire to a holistic integration of these components. Projects that reflect this holistic integration include the Miami Conservancy District and the LA River Master Plan (explored in Chapter Four).

DESIGN APPROACHES

Many design and planning approaches have been put forward that aspire to that integration, and each has its own emphasis that may be of relevance to waterscape design. These design approaches have specific areas of focus, both in terms of their priorities and assumptions, and their spatial focus. Some are focused on rural and undeveloped areas, while others take the city and its suburbs as their target. And to varying degrees, they incorporate contemporary ideas of resilience and responsiveness to environmental hazards, an important concern when addressing temporally and spatially dynamic river systems. These approaches reveal a prominent stream of interests in modern sustainability discourse, outside of which the question of rivers falls. Though not directly oriented towards river systems in a whole, these approaches can provide insights useful to the management and design of particular components of river systems.

Consider these design and planning schools of thought as a variety of strategies for implementation of a sustainable future, each proposing a unique combination of an array of design tactics. Each strategy provides an insight into the relationship between its overall goals and the tactics it endorses, which will be useful in developing an approach specifically targeted to the challenge of rivers and streams as distinct features in the modern landscape. In the remainder of the chapter, six prominent approaches to sustainable design and management are discussed. These have been classified, based on the kind of sites they investigate, as oriented either toward urban systems or ecosystems (Deming and Swaffield 2011, p 126).

Managing Urban Systems

Given that sustainability is inevitably concerned with the role of human development in the environment, it is fitting that urban areas--and the economic and development processes that produce them--have been a significant line of investigation within the sustainability genre. In recent years, many design schools have attempted to answer the question of urban development, proposing many a range of design and planning solutions across many scales (Jabareen 2006). Smart Growth-ers, and their most ideologically-pure sect, the New Urbanists, have dominated the field, successfully reforming zoning codes and thinking across the country, with an emphasis on compact urban form as alternative to energy-intensive sprawl. The insurgent Landscape Urbanists have vocally challenged them in recent years, embracing a messier view of the relationships between city and wilderness. The surprisingly antagonistic relationship between these two camps has been covered a great deal, but viewing that fight through the lens of rivers provides an opportunity to see a number of interesting and clarifying distinctions between them. Other approaches, such as Green Infrastructure and Low Impact Development, take a more utilitarian approach, and avoid many of the theoretical discussions of the various Urbanist camps.

New Urbanism:

Known more generally for the quaintness of its small town design vocabulary than its environmentalist bona fides, New Urbanism and associated concepts such as “Smart Growth” aim for sustainability by densely developing in certain areas, sacrificing the ecological performance of those spaces so that others might be performed elsewhere.

This attitude is evidenced in comments by Andres Duany, a key figure in the movement, who has often suggested that many of the environmental benefits generated by Manhattan are due to the city's willingness to pipe most of its original streams. Land kept from development for environmental purposes would only serve to decentralize the city and cause greater environmental harm elsewhere. "The refusal to move water through a pipe to be processed elsewhere negatively affects density and increases automobile use," an article in the Congress for New Urbanism's (CNU) newsletter states, summarizing Duany's comments (Steuteville 2011). However, this attitude is beginning to change, with documents like the CNU's *Canons for Sustainable Architecture and Urbanism* placing a much heavier weight on the preservation of wetlands and riparian corridors (Congress for the New Urbanism 2009).

Nonetheless, New Urbanism is focused on the human environment, and much of its attention goes to the design of buildings and the spaces that they inhabit. Even as the movement responds to and adopts specific design strategies from Green Infrastructure, Landscape Urbanism, and others, its emphasis remains on creating compelling urban spaces within a traditional spatial language (Duany, Speck et al. 2010). That language allows for piping streams or creating lakes in many projects, creating a greater variety of interfaces between community and water in its built projects (Duany and Plater-Zyberk 1992). Those interfaces are often the kind that more sensitive approaches to environmental areas seek to avoid. Successful as it may be at creating vibrant urban waterfronts and parks that create meaningful connections between people and water, Smart Growth's view of rivers and streams as simultaneously environmental and infrastructural corridors is unclear. Its sustainability agenda is focused more on the developed landscape, with water often seen primarily as an amenity or a development constraint. And though there are recent acknowledgements of resilience thinking in New Urbanist dialogue, the ideas have yet to be formally adopted in documents like the *Canons for Sustainable Architecture and Urbanism.*

From Tallulah Falls Village, considered in the first part of Chapter Five, to the many second-home communities that dot the major reservoirs, New Urbanism could provide a compelling alternative to the typical approach to development along these spaces, with its approach to compactness and hard edges between development and open space well-suited to buffering those sites while creating a unique and meaningful landscape along the river. Those hard urban edges would mean higher habitat integrity within undeveloped areas, and limitation of noise, light, exhaust and other urban symptoms. There would also likely be less intrusion into key river viewsheds, and opportunities to align urban public realms and views with river features.

However, in some cases, such as the canal system within the fabric of Downtown Augusta, this approach may offer fewer beneficial elements, which other approaches, such as Landscape Urbanism and Green Urbanism below, may be better suited to address.

Landscape Urbanism:

Landscape Urbanism maintains a similar emphasis on the urban environment as New Urbanism, but adds to a focus on urban development an equal interest in the environment, with landscape as a model through which to understand contemporary horizontal cities (Corner 2006, p 24). Further, it grants agency to both by embracing time and process as a component of human and natural systems (Corner 2006, p 39). This emphasis on time is a compelling one, given that rivers and surrounding spaces are especially dynamic. Meandering channels and highly variable flooding regimes are not always recognized and accommodated by static master plans, and the temporal approach to planning offered by Landscape Urbanists may suit rivers well.

This discourse places especially heavy weight on economic and infrastructural development as drivers of urban form over time. This reconnection of civil engineering and landscape (Tatom 2006, p 181) is an especially important notion in discussing bundled river corridors, where transportation and other infrastructure overlay ecological spaces. It also allows for more fruitful consideration of ecological spaces as useful alternatives to conventional "hard" systems, drawing upon the ideas of green infrastructure. There a number of projects within the world of Landscape Urbanism that compellingly touch on rivers and waterways through implementation of these tactics, such as the Don River competition in Toronto.

Criticism of Landscape Urbanism, much of it from New Urbanists, frames landscape urbanism as an embrace of urban sprawl and a conceding of the rural landscape (Neyfakh 2011). "Sprawl in a Pretty Green Dress," one online headline scolds (Mehaffy 2010). In their embrace of the chaotic and blended character of the contemporary city, Landscape Urbanists may cede too much ground on the environmental front. James Corner suggests "to continue to oppose nature against culture, landscape against city... is to risk complete failure of the architectural and planning arts to make any real or significant contribution to future urban formations" (Corner 2006, p 28). In an essay questioning many of the assertions of Landscape Urbanism, Ian H. Thompson suggests that "there is the lurking danger that Town–Country, were it to become the dominant landscape type, would replace both Town and Country with a sort of homogenised Nowhere" (Thompson 2012, p 18). Thompson presses further, arguing that Landscape Urbanists do not recognize wilderness as existing at all (Thompson 2012, p 20). Shanti Levy links

Landscape Urbanists to earlier writers such as Benton Mackaye and Lewis Mumford who "stand apart from tendencies that posit environmentalism as the conservation of designated wilderness areas" (Levy 2011). And though Landscape Urbanists may technically be correct, and there may no longer be entirely pristine wild spaces, especially not within cities, there are certainly many where there is considerable ecological integrity. A better framework would recognize what Donald Waller describes as "degrees of wildness" (Waller 1998, p 544); White's notion of organic machine certainly embodies this spirit, acknowledging the wild power of the river's flow, even as other aspects of the river are subjugated. With insistence that everywhere is under the influence of the horizontal city, and no land is sacred, the importance of largely intact and ecologically significant places could be lost. Though Landscape Urbanism seems more tolerant of the complex networks that link distant hydroelectric power stations and reservoirs to urban centers, in many of those cases human infrastructure occupies a small foreground compared to the expansive wild or undeveloped spaces that frame many river sites. Those kinds of spaces seem to fall outside of the Landscape Urbanists' area of interest.

What this approach seems well suited to address, however, is the complex system of dams, river, and canals that weaves through urban Augusta, considered in the last part of Chapter 5. Such an entwined infrastructure invites the sorts of complex interactions that Landscape Urbanism's touchstone projects build upon. The multi-functional Canal, which combines power generation and urban runoff with possibilities for parkland, urban redevelopment, and habitat, might if redesigned resemble some of the semi-vegetated urban river spaces proposed for the Los Angeles River (considered in Chapter 4). Though Landscape Urbanism effectively addresses the broad themes of a space like the canal, the specific design moves that might be implemented on a reworked canal system are ones that approaches like Green Infrastructure also speak well to.

Green Infrastructure:

Green infrastructure takes a more moderated and utilitarian approach, considering ecological spaces primarily in the context of their function, in contrast with the “gray” built environment as conventionally developed. Ecosystems become models upon which to base alternative designs of urban infrastructure, and species are considered in light of the services they might provide (Wise 2008). The approach can be fairly expansive in scope, as highlighted by the Conservation Fund, a major advocate. They define green infrastructure as "a strategically planned and managed network of natural lands, working landscapes, and other open spaces that conserves ecosystem values and functions and provides associated benefits to human populations" (Conservation Fund).

In his description of Green Infrastructure, Ed McMahon links the approach to the model of conservation biologists, and views the urban networks of green hubs and corridors as analogues to regional refuges of linkages (McMahon 2000, p 5). He outlines a number of trends influencing the development of this agenda, including the federal regulations for cleaner water, reaction to habitat fragmentation, and urban and sustainable development demand (McMahon 2000, pp 4-5).

However, the term can also be used specifically for alternative stormwater management approaches, a narrower view of green infrastructure’s roles and benefits. The Environmental Protection Agency (EPA) for instance defines green infrastructure as follows:

> *Green infrastructure is an approach that communities can choose to maintain healthy waters, provide multiple environmental benefits and support sustainable communities.*

Unlike single-purpose gray stormwater infrastructure, which uses pipes to dispose of rainwater, green infrastructure uses vegetation and soil to manage rainwater where it falls. By weaving natural processes into the built environment, green infrastructure provides not only stormwater management, but also flood mitigation, air quality management, and much more. (US Environmental Protection Agency 2014)

Green Infrastructure is broader than similar approaches like Low Impact Development, which focuses on stormwater (US Environmental Protection Agency 2014), and presents a significantly more harmonious vision than the Landscape Urbanists's chaotic cities in flux, despite drawing on similar design tactics. However, with its interest in water, it may speak most directly to the question of rivers, albeit at the watershed scale. American Rivers presents Green Infrastructure as a choice of softer measures: restored floodplains instead of levees, treatment wetlands versus sewage treatment plants. It means choosing water efficiency instead of building a new water supply reservoir, and bioswales instead of pipes (American Rivers n.d.). And though green infrastructure doesn't necessarily respond to the river sites themselves, it does give good insights into how to improve rivers from the watershed perspective. As the municipalities along the Savannah took an interest in the rivers and lakes along the corridor, they could implement the kinds of best management practices that Green Infrastructure and LID suggest in their operations and ordinances.

Despite their differences, all of the above classes of sustainable design are fundamentally urbanisms, and the nature of city development on the land is a fundamental preoccupation. Each presents unique opportunities for relating to rivers and reconceiving their roles within the human environment. However, none addresses rivers primarily, or captures the full range of contexts where river infrastructures occur.

Managing Ecosystems

Other design approaches are oriented more toward ecosystems and ecological performance, rather than the spaces specifically inhabited by humans. These activities have diverse viewpoints regarding the character of ecosystems. Some highly value the intrinsic character of native ecosystems and landscape processes. Others take increasingly utilitarian views of ecosystems. But what they share is in interest in biotic and physical processes as active agents in the landscape.

Ecological Restoration:

At the narrowest range are notions of ecological restoration, of which river and stream restoration are a subset. Restoration itself is but one of many activities that can be undertaken to improve degraded ecosystems. Other activities include reclamation, rehabilitation, remediation, and mitigation, suggesting various degrees of restoration of ecosystem structure and function (Bradshaw 2002). The National Oceanic and Atmospheric Administration (NOAA) describes river and stream restoration as “returning degraded ecosystems to a stable, healthy condition” (Administration, n.d.). The European Centre for River Restoration (ECRR) defines river restoration as “restoring the natural state and functioning of the river system in support of biodiversity, recreation, flood management and landscape development” (European Centre for River Restoration 2013). In their analysis of restoration’s definition, the Environmental Protection Agency cities several definitions of restoration, including “the process of returning a damaged ecosystem to its condition prior to disturbance," and "an earlier natural, self-sustaining ecosystem that is in equilibrium with the surrounding landscape" (US Environmental Protection Agency 2012).

An oft-cited definition of restoration created by the National Research Council in a report entitled *Restoration of Aquatic Ecosystems: Science, Technology, and Public Policy* hints at the complexities and challenges of restoration saying that "all restorations are exercises in approximation and in the reconstruction of naturalistic rather than natural assemblages of plants and animals with their physical environments" (National Research Council 1992, p 18). This description acknowledges the impossibility of actually achieving "restoration." Other challenges include reconstructing what systems looked like previously, and determining to what time period they ought to be restored (Bradshaw 2002). Even when restoration goals are clear, they aren't always achieved. In some cases, channel restoration can actually negatively impact biodiversity; more nuanced strategies that focus on diverse factors such as surrounding land use and stormwater runoff may be more important (Palmer, Menninger et al. 2009, p 14).

What these definitions share is that they present restoration as an either/or proposition. As framed by traditional ecological restorationists, each act leads either toward restoration and the site's status as a natural entity, or away from it (Hobbs and Norton 1996, pp 95-6). This conception may be fine for rivers like the Elwha, currently undergoing ecological restoration deep in the heart of Olympic National Park, and far from developed areas, which could itself provide a model for the century old dams on the mountain tributaries, the Tugaloo and the Tallulah, considered in Chapter 5. Those reservoirs are surrounded by the Chattahoochee National Forest and strong natural-resource-oriented tourism centers; restoration of these rivers would only enhance those programs, and would have immediate connectivity to other habitat.

But the framework is challenging for urban sites, where even approximation of previous natural conditions may be unlikely. Consider Augusta, where a major city depends on water from the historic canal. Though focused on the challenges of river and streams sites specifically, and responsive to their dynamic character, stream restoration is less flexible about the human components of river systems, with little to say about systems destined to remain in the middle, such as urban rivers that have inextricably been woven into the infrastructure of the city. Accomplishing restoration goals within complex social contexts is a major challenge for the science of river restoration (Wohl, Angermeier et al. 2005).

Novel Ecosystems:

Novel Ecosystems is an emerging discourse that accepts the impossibility of immediate restoration in most cases, and offers alternative management approaches that acknowledge the persistence of invasive species and the altered underlying conditions that inform modern ecosystems. Advocates of this approach argue that most systems currently qualify as novel ecosystems, with truly intact native ecosystems becoming increasingly scarce (Seastedt, Hobbs et al. 2008). They categorize ecosystems as "those that maintain their historical configurations, those that develop hybrid qualities mixing new and old components, and those that form entirely novel systems" (Hobbs, Higgs et al. 2009, p 604). They suggest that the first of these has become so rare as to be nonexistent in most cases. The latter two are becoming increasingly common, and are difficult to revert. In cases where native species depend on non-native ones, or non-native ones can't be eliminated, a framework that allows for management goals that includes non-native species is needed (Hobbs, Higgs et al. 2009, p 603). Foreign species can help in restoring habitat connectivity, to the benefit of endemic and native species (Lugo and Helmer 2004).

Proponents of novel ecosystems argue that these assemblages, despite being composed of non-native spaces, can nonetheless provide important ecosystem services or habitat (Lindenmayer, Fischer et al. 2008, p 133). The term is also important in understanding ecological change over time, and offers a more objective view of disturbed systems than pejorative terms like “trash ecosystem.” Those systems may have unrecognized values, and a framework that addresses biases towards native species can better allow for these opportunities to be seen (Marris, Mascaro et al. 2013, p 348). However, overcoming those biases and accepting these systems will require “significant adjustments” of attitudes regarding ecosystems and natural spaces (Hobbs, Higgs et al. 2009, p 604).

Other landscapes, primarily seen as constructed spaces, are also forming new ecosystems. Some of these are even managed, without necessarily being considered novel ecosystems, with fisheries in the Hartwell, Russell, and Thurmond reservoirs on the Savannah being prominent examples. These vast open bodies of water in the historically lakeless Piedmont have created a range of new physical conditions, including open shorelines, deep water, islands, and river deltas, which are foreign configurations for the region. How native species and imported ones have collectively occupied those spaces is a question that the novel ecosystems discourse seems well suited to answer.

The theme of function, rather than species composition, is especially applicable on these lakes, for which water quality is one of many purposes. Though the natural river channel is under water, the benefits of riparian vegetation (filtration, erosion control, habitat corridors) are important. A lakeshore ecosystem may not directly resemble the plant communities that once occupied the Savannah's shoals, but it may be able to provide other benefits that support water quality to the benefit of downstream users. Likewise, the health of a dam-locked non-native fishery within the lakes may benefit other species that can move more freely, such as birds and terrestrial species. Even the deltas that have formed at the upstream of each dam may provide some cover and habitat for migrating bird species.

Visual Assessment:

A final approach to ecological management worth considering is the discipline of visual or landscape assessment. Ndubisi says of these approaches that, "unlike other ecological-planning approaches, studies of landscape values and perception address the perceptual outcomes of, as well as the experiences people have in, interactions with landscapes" (Ndubisi 2002, p 197). Many land management agencies have developed guidelines for conducting these kinds of analyses, including the United Kingdom's Countryside Commission, the US Bureau of Land Management, and the US Forest Service (Lothian 1999, p 179). The Forest Service's most recent iteration of this approach is called the Scenery Management System (SMS), created "for the inventory and analysis of the aesthetic values of National Forest lands" (US Forest Service 1995, p 6). Approaches like the SMS attempt to balance aesthetic goals with infrastructural and economic ones. These can include the construction of roads, timber harvesting on forest lands, utility construction, and fuel breaks for controlling fires (US Forest Service 1995, p 12).

The desire to objectively site infrastructure in order to minimize impacts on cultural and ecological resources is a good one, but this approach is not without flaws. Some visual assessment methodologies, like the SMS, equate high landscape aesthetic quality with naturalness, which may or not be the case; ecological quality isn't necessarily correlated with high scenic quality and may change over time due to processes like succession (Daniel 2001, p 275). Further, the requirements of managing for ecosystems may not align with those of aesthetic management: "Typical procedures for presenting a particular landscape scene as it appears at a particular point in time are poorly suited to determining relationships with ecological quality" (Daniel 2001, p 275).

These methods attempt to create an objective value for scenic qualities, suggesting "the quality of the landscape is an intrinsic attribute of the physical landscape, just as landform, water bodies and hue are physical qualities" (Lothian 1999, p 178). The SMS defines landscape character as "a combination of the objective information contained within ecological unit descriptions and the cultural values that people assign to landscapes. Together they help define the meaning of "place," and its scenic expression" (US Forest Service 1995, p 1-1). Approaches that don't attempt to create an objective value for scenery may more rigorously determine community value of landscapes (Lothian 1999, p 195). In the future, "communal decision making schemes emphasizing negotiation and consensus building" may become a more prevalent approach to management than those focused on expert-driven or "perception-based" assessments (Daniel 2001, p 278).

Though visual assessment methodologies, as often realized, are targeted towards large tracts of forestland, and not without criticism, these methodologies are compelling in that they suggest an attempt to balance a variety of social and ecological functions in a rational way. However, river spaces are often so compact (only a few hundred yards wide, compared to the miles and miles of an expansive National Forest) that the functions visual assessments often seek to separate will necessarily coincide in impactful ways.

But there are some cases where the framework may be uniquely applicable to the management of rivers; if tuned toward how people respond to different kinds of riverine spaces, it might provide useful feedback for managing water. An instance of this sort of experiential management (the establishment of aesthetic flows at Tallulah Falls) will be considered later, in Chapter 5. The potential for such aesthetically oriented management of water resources is also apparent in cases where full or depleted reservoirs have significant economic consequences for surrounding communities (Allen, Carey et al. 2010).

CONCLUSION

The discourses outlined above are some of the most prominent in sustainable design. At first, it may seem that the answer to the question of sustainably designed rivers lies somewhere in the above paragraphs. The right combination of sustainable landscape design and planning tactics should lead to safe and healthy river corridors. However, because all take terrestrial landscapes (or the cities that occupy them) as a starting point, none specifically address the multi-functional river sites presented by White and Manganiello. And because each of these is inherently prescriptive, when each is applied individually to river sites, there is a danger in masking the characteristics of rivers as they are. None effectively captures the complexities of rivers as unique spaces or offers an integrated or holistic approach.

What these examples reveal is that, though many aspire to a universal approach to the landscape, some approaches are better suited to certain classes of sites. A view of the Savannah River system focused on ecological restoration might be well suited to the tributaries in the rivers' headwaters, where development is spread out, and National Forest land is prominent. The same lens is less appropriate to suburban Augusta. Likewise, an approach focused on urban systems and growth may be very responsive to the problem of urban flooding, but offer little to sparsely populated mountain regions, where infrastructure, rather than development is the primary human footprint.

As Ndubisi says regarding ecological planning, “not all approaches may be applied in every situation” (Ndubisi 2002, p 3). If a unified approach to these sites is desired, a box is needed that captures only these riverine sites, and not the non-riverine infrastructures, urban sites with more tenuous connections, or upland ecosystems.

To effectively address river corridors, we need a new framework capable of describing river spaces in a more open-ended fashion. Concepts like “waterscape” offer that frame, capturing essential relationships, but remaining uncluttered by more tangential ones. This term comes from outside design discourses and is primarily a critical one. The coiners of those critical terms have written from an analytical perspective, studying the complex relationships and histories that produce these river spaces and the conflicts inherent in them. Those dialogues aren’t prescriptive, but the work of designers is. The next chapter will investigate that discourse, and consider how that spatial delineation could be adapted to the goal of managing and designing rivers in ways that respond to those conflicts, many of which relate to a less than sustainable historical approach to managing river resources.

CHAPTER 3

OPERATIONALIZING WATERSCAPES

Addressing the infrastructure sites on the conceptual transect between the Chattooga and New Savannah Bluff will require new approaches to site beyond the typical notions that designers employ. In his essay "Terra Fluxus," James Corner points to the need for "contemporary techniques of representing the fluid, process-driven characteristics of the city, wherein the full range of agents, actors, and forces that work across a given territory might be brought into consideration, mobilized, and redirected" in contrast to the more static conceptions of sites and relationships (Corner 2006, p 30). The theme relates well to notions of "urban metabolism," first studied by Abel Wolman, which attempts to describe the array of inputs and outputs in a city and is being adapted to produce more sustainable urban processes (Kennedy, Pincetl et al. 2010). Corner suggests that ecology is a useful model for describing cities as well, saying "apparently incoherent or complex conditions that one might initially mistake as random or chaotic can, in fact, be shown to be highly structured entities that comprise a particular set of geometrical and spatial orders. In this sense, cities and infrastructures are just as 'ecological' as forests and rivers." (Corner 2006, pp 29-30). What this points to is a need for a new approach to classifying water sites and systems that is focused around the kinds of processes as well as spatial properties at work, and effectively spans the scales at which water systems operate.

Typology is defined as a "taxonomic classification scheme applied comprehensively to entire categories of built form" that "seeks to categorize and marshal a vast array of variant design forms and motifs, typically as a response to pragmatic cultural and environmental problems" (Deming and Swaffield 2011, p 133). Many current approaches to sites are relatively static, as Corner suggests. In their suggested case study methodology for landscape architecture project research, the Landscape Architecture Foundation (LAF) suggests two kinds of site typology. "Landscape Typology" refers to various kinds of physical designed spaces like parks, waterfronts, and greenways that landscape architects produce. "Issue Typology" suggests a way of organizing thematic approaches to site design, such as management, costs of development, and community engagement (Francis 1999, p 22). Though these are offered in the context of evaluating and comparing built works of landscape architecture, they do suggest ways that sites are typically categorized.

There are possibilities for unconventional or alternative descriptions of site that are nonetheless essential to understanding the contemporary landscape. Grady Clay, in *Real Places*, explores many everyday, intangible, and ephemeral landscapes. He names, describes, and celebrates these places in a way that isn't typically done for these often-unconsidered sites. His 'real places' include parade routes and riot scenes, vacant lots and tent cities, gentrifying neighborhoods and boomtowns. "To understand our man-made neighborhoods and the world beyond, we must deal with classes of places—sorts of places which do not exist "out there" but are products of the human mind… As generic places, they have no latitude—no matter how much we take in describing them. They have no longitude. But without them we cannot navigate in today's world" (Clay 1994, p xix).

As Clay has offered up his real places, designers and planners are developing a new language of their own through which to address the modern landscape. These newly created site typologies simultaneously imply certain kinds of physical space, certain existing conditions, and a set of outcomes. In *Manufactured Sites*, Niall Kirkwood offers up three definitions to the title term: 1) “a class of site found in older manufacturing cities and towns and whose present condition is a result of manufacturing and industrial processes or disposal of waste;” 2) “it can signify both the presence of environmentally challenged sites and the relationship to process and techniques used to clean up these conditions;” and 3) “it presents an interdisciplinary approach to reclaiming sites altered by industrial activity” (Kirkwood 2001, pp 4-5).

Another term for “manufactured site” is brownfield, the first in a rainbow of “-fields” being coined. There are brownfields (contaminated former industrial sites), grayfields (derelict commercial spaces), greenfields (sites of undeveloped land on rural fringes receiving sprawl development), and most recently redfields (foreclosed properties that clog local real estate markets). Like manufactured sites, all of these typologies suggest certain problems and solutions in their identification that are richer than the narrower categorizations offered by LAF. Collectively, they suggest a new vocabulary of sites that begins to create a more robust approach to site typology that achieves the ecological richness Corner hints at (Corner 2006, pp 29-30). Think of waterscapes as “bluefields” that contribute to a family of contemporary site typologies.

These terms connect physical sites to the economic and social processes at work on them, much more effectively than particular use-oriented taxons like “park,” “cemetery,” or “mixed-use development.” Their utility at mobilizing interest and capital towards addressing the issues associated with the sites suggests the importance of this kind of approach for thinking about and categorizing sites.

The Northeast-Midwest Institute, a nonprofit think-tank focused on an area of the country also known as the Rust Belt, held the first conference on brownfields in 1991, bringing the first of these terms into the professional lexicon (Northeast-Midwest Institute, n.d.). Interest in the remediation of those sites, a common problem in that region’s industrial cities, grew quickly thereafter. In 1995, the Environmental Protection Agency launched its brownfields program, providing resources to communities across the country to address these sites (US Environmental Protection Agency 2012). Redfields, the newest addition to the spectrum, emerged in 2010 from an initiative at Georgia Tech. Sprawl-heavy Atlanta was the initiative's first focus (Lerner 2010). The project quickly drew interest from community improvement districts around the city, which began pooling funds for such an initiative in Atlanta as part of a match for a federal stimulus money bid (Landscape Online 2013).

In Europe, where urban development is much more intensive, efforts like "Circular Flow Land Use Management" (CircUse) attempt to address the question of growing population and limited land. The developers of this approach say that new typologies are an important part of this work: "Circular flow land use management needs a comprehensive definition of land types (incl. greenfield and brownfield areas)" (Preuss, Verbucheln et al. 2011). CircUse site types include brownfields, greyfields, greenfields, and remnant gaps in the urban landscape. They categorize sites based on its phase of development (or abandonment) as well as spatial attributes (Otparlik, Siemer et al. 2011). Those ideas of process and production of wasted or underutilized land are reminiscent of Alan Berger's conception of "drosscape," another process-oriented site typology (Berger 2007).

The German concept of "Leitbild" is a useful one, and suggests a more synergistic approach to the design of landscapes. Leitbild is defined in planning contexts as "something that describes a desired future state for a landscape or region, and a set of proposals or guidelines about how that state can be realised or achieved" (Potschin, Klug et al. 2010, p 657). Leitbilds "combine natural, social, economic, and political sciences and that the synergies of all together increase the knowledge about feasible landscape change towards an aspired future state" (Klug

2012, p 617). A holistic framework such as this could be useful to the envisioning and implementation of sustainable rivers.

And though sustainably managed rivers are an important goal, retaining an ability to see and evaluate rivers critically is also an important consideration. Rivers are curious objects, defying our conventional approaches to defining and designing space. At a certain scale they are linear systems, simultaneously narrow in physical footprint, and regional in influence and relationship. At closer scales, they are incredibly rich spaces, producing a variety of physical and ecological configurations in response to variations in flow.

Like Leitbilds, these contemporary typologies, including brownfields and waterscapes provide that synthesis, pulling together a more complex understanding of site from outside typical design description, be it the soil chemistry of a brownfield site or an evaluation of the complex web of relationships that surrounding a hydroelectric power plant, and also imply a certain set of possible outcomes.

The idea of "waterscape," standing on its own, is not intended as a new design philosophy to compete with the various "-isms" that fade in and out of fashion in design discourse (though Chapter 4 will suggest a range of design moves that may contribute to the development of "sustainable waterscapes"). Rather, it is an addition to the range of contemporary site typologies that designers are beginning to address in modern practice, though waterscapes are notably more diffuse in terms of scale than many of these other spaces. Waterscape is a way to describe the places where the particular problems of rivers are made most apparent, and the infrastructures that create or address those problems. Waterscape collects and synthesizes kinds of places that designers know and work with frequently, but do not currently have a name for.

The identification of these kinds of site typologies can mobilize attention to the problematic landscapes they capture.

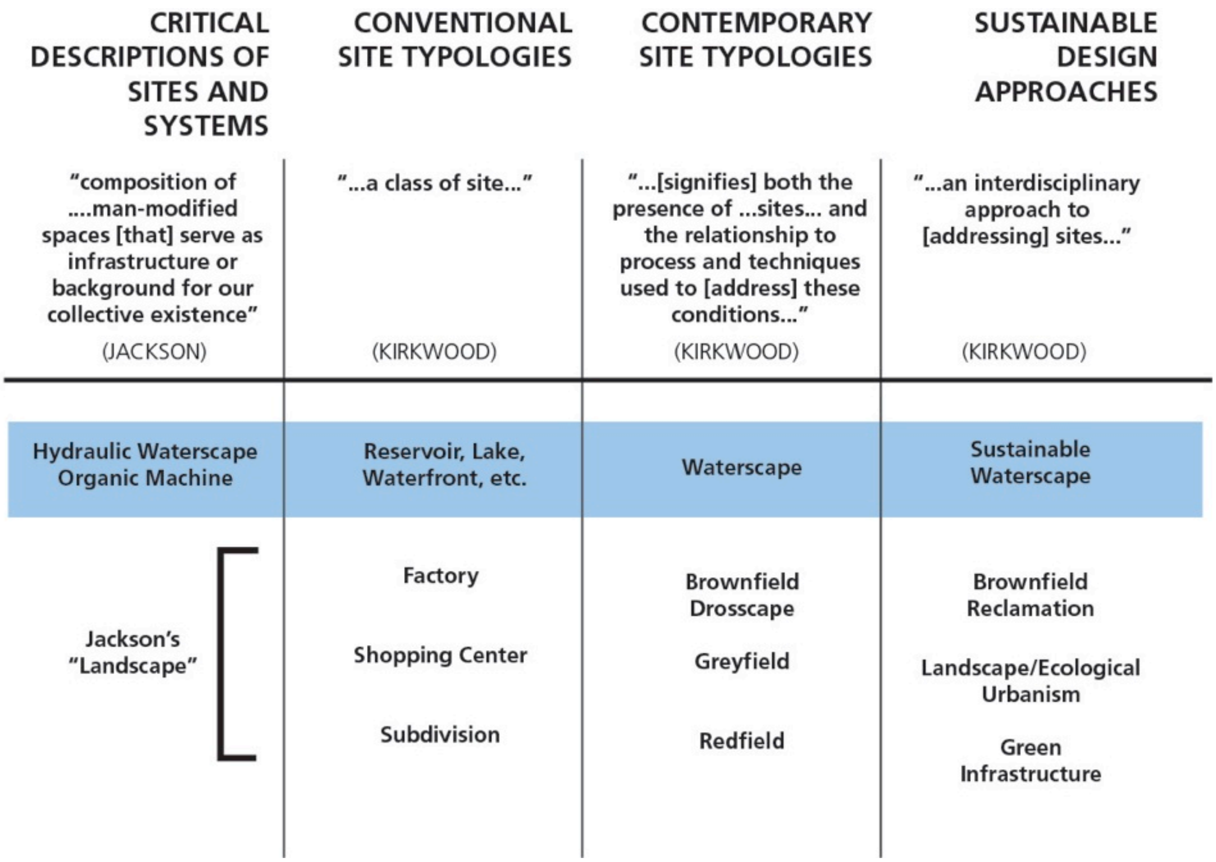

Figure 8. Relationship of "Waterscape" to site typologies and design approaches (Source: Author)

As the diagram above shows, we have many ways of describing places, from the more historical, critical, and sometimes conceptual analyses of landscapes and waterscapes that authors like Manganiello and Jackson offer, to more descriptive, or process-oriented typologies of particular kinds of spaces. Those typologies often have relationships between one another and to specific approaches that address them, following Ndubisi's argument outlined in Chapter 2. The term waterscape, as used to describe systems of spaces related to river infrastructure here, fills a critical gap in our contemporary language of sites, spaces, and landscape. And though organized with brownfields, greyfields, and other more conventionally delineated if similary process-influenced sites, "waterscape" necessarily operates at a fuzzier scale, oscillating between site and system in its scope in response to the dynamic human and physical components of river systems and infrastructure.

The remainder of this chapter explores the need for waterscape as a frame for unseen sites, the typology's relationship to theoretical conceptions of "landscape," and how waterscape can be refined from its critical usage to one more appropriate to design inquiry.

FINDING WATERSCAPES

The Savannah River is the border between South Carolina and Georgia. Politically, it is an edge, a fringe. This is a common condition. An analysis of 35 of the world's largest rivers found that over 80% of those rivers flowed between two or more nations (Varady and Morehouse 2003, p 143). A quick glance at a map of the United States reveals a similar pattern at lower levels of government. The Chattahoochee River forms much of Georgia's western border, and a portion of its southern edge follows the St. Mary's River. The Potomac separates Maryland and Virginia, and the Ohio separates Kentucky from states to the north. Ten states rely on the Mississippi to define their jurisdiction. At the county level, similar trends can be seen.

Streams and rivers are readily visible features in the landscape, much more apparent than the often subtle lines of watersheds, which are just as likely to be formed by gentle folds and hills as knife-edge mountain ridges. In the days of treacherous fords and harrowing ferries, rivers were significant barriers to travel. Their frequent use as a boundary between spaces is therefore unsurprising. The results however, have made once-apparent rivers significantly less so. Rivers become shared spaces, requiring interest from and cooperation between multiple entities and rarely achieving either. Water's frequent status as a border has often given it an often distant position in the realms of those who govern it: “the persistence of political and administrative practices that treat border areas as peripheries has prevented transboundary management issues from receiving the attention they deserve” (Varady and Morehouse 2003, p 143).

Despite their apparentness on maps, and utility in demarcating space, riparian corridors’ role and position in the human landscape is under-appreciated. Their physical character and arrangement is often hidden or difficult to understand. In many cases, riverine, riparian, and upland landscape slowly shift into one another, requiring a fuzzier conception of space.

In addition to the ambiguous political status hydrologic corridors often attain due to factors like those above, they are rarely experienced in a way that illustrates their relationship to the landscape. In the modern landscape, river and stream corridors may be hidden in backyards, or channelized in pipes and culverts. When they are seen, it is often in a disconnected fashion. They are bridged and impounded with perpendicular structures. As these crossings are experienced, only disembodied glimpses of corridor fragments are offered, with an unclear position in the system. Travel along riparian corridors--and the experience of the river’s linear character that this affords--happens less frequently.

Kevin Lynch’s notions of legibility provide an important lens with which to evaluate the visibility and comprehensibility of riparian spaces. Lynch defines legibility of a city as “the ease with which its parts can be recognized and can be organized into a coherent pattern.” He goes on to say “a legible city would be one whose districts or landmarks or pathways are easily identifiable and are easily grouped into an over-all pattern” (Lynch 1960, pp 2-3). Lynch’s descriptions of the riparian environments in the cities he studied illustrate that legibility is not a quality that they often possess, and hint at the difficulty in perceiving waterscapes.

Description of the Charles River, in Boston, Massachusetts:

> *The water edge on the other side, the harborfront was generally known, and remembered for its special activity. But the sense of water was less clear, since it was obscured by many structures, and since the life has gone out of the old harbor activities. Most subjects were unable to interconnect the Charles River and Boston Harbor in any concrete way. Partly this must be due to the screening of the water at the tip of the peninsula by railroad yards and buildings, partly to the chaotic aspect of the water, with its myriad bridges and docks, at the meeting of the Charles River, the Mystic River, and the sea. The lack of frequented waterside paths, as well as the drop in water level at the Dam, also breaks the continuity. Farther west, few were aware of any water in the South Bay, nor could they imagine any stop to development in this direction. This lack of peninsular closure deprived the citizen of a satisfying sense of completion and rationality in his city.* (Lynch 1960, p 62)

Description of the Hackensack River in Jersey City, New Jersey:

> *In Jersey City, the waterfront was also a strong edge, but a rather forbidding one. It was a no-man's land, a region beyond the barbed wire. Edges, whether of railroads, topography, throughways, or district boundaries, are a very typical feature of this environment and tend to fragment it. Some of the most unpleasant edges, such as the bank of the Hackensack River with its burning dump areas, seemed to be mentally erased.* (Lynch 1960, p 63-4).

Even Lynch's description of the Los Angeles freeways, which weave submerged through the city, provides an opportunity to understand how difficult rivers are to see:

> *Freeways, which also can be thought of as major boundaries, and are both much more important as paths and physically imposing. The fact that Figueroa and the other surface streets are conceptually part of the general grid, and have been familiar for some time, as well as the relative invisibility of the depressed or landscaped freeways, all conspired to erase these freeways from the image. Many subjects had difficulty in making a mental connection between the fast highway and the remainder of the city structure, just as in the Boston case. They would, in imagination, even walk across the Hollywood Freeway as if it did not exist.* (Lynch 1960, p 65).

Though Lynch's observations are many years old, the kinds of conditions he describes often persist, though in some cities new waterfront parks have begun to reconnect people and their rivers and harbors, and efforts related to Green Infrastructure and Landscape Urbanism do strive to these illustrate these processes in the landscape.

Nonetheless, rivers and streams remain difficult to perceive spaces, often out of sight or on the edges of the spaces we inhabit. This is despite their central place in the logic of the physical landscape. These corridors are the organizing features of topography, the gravitational low points that entire landscapes orient toward. As the examples in the previous chapter illustrate, our focus is often much more on cities, forests, and other terrestrial environments. In managing ecosystems and achieving sustainable goals, this may be appropriate, as these spaces are much more expansive, and our use of them much more apparent and impactful. But it may just as likely be a product of the biases in spatial organization and language that deemphasize rivers. What is needed is a way of describing water systems that puts the focus on them, and treats them as the central elements they are, recognizing the unity of relationship and form that they give much of the landscape.

FRAMING WATER SYSTEMS

Although water may be difficult to locate conceptually and in space, this isn't to say that water is a mystery. Manipulation of water is an important part of landscape architectural practice. There are fountains and ponds, rain gardens and bioswales, greenways and waterfronts. But for all of this attention, water and the riparian systems that convey it seem to retain a secondary and peripheral status in the theory of landscape. We have a rich vocabulary with which to describe water, the forms it takes, and the spaces it defines. Between the arbitrarily small reach and large watersheds, encompassing the maximal level of hydrologic connectivity (at least on the surface) is a broad spectrum of features, often distinguished by size. There are pools and ponds and lakes of still water. In motion, there are streams, creeks, and branches, rivers and tributaries, capable of being precisely placed and classified by order within the watershed. There are floodplains of varying size, defined by probability of inundation, and artifacts of specific geomorphological origin, such as shoals, rapids, and cataracts; swamps, marshes, and bogs; arroyos and washes; oxbows, wetlands, and carolina bays.

There is also a stronger, critical vocabulary of water being developed by historians, human geographers, and others that gives water systems a great deal more agency in the environment and speaks to the nuanced relationships between water systems and humans. Referring to the oldest of these relationships, the term "hydraulic civilizations" describes "a specific type of social formation founded upon centralized state authority with its own forces and relations of production emerging out of water engineering and control" such as early societies that developed irrigation and agriculture (Cosgrove and Petts 1990, p 2). In developing this concept, the authors argue that the "control and appropriation of water have been fundamental to the building of human cultures and civilizations" (Cosgrove and Petts 1990, p 2). Richard White, describing the manipulation of the Columbia in Oregon and Washington for first salmon then hydroelectric power says "...the Columbia is not just a machine. It is an organic machine. Our tendency to break it into parts does not work. For no matter how much we have created many of its spaces and altered its behavior, it is still tied to larger organic cycles beyond our control" (White 1995, pp 111-2). Christopher Manganiello uses the term "hydraulic waterscape" to describe the various eras of exploitation of the Savannah River, including "the hydroelectric dams, transmission lines, and reservoirs with their associated leisure economies" as part of the same conceptual space as the river itself (Manganiello 2015, p 7).

These characterizations are in many ways similar to the theoretical approach given to the concept of "landscape." In analyzing the linguistic origins of "landscape," and its migration into the English from the German *landshaft*, JB Jackson, in *Discovering the Vernacular Landscape*, proposed a new, and more active definition than its typically scenic usage. He establishes landscape as "a composition of man-made or man-modified spaces to serve as infrastructure or background for our collective existence" (Jackson 1984, p 8). He also identifies a much older definition of waterscape, dating back a millennium, that mirrors Manganiello's usage:

> *An English document of the tenth century mentioned the destruction of what it called a "waterscape." What could that have been? We might logically suppose that it was the liquid equivalent of a landscape, an ornamental arrangement, perhaps, of ponds and*

> *brooks and waterfalls, the creation of some Anglo-Saxon predecessor of Olmsted's. But it was actually something entirely different. The waterscape in question was a system of pipes and drains and aqueducts serving a residence and a mill.* (Jackson 1984, p 7)

From Jackson's analysis, we can draw two important historical variables that landscape and waterscape, in their modern, critical usages, continue to share. Firstly, he suggests that a landscape is "a man-made system of spaces superimposed on the face of the land," and secondly, that it functions "to serve a community." These factors are shared by the idea of waterscape, as defined by Manganiello, and resonate with White's conception of rivers as organic machines. Arguably, both waterscapes and landscapes are infrastructural systems of spaces that do work beyond providing scenic benefit.

The themes of work and energy are especially important in Richard White's conception of rivers. "Like us, rivers work," White says, "They absorb and emit energy; they rearrange the world" (White 1995, p 3). That work can be the redistribution of calories from the ocean to inland ecosystems via spawning salmon or the conversion of potential to kinetic energy by water traveling downhill. According to Jackson, a landscape is "a space deliberately created to speed up or slow down the process of nature" (Jackson 1984, p 8). This hints that these "scapes" are places where we manipulate natural processes to our own ends. And if a landscape is a space where we are harnessing the work of a terrestrial system, such as the conversion of sunlight into stored energy or natural resources by crops and trees, then the spaces where we capture a river's energy for similar purposes is a waterscape.

Though Jackson emphasizes our control over the natural landscape, it is important to bear in mind nature's agency as well: "...The river we have partially created changes before our eyes, mocking our supposed control. It changes, and as it changes, it makes clear the insufficiencies of our own science, society, and notions of justice and value," says Richard White (White 1995, p 113), a reminder that is just as relevant for terrestrial sites as riparian ones. Indeed, granting agency to the natural forces acting on the non-riparian environment is an important contribution to thinking about landscape that waterscape offers.

This may seem like a distinction without difference, especially given the ubiquity of "landscape" in our general vocabulary. Landscape, after all, is the vessel that contains the water passing over it, and water is a formless liquid, taking the shape of its container. Not reflected in this line of thinking is water's ability to reconfigure landscape, or the fact that in many cases, the land around a water system is rather irrelevant. What's more important is the channel itself; properties such as flow, depth, and gradient are much more significant for many of the infrastructural uses of rivers. With all that we ask of water systems, the concept of waterscape as a distinct kind of space is relevant and needed in the design and management of the spaces where water plays an outsized role.

DEFINING WATERSCAPE

There are many potential infrastructural demands to consider when evaluating a particular reach and its position within a broader waterscape. When USACE was initially planning the Savannah River system, they argued for several benefits, including "reduction of dredging costs in Savannah Harbor; reduction of saltwater intrusion into the lower reaches of the river; and benefits to recreation, wildlife, and general industrial development..." with the primary purposes being "flood control, navigation improvement, and power development" (US Army Corps of Engineers, n.d). Other human demands on the Savannah include drinking water supply, industrial withdrawals, discharge of treated effluent, and discharge of warmed water from the Vogtle Nuclear Plant's cooling systems. Environmental regulations for downstream flow and habitat connectivity also place claims on a river's resources.

But how do these various uses inform the physical space of a waterscape? Developed as he studied the Savannah's numerous dams, Manganiello's definition is expansive, describing networked assemblages spanning many miles (Manganiello 2015). The waterscape built by Georgia Power on the tributary Tugaloo and Tallulah, following Manganiello's definition, would include not only the dams and reservoirs, but the many communities of Rabun County where these six lakes are located, transmission lines reaching to Atlanta, and even the streetcars that were historically powered by the system. Likewise, the three dams that comprise the USACE's flood control project on the Savannah are linked to Augusta, the city they purportedly protect. Even the Augusta Canal's waterscape, though a much more legible and contiguous space, is still quite interwoven with the city, with a network of canals and outfalls bringing water from the canal through buildings and under streets before returning water back to the river. The expansiveness of these waterscapes could be seen as an argument against the utility of the term. However, its value as a critical framework is one that those working with water systems should take note of as they consider the external forces at work on more bounded sites.

The notion of "reach," used more by ecologists and geomorphologists than designers, presents another interesting analogue for framing rivers and streams that may be of more use to designers and planners. In geographic contexts, a reach is generally defined as an arbitrarily long continuous stretch of a river or stream (Langbein and Iseri 2014).[1] "Site" is its terrestrial twin, defined by a specificity of position rather than size. It further emphasizes the broader

[1] Though in the context of stream restoration, Dave Rosgen does offer a more specific measurement for reference reach of twenty times a stream's bankfull width, or long enough to capture two meanders. http://www.wildlandhydrology.com/assets/The_Reference_Reach_II.pdf p6

conceptions of water available to designers, should they begin to give riparian corridors greater theoretical weight.

Site descriptions of river sites and reaches can also vary in how far into the surrounding landscape they extend, from “bankfull” widths to 100-year and 500-year flood plains. Changing jurisdictional relationships between land and water also highlight the range of scales and scopes that river spaces can take. A proposed rule from the EPA would expand legal “Waters of the United States” under regulation to include wetlands that have a “significant nexus” with waters traditionally considered state waters (Rojas 2014).

The critical approach offered by historians like White and Manganiello offers a new way of seeing rivers for the complex systems that they are. Terms like waterscape give life to the arguments that underlie them, providing an easier way for landscape architects and planners to describe the work that they in many cases are already doing with river systems. Landscapes and waterscapes are both complex, and relationships extend far beyond the property lines or site boundaries. Embracing fuzzy boundaries is essential.

Manganiello’s definition of hydraulic waterscapes presents a more complex network than may be useful for effective design intervention at river sites. In order to properly frame the term for use in design, rather than critical and historical contexts, some qualification is required. Like landscapes, waterscapes can be considered to be collections of spaces as much as systems, containing proximate features, including physical, biological, and human-made components, historical and contemporary. They may include lands directly related to those processes such as oxbows, wetlands, floodplains and canyon walls in the case of natural features, or spillways, levees, recreation areas, and associated developments. These spaces will have unique associations and processes that shape them—climatic, ecological, social, and economic—and that connect them to other waterscapes, and landscapes.

CONCLUSION

Though the relatively modern problems of the Savannah suggest that "waterscape" has important work to do describing and addressing contemporary sites, the term—and the systems it describes—has a rich history. At its best, our vocabulary of space should conjure not only simple physical elements of sites, but the relationships and processes that shape them. Rivers and their overlaid infrastructures are complex systems of spaces, and we need to develop typologies that can capture those ideas more effectively than simple nouns like "waterfront" or "reservoir." Waterscape could do that job. By coopting waterscape as a landscape typology, rather than as a critical or conceptual descriptor, the term can be operationalized by designers, and investigated through the design process. This frame, which focuses on the demands of rivers as economic and social, as well as ecological infrastructures, invites scrutiny into how those goals are balanced, and whether they can be in a holistic and sustainable manner.

In the next chapter, built and proposed projects that fall within the realm of waterscape as a physical, designed space will be considered. Collectively, these projects will better illustrate waterscape as a unique class of site, and suggest the formation of an approach for creating sustainable waterscapes.

CHAPTER 4

PRECEDENTS FOR SUTAINABLE WATERSCAPES

The following projects are prominent examples of engineering and design that are often considered atypical solutions to the question of river management, but are nonetheless successful and prominent in discussions of infrastructure. They are organized directly around their respective waterways, and combine a variety of programmatic goals into uniquely synthetic spaces: sustainable waterscapes. Starting in the 19th century, when Landscape Architecture and other disciplines were just beginning to establish themselves as professions, and moving forward in time, these case studies highlight an important and successful if seldom-employed typology of design for waterways.

The first three of these, in Boston, Ohio, and Los Angeles, are important mileposts that show the way toward a new typology of sustainable design focused specifically on rivers, which is being referred to here as “sustainable waterscapes.” Some of the methods employed in these three projects are also applicable to the Savannah. For instance, the Miami Conservancy District was created for the purpose of flood control, like USACE’s three reservoirs.

The fourth project, in nearby Columbus, Georgia, though only recently completed and without a great deal of critical discussion, is included because it addresses a river that is very similar in character to the Upper Savannah. Each of these projects, though developed in a specific context, and not necessarily as part of a sustainable dialogue, contributes to the development of a family of projects that show alternative methods of river development, a new typology of site and approach.

THE EMERALD NECKLACE, BOSTON

Watercourses figure prominently in Frederick Olmsted's work. Sites like Prospect Park in Brooklyn feature complicated series of pools and streams, all designed (Prospect Park Alliance 2013). But these do not rise to the ambitiousness of waterscape, as it could be used to answer the question of rivers. Central Park could be considered part of a waterscape of sorts, with two drinking water reservoirs located the site historically. One has since been torn down, and the other decommissioned to serve only as a lake (Central Park Conservancy 2014). The end point of the Croton Aqueduct, those features date back to the 1840s. Water from the Croton River in nearby Westchester County, NY was pumped to growing New York City, and stored in the park (NYC Environmental Protection 2014). Though the Central Park landscape coincided spatially with the Reservoir system, the systems don't conceptually mesh.

In Boston, however, we see a much more realized hybrid system that provides an important milestone in developing waterscapes. Over almost twenty years, Olmsted worked to create the Emerald Necklace along the Muddy River, from Jamaica Pond to the Back Bay Fens (Beveridge and Rochelau 1998, p 86). Though manipulation of water was the project's primary purpose, it also included transportation and recreation elements, including a complex system of paths and parkways.

Figure 9. Muddy River under construction. (Source: http://tpsnva.sonjara.com/primary_sources/item.php?item=18434)

Engineers initially considered concrete infrastructure, but Olmsted instead proposed a naturalistic channel to provide for flood control and sanitation. The project transformed a blighted urban dumping ground (Spirn 1998, p 104). In addition to carefully crafted channels along the Riverway, the Fens include specialized shelves to control flows and provide space for flood waters; at high water, over 50 acres of surface water would be contained in the space (Beveridge and Rochelau 1998, p 85). This may be one of the first instances of an artificially constructed wetland (Spirn 1998, p 104). Olmsted saw the Back Bay first as an infrastructure project, and called it the "Muddy River Sanitary Improvement," avoiding use of the term "park" to describe the site (Beveridge and Rochelau 1998, p 83).

The project is a favorite of the Landscape Urbanists, which is cited throughout their *Reader* as an early example of the kinds of hybrid infrastructure they aspire to. Elizabeth Mossop says that “Frederick Law Olmsted’s proposals for Boston’s Emerald Necklace illustrate the intertwining of transport infrastructure, flood and drainage engineering, the creation of scenic landscapes, and urban planning. Here the close collaboration between landscape design, urban strategies, and engineering produced a complex project integrating ideas about nature and infrastructure as well as health, recreation, and scenery” (Mossop 2006, p 165). And Charles Waldheim calls the project a “canonical example” of integrating landscape with infrastructure, though he comments on a “camouflaging of ecological systems within pastoral images of ‘nature’” (Waldheim 2006, p 39). And Jacqueline Tatom praises the project’s “spatial cohesiveness” which she says emerge from a pairing of “diverse urban and natural elements that is both deliberate and opportunistic” (Tatom 2006, p 186). She further characterizes it as a “highly constructed urban landscape” where “nature and infrastructure are put to the service of making places for people to be” (Tatom 2006, p 187).

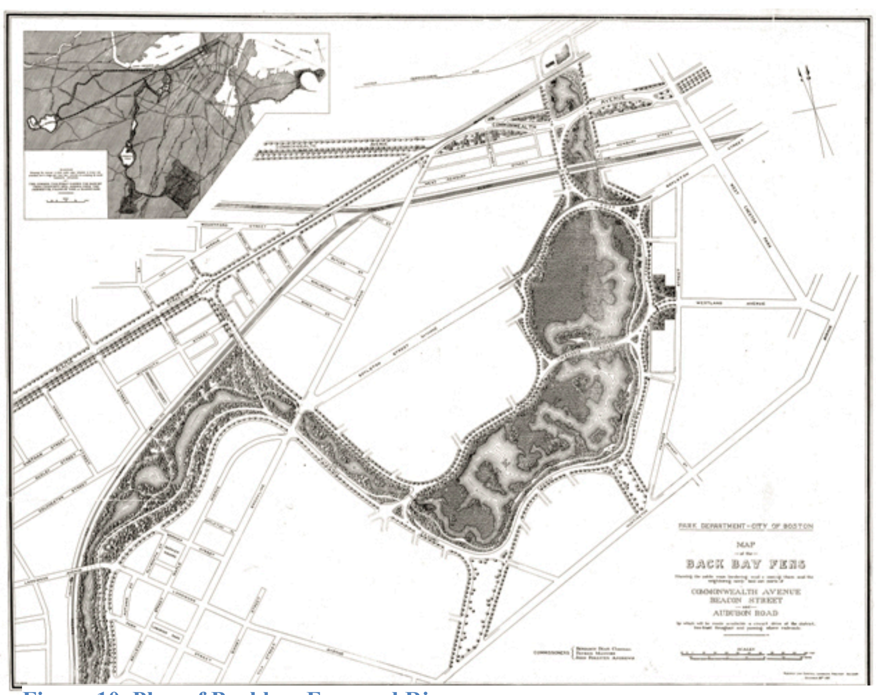

Figure 10. Plan of Backbay Fens and Riverway

(Source:http://www.olmsted.org/storage/images/FLO_Papers_Images/03_The_12_Volumes/Volume_8/1503-00916-09_FLONHS_plan_00916-1887_litho.jpg)

But Spirn considers the project to be almost too successful at blending infrastructure and its “natural” setting. Though wholly constructed, their naturalistic design of the plantings may have masked the design over time, which is why the project has been so little repeated. She writes that “on the one hand, their ‘natural’ appearance concealed their construction; on the other, the persistent mental opposition of nature and city gradually eroded the memory of Olmsted’s contribution” (Spirn 1998, p 108). Based on these analyses, it appears that Olmsted was highly successful at blending infrastructure, environment, and social programs along the Muddy River.

Although situated in coastal and urban conditions, the project is compelling for the level of unity the design achieves between ecological, social, and infrastructural programs. The scale and context of the project may not make the design itself directly applicable to the Savannah, but that unity in the design is a good measure with which to compare other waterscapes as distinct designed spaces.

THE MIAMI CONSERVANCY DISTRICT, OHIO

The Army Corps of Engineers has long been a primary agent of flood control and river management projects in the United States. Throughout the country, they built massive dams as part of large multi-purpose projects, including the four structures on the Savannah. Lake Lanier and other dams on the Chattahoochee are other regional examples of their work. Another model, on the Miami River, in Ohio, provides an entirely different approach to addressing flood control. The project is distinct in terms of both its physical form, and the political and social framework that created the system.

In March of 1913, a devastating flood hit the Miami River Valley, flooding several communities, including Dayton, the largest in the area. The flood killed 361 and caused over $100 million in damages (Sealander 1988, p 45). Response to the disaster was primarily led by progressive local businesses, and the infrastructural response thereafter was similar in its community focus (Sealander 1988, p 53). The community at large even contributed directly to the financing of the project, with over $2 million in support of the project contributed through

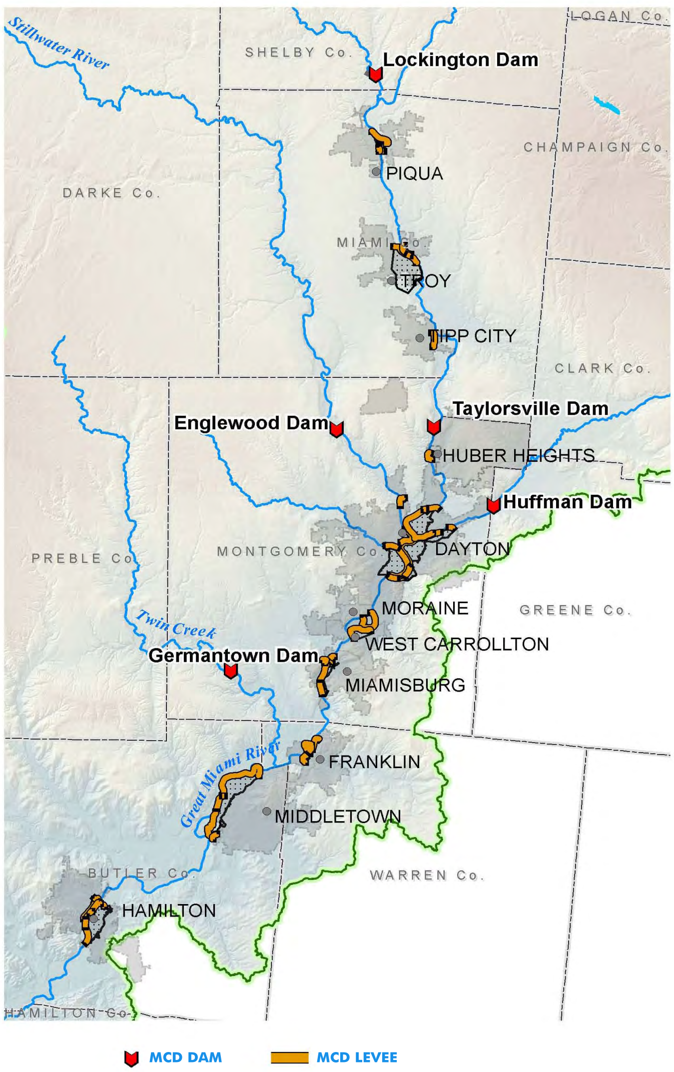

Figure 11. Miami Conservancy District system. (Source: https://www.miamiconservancy.org/flood/pdfs/MCD_dams_levees.pdf)

fundraising rather than taxes (Sealander 1988, p 56). Though initially levees and other conventional infrastructure were proposed, an alternative approach, using "dry dams" that would protect the entire valley were found to be considerably cheaper than conventional improvements for Dayton alone (Giertz 1974, p 65).

The solution was a series of five "dry dams," distinct from typical dams for flood control in that there is no standing reservoir, but rather "retarding basins" that mimicked the behavior of natural floodplains. Four of these were located upstream of Dayton, with one below. Designed to last "a thousand years," the project was conceived as a "reshaping the region's topography," and the earthen dams were characterized as large hills rather than dams by their designers (Sealander 1988, p 59). At the base of each structure is a conduit for water that allows for continuous base flow of the river, but restricts flows above a rate so as not to inundate downstream areas; rather than the water contained in a massive flood passing through the valley in two to three days, the dry dams release it in smaller amounts over ten to twelve days (Sealander 1988, p 58-9).

Other design details included a ring of concrete pillars upstream of the concrete conduits, intended to catch debris moving downstream and prevent clogging, and a specialized shape for the bottom of the conduit to diminish the erosive force of the water as it leaves the conduit. Upstream of each dry dam, large protected floodplains were established, primarily used for recreation and farming, and totaling over 30,000 acres. When flood levels were reached, the river would become a calm lake, spilling out onto the floodplain and depositing sediment to the benefit of farmers using the land. The basins have a capacity equal to 140% of the 1913 flood. The system, with no floodgates or moving parts designed to operate entirely independent of human control, and render the valley "forever floodproof" (Sealander 1988, p 60-1). Construction of the project was completed in 1922 (Sealander 1988, p 75).

Shortly after the flood, legislation was introduced in the Ohio legislature that would allow local communities to create “Conservancy Districts.” Five hundred signatures on a petition would trigger development and consideration of a plan, debated by the public, and evaluated by a “conservancy court” comprised of judges from affected counties. If deemed to be a worthwhile project, the District would be created as a special political organ of the state, with various powers including eminent domain and taxation (Sealander 1988, p 62-3).

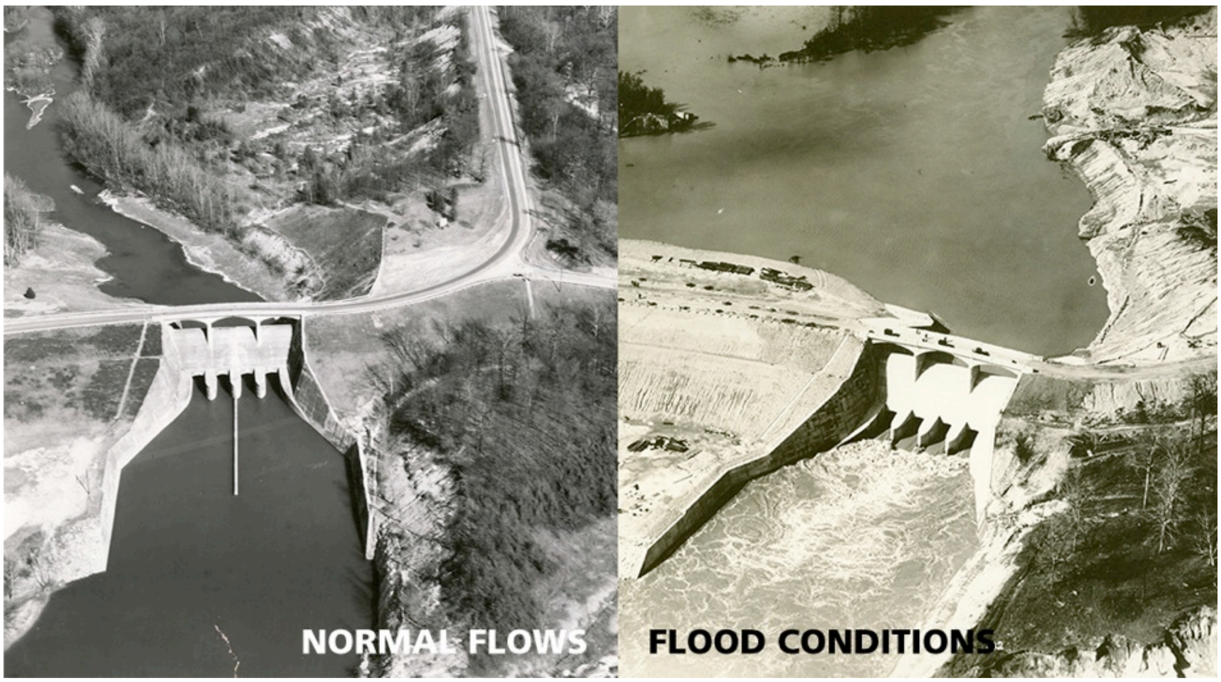

Figure 10. Taylorsville Dam under varying flow conditions (Source left: http://www.libraries.wright.edu/special/ddn_archive/DDNUploads/2013/03/DDN_Miami-Conservancy-District_16.jpg Source right: http://www.libraries.wright.edu/special/exhibits/1913_flood/images/MS128_1_12_4.jpg)

Elmer T. Peterson, writing in protest of large dams proposed in the Midwest planned by USACE, held the Miami Conservancy District up as “admirable” example of flood control planning through local control, saying “One of the best devices for restoring autonomy is the setting up of conservancy districts under state laws, whereby local communities can initiate whatever action they see fit...” (Peterson 1954, p 34). The loss of local control, either due to federal or for-profit management was also a concern to the builders of the dry dams. They worried that should the federal government manage any flood control structures, they might be more concerned with flooding downstream on the Ohio and Mississippi, building larger than necessary structures, and negatively impacting the communities that the infrastructure supposedly would help (Giertz 1974, p 65).

Citizens were also worried that should hydroelectricity be made a part of the project, the desire for profit would conflict with the goal of disaster protection (Sealander 1988, p 68). To warn against such a fate, the builders carved on each structure the following warning: “The dams of the Miami Conservancy District are for flood prevention purposes. Their use for power development or for storage would be a menace to the cities below” (Peterson 1954, p 58). In many ways, the Savannah River Basin illustrates the prescience of the warning engraved on the MCD dams. Had the Savannah project instead incorporated several dry dams, much of the sprawling lakeside development surrounding Hartwell and Clarks Hill might not have occurred.

The creation of a political unit organized around rivers is a compelling feature of the Miami Conservancy District’s approach. Compared to USACE’s multi-use projects, the MCD demonstrates an attenuation to local communities, human and ecological, that is found nowhere else in the United States. Further, with citizens’ dollars directly invested in the project, the design is cognizant of operational and maintenance costs and is decidedly more resilient than structures developed by USACE, requiring little human supervision to do its job. The model of local control is one that could be relevant to Georgians both in the Savannah River Basin and further abroad, providing revenue and local control for projects to improve water supply within river basins, an alternative to state-level planning and the risks of interbasin transfers that that invites. Additionally, the affordability of the structures, and low-tech approach to long-term costs that the design of dry dams embody, are two priorities that should guide all infrastructure projects that aspire to sustainability.

LOS ANGELES RIVER REVITALIZATION MASTER PLAN

In September of 2013, the Army Corps of Engineers' Los Angeles District released a draft feasibility study evaluating the restoration of eleven miles of habitat along the Los Angeles River and began soliciting public comment (Scopek 2013). Slicing through the heart of the region, the 51-mile river is channelized in a trapezoidal conduit for much of its length, an imposing and unwelcoming feature for both humans and wildlife. The project, designed to control the area's dramatic flash floods, was built in the 1930's. Seventeen significant floods had been reported since the city was first established; even with this extensive treatment, the city still flooded, requiring extensive levee expansions (Salazar 2013). The proposed revitalization project would be a substantial step toward restoring the ecological function of this heavily impaired system.

Since the 1980s, advocates and public officials in the City of Los Angeles have been slowly exploring the idea of a restoration of the Los Angeles River. Several non-profit organizations and government committees have been established that now focus on the river and have contributed to the development of many small projects that contribute to a more natural LA River corridor (City of Los Angeles 2014). In 2007, a comprehensive vision for the river, entitled the *Los Angeles River Revitalization Master Plan* (LARRMP), was released. It aims to restore "ecological and hydrological functioning" of the LA River "through re-creation of a continuous riparian habitat corridor within the channel, and through removal of the concrete walls where feasible" (City of Los Angeles 2007, p ES-8). The project proposes new multi-purpose green spaces for flood control along the corridor that would function as habitat, as well as park space for nearby communities, many of which are low-income. The social dynamic in these sites is an especially important one, and the project is framed in environmental justice terms as well. Many of these new spaces would be reclaimed from industrial uses, such as rail-yards. (City of Los Angeles 2007, p ES-3).

Figure 11. Current conditions for Los Angeles River (Source: http://geology.campus.ad.csulb.edu/people/bperry/GrantPhotos/SanGabMtns1Dec05/009LARiver710FreewayBellGardensBellDec05L.jpg)

Figure 12. Proposed improvements to LA River (Source: http://www.lariver.org/stellent/groups/electedofficials/@lariver_contributor/documents/contributor_blogentry/lacityp_026821.jpg)

The bulkheads that currently contain the river will likely never completely go away. In many sites, the Master Plan takes the concrete river corridor's design language as a starting point, and considers how this flood control infrastructure can be adapted into a space that accommodates other users. Concrete channel bottoms are proposed to be removed, and meanders created that allow for vegetation to grow (City of Los Angeles 2007, p 4-5). Human-scaled terraces and steps, rather than consistently sloping walls allow for interaction with the water. In other cases, where land adjacent to the river is available, secondary channels are proposed that would provide for greater green space creation, as well as additional flood storage; these spaces meet the project goal of actually enhancing, rather than simply maintaining, floodwater storage (City of Los Angeles 2007, p 4-3). In addition to flood control infrastructure, the river is also imagined as an important opportunity to enhance alternative transportation in the city, through creation of a continuous bikeway along the River, with grade separated crossings along its entire length(City of Los Angeles 2007, p 5-5). These crossings would take advantage of the river's "sunken" position within the urban landscape. The vision is well supported by the Los Angeles community, and when USACE released its proposal for public comment, which recommended a slightly less ambitious (and more affordable) restoration of the river, many in the community lobbied for the more extensive reworking (Office of Los Angeles Mayor Eric Garcetti ; Times Editorial Board 2013).

For James Corner, dialogue surrounding the project illustrates conflicting ideas about nature. For USACE, which built the flood control structures, nature is "a violent and threatening force" (Corner 2006, p 25). Advocates of river restoration, on the other hand, focus on a more pristine vision of nature, which flood control infrastructure has marred. He says that for advocates of restoration, the "concrete river channel is not recognized as a landscape element, even though its landscape *function* is solely hydrological" (Corner 2006, pp 25-7). His comments, published shortly before the release of the Master Plan, illustrate the dangers of society-nature binaries, especially in regards to rivers. What the master plan achieves, however, in its vision of vegetated concrete terraces and heavily designed flood control parks, could never have been mistaken for wild or unspoiled nature. The space is obviously thoroughly constructed; nonetheless, it accomplishes many goods for the city, social, economic, and ecological, within the confines of the river's levees.

A compelling aspect of this project is its respect for the LA River's existing levees and concrete features. The design reveals its constructedness much more than works like the Back Bay Fens, which aim for a naturalistic form. A rich variety of river technologies and strategies may await designers who leave some obviously structures in the stream, rather than aiming for totally naturalistic features. In the case of both Augusta and the Georgia Power lakes of North Georgia, the question of how existing infrastructures can be modified while retaining some of its design purposes is particularly relevant.

CHATTAHOOCHEE WHITEWATER COURSE, COLUMBUS, GEORGIA

In 2013, the cities of Columbus, Georgia and Phenix City, Alabama opened what is dubbed the world's largest urban whitewater course. The project, 2.3 miles long, is also one of the most substantial in terms of flow levels. The Chattahoochee River separates these two downtowns, and a series of riverside parks have been created in each. The whitewater project takes the goals of reconnecting to the river even further by turning a series of historic rapids into features for recreation and tourism. (Williams 2013).

Figure 13. Construction of the whitewater course in Columbus, Georgia. (Source: Author)

Two failing dams, obsolete remnants of the area's history as a textile center, were rapidly deteriorating and creating a maintenance concern for the community. Rather than repair the structures, they elected to tear them down, and restore the Fall Line shoals beneath them. The design includes recreational spaces for wading, paddle boarding, fishing, kayaking and rafting, as well as restored habitat (Williams 2013). Species potentially benefiting from the habitat restoration include numerous species listed as endangered or threatened by either the state or federal government, including shoal bass, bluestripe shiner, and other fish species; alligator snapping turtle and Barbour's map turtle; thirteen species of freshwater mussels; and the shoals spiderlily (Paine, Newton et al. 2009, p 515).

The design includes numerous artificial structures in the riverbed and other modifications to the channel. These include recreations features, such as sills, weirs, that produce safe but entertaining whitewater features, and a structure called the "Waveshaper" that manipulates the river's flow to produce standing waves to allow for kayaking "playboating" (Williams 2013). The design of these elements involved extensive modeling of the river's natural and proposed features at a variety of flow levels. Features were designed to allow for safe passage of both people and aquatic creatures. The models allowed designers to identify and eliminate conditions that would trap swimmers, prevent fish from swimming upstream, or trap fish during dry conditions (Paine, Newton et al. 2009, p 516). The design also required coordination with Georgia Power to ensure that an existing dam had enough water to operate its turbines. The reservoir created by the now-removed dam had provided that pool before, and a new structure had to be created to maintain that condition.

The creation of smaller pools tailored to particular infrastructure demands, such as turbine outflows or drinking water intakes, is a strategy that is particularly relevant in cases like Augusta, where so many demands are placed in such a narrow stretch of river. Smaller pools such as these, stepped along a river, could accommodate a variety of infrastructural demands, while still allowing a gentler grade than the severe drops of major reservoirs. The rock ramp at New Savannah Bluff, illustrated in Chapter 1, provides another example of this strategy.

Though some features of the river, such as Coweta Falls, have historic place names, but new names are also being created that reference local culture and history. Class II "Gooder n' Grits" references a mill historically located nearby (Chitwood 2013). John Turner, an instrumental figure in the river restoration project for many years, is presumably the namesake of "Turner's Tumbler."

Though the project has numerous environmental and social benefits, it is the economic argument that drove the project. In addition to the cost savings of removing the dams instead of repairing them, the project is a significant component of an urban economic revitalization strategy. An economic impact analysis for the project predicted that it would draw 60,000 to 100,000 visitors annually, deliver between $7 and $12 million in economic impact to the community, and create 150 to 250 new jobs (Daniels and Lazzara 2005, p iii). Whitewater sports are a growing industry, and Columbus is uniquely positioned in the region to capture some of that interest (Daniels and Lazzara 2005, p 2). The project, focused on the downtown area, also helps to cement that district's competitiveness as a housing and employment location for the region, potentially reducing sprawl (and associated watershed impacts) elsewhere by contributing to the vibrancy of the urban core.

Rather than treating the river as a scenic backdrop, the river becomes a lively component of the city, experienced directly in a variety of ways. Though Augusta lacks the dramatic rapids of the Chattahoochee, a host of other experiences may emerge from a reengagement with the river and encouragement of interaction with water by the city's visitors and residents.

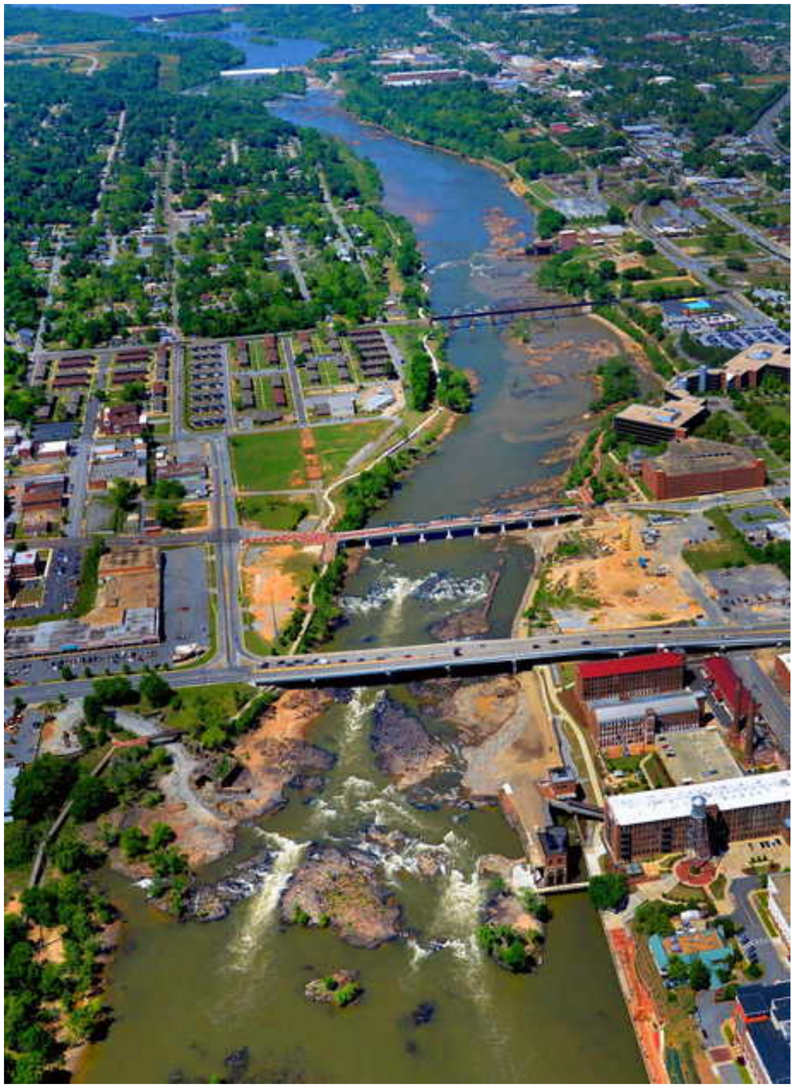

Figure 14. Chattahoochee River in Downtown Columbus, after completion of construction

(Source: http://media.ledger-enquirer.com/smedia/2013/05/23/17/58/9IGW1.AuSt.70.jpeg)

CONCLUSION

The term waterscape is expansive in its descriptive usage, covering both “good” and “bad” sites, at least in the eyes of environmental designers aiming for a more sustainable landscape. Just as the LA River’s revitalization could result in what could be called a sustainably-designed waterscape, its current state, created by USACE over 70 years ago could be consider an unsustainable waterscape. But these four sites illustrate the kind of benefits that can be achieved when rivers are seen as systems, and sustainable design goals are applied.

All of the projects involve a low-tech manipulation of water through structures that shape, contain, or channel it. From the carefully crafted whitewater features in Columbus to the massive retarding basins of the MCD, moving parts are rare. Instead of totally containing or diverting the river's flow, the focus is on manipulating and reshaping the existing flow across a variety of conditions. Designed purposes mimic existing natural features and dynamics, such as the small, in-stream pool of the Chattahoochee, the use of floodplains and basins for flood control, or attempts to create a more conventional section on the LA River. At the same time, they also actively respond to human uses, creating opportunities for compatible uses, such as farming in the MCD flood basins or community gardens in the Fens, as well as opportunities for recreation, fishing, and interaction with the river.

Though some of these projects predate the ideas of sustainability as we now describe them, they do share a similar design approach, which is multi-functional and holistic, and have a strong interest in responding to natural and human systems. Collectively, the approaches undertaken offer a suggestion for what a sustainable design approach to rivers, within the broader framework of sustainability, might look like.

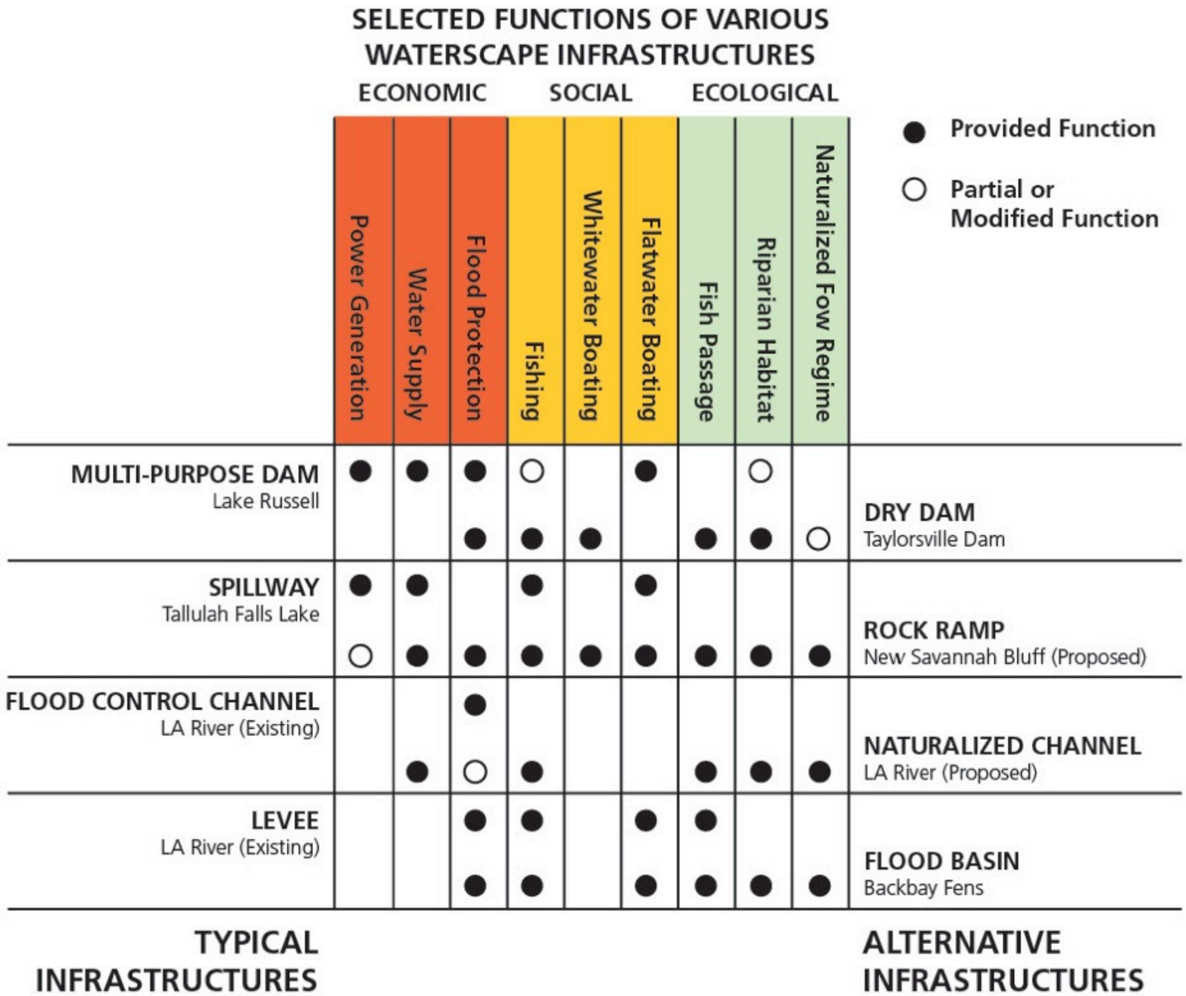

Figure 15. Selected functions performed by various infrastructure types. (Source: Author)

Considered individually, the various infrastructure components of each of the waterscapes explored in this chapter generally provide a broader range of benefits than their conventional and historical counterparts. The conventional structures tend to provide very little benefit in terms of ecological function, and are typically limited to the very specific recreational function of flatwater boating. Their "green" counterparts do a better job of providing for a diversity of human and ecological functions, however they typically require a sacrifice of economic output. This shift in emphasis is illustrated in the shift to the right for each pair of conventional and sustainable infrastructures in Figure 16. If this shift were purely a replacement of one economic value with an ecological one, this would not necessarily achieve any greater integration of the components of sustainability. However, some of the sustainable infrastructures derived from these waterscapes, for instance the choice between levees or a flood basins, illustrate satisfaction of a greater number of goals, and therefore a net increase in the sustainability of those waterscapes. And although this analysis is largely conceptual and by no means expansive, it suggests a framework for evaluating particular design strategies at the site scale, illustrating which needs are met, and which are unmet.

The diagram is a suggestion for how decision-makers might begin to collect and quantify the vast diversity of potential experiences and benefits generated by varying infrastructure elements or water-oriented spaces, in order to more clearly determine the desired components of new or reconfigured waterscapes. The diagram highlights a diversity of potential constituencies, and reveals interesting relationships that may emerge between them as alternative infrastructures are explored to their collective benefit. The diagram suggests degrees of function, conceptually drawn from the projects considered earlier, and further research into the performance of varying structure and space types would further refine the effectiveness of each method. There is growing interest in evaluating the performance of human-created and managed landscapes and quantifying the benefits of multi-functional spaces (Lovell and Johnston 2009). The Landscape Architecture Foundation has developed the “Landscape Performance Series,” aiding efforts to expand understanding of landscape performance and research into the subject (Landscape Architecture Foundation n.d.). These research agendas could provide a framework within which evaluations of waterscapes might occur.

The four sites considered above fall easily within the critical descriptions of organic machines and hydraulic waterscapes, but those definitions don't distinguish them from the dams and more utilitarian infrastructures, and though they are may be further along than conventional infrastructures in satisfying the diverse demands of sustainability, measuring them purely based on their function would miss some of what makes them successful. What the four projects above, which are located in disparate regions, and are distinct in terms of scale, context, and history, have in common is a unity in their design with the landscape and the communities they pass through. They suggest the possibility of not only successfully balancing the many demands put on rivers in an equitable fashion but also achieving a more substantial interconnectivity of form, space, context, and vision and that resembles the Leitbild approach mentioned in Chapter 3. The site typology of waterscapes, like the description of a brownfield implying remediation, suggests the establishment of a harmony of between infrastructure and natural flows in its characterization. The kind of unified vision and deliberate approach that Leitbilds offer (Potschin, Klug et al. 2010, p 663) is a good analog here, though a Leitbild is a site specific vision, and site typologies are general classes of site.

Another factor to consider in developing the idea of sustainable waterscapes is the unity of design vision that the spaces above suggest. This is a more qualitative consideration of the sites, harder to illustrate than the success of particular design strategies in satisfying particular uses or constituents, and more easily delivered in the narrative vision of the site.

In the following chapter, we will look at the application of this idea of sustainable waterscapes to the Savannah River system and consider how infrastructure there might be modified to accommodate a more diverse range of site goals. The specific technologies identified in these projects will be used as inspiration for interventions on the Savannah.

CHAPTER 5

RECONNECTING THE SAVANNAH

The following three sites are unique opportunities to rethink how ecological, social, and economic priorities are balanced on the Savannah River. The projects considered are massive, with significant engineering involved in their creation. This thesis can't hope to address the challenges of these sites as comprehensively as would be necessary to actually implement any changes. What can be done, however, is to consider how a shift in priorities might result in the implementation of other infrastructure elements, such as those identified in the conclusion of Chapter 4, and secondly how those infrastructure elements contribute to a broader vision of each site. These sites span urban, suburban, and rural locales, and range in scale from small mountain tributaries and tight urban channels to massive reservoirs. The diversity of sites collectively considered under the umbrella of waterscapes illustrative of the unity of approach that waterscape offers as a site typology.

These sites where the heaviest interventions are proposed were identified in Chapter 1, by evaluating the feasibility of removing particular structures along a transect of the region (from the Chattooga down to New Savannah Bluff), based on their obsolescence or ongoing utility to nearby communities and the region, and the intensity of surrounding development. And though wholesale removal of many of these structures is unlikely, modifications to the structures or management regimes may be possible that contributes to the goals of a reconnected system, while maintaining critical social and infrastructural goals. The river system's many layered infrastructures are broken down into three "organic machines" and a series of modifications are proposed. Some of these modifications may be more effective that others at achieving the holistic vision of rivers; the diagrams of each system show the relative success of achieving that vision, by scoring the relative responsiveness of each design strategy to the three interests of sustainability (economic, social, and ecological), and comparing that sustainable responsiveness to the existing infrastructure.

These ideas are focused specifically on the Piedmont sections of the Savannah, and its tributary rivers, and do not specifically respond to Coastal Plain portions of the river, which flow largely unimpeded to the City of Savannah and the river's mouth. That stretch of river flows unimpeded below Augusta, and legal settlements have ensured that it will be returned to a more natural state. Neither do these sites respond to the many headwaters and tributary streams that comprise the entirety of the watershed, which are much more effectively addressed by approaches such as Green Infrastructure and Ecosystem Restoration, considered in Chapter 2. The narrow focus on these Piedmont waterscapes allows scrutiny of the gap between these two ends of the Savannah River System, headwaters and mouth. Working upstream, each connection that is remade not only brings another portion of the river back into a network with the ocean, it also reconnects all the small streams and tributaries that feed that section. And even in the headwaters, which may be forever isolated from the sea by the most entrenched of these dams, connections can be made between smaller watersheds, linking fragmented populations that improve the overall health of headwater ecosystems. These ecological benefits would manifest in more robust systems better able to provide ecosystem services as well as the direct social benefits that would be gained from the repurposing of the spaces themselves.

Many of the solutions suggested would require significant political capital to achieve. Yet, as these alternative infrastructures broaden the beneficiaries of river infrastructure, they also broaden the pool of potential stakeholders and supporters. They suggest unconventional political alliances that could be built around alternative visions for the region.

The first site, Tallulah Falls, illustrates the choice between two modes of economic development and the physical results of that decision. The second, Trotter's Shoals, considers how the flood control engineering of the Miami River might be applied on the Savannah. The third, at the Augusta Shoals, considers how a vital urban infrastructure and an important historic landscape, which depends on river flows from the Savannah, could be maintained if water were also poured into the shoals. In short, they consider how the waterscapes of the Savannah might be made more sustainable through the implementation of technologies, strategies, and approaches successfully implemented elsewhere: how the parts of the organic machine that is the Savannah might be swapped out to produce a more equitable system. These three examples also put forward specific characters for each waterscape—Leitbild-esque visions—that describe a more integrated relationship between river, landscape, and community, that perhaps aspire to the same thousand year tenure that the Miami Conservation District's project reach for. The diagrams that follow lay out that shift in balance, as explore more generally in Chapter 4, while the narratives describe the vision for these waterscapes.

TALLULAH FALLS

In 1913, Tallulah Falls were effectively shut off (McCallister 2013). A dam built by the Georgia Power Company reduced the roaring river to a mere trickle: only 12 cubic feet per second of the river's flow leaked through the diversion dam for almost a century, silencing the falls (Federal Energy Regulatory Commission 1996, p 18). The majority of the Tallulah's water was diverted by the dam into a mile long underground conduit, and returned to the river below the falls. A little more water comes through the gorge nowadays, and visitors are occasionally able to view to Tallulah Falls as they once were. As part of the dam's relicensure, advocates negotiated for releases of 35 to 50 cubic feet per second, with "aesthetic" and "whitewater" releases of 200 and 500 to 700 cfs respectively on a few weekends throughout the year (Georgia Department of Natural Resources 2014).

Tallulah Falls is actually comprised of four major water falls, ranging in height from forty to almost one hundred feet tall, along with numerous other rapids, including Indian Arrow Rapids, which now lies underwater behind the dam. The Gorge is over 1000 feet deep in some places, and only a few hundred feet wide. Before construction of the diversion, the falls' journey through the gorge included over 450 feet of vertical drop (Calhoun and Speno 1998, p 15).

It is a dramatic landscape and was touted by many as the "Niagara of the South" before construction of Georgia Power's dams. The Falls created a thriving tourism industry dating back to the middle of 1800s. When a rail connection arrived to the town of Tallulah Falls, many came to visit, resulting in many hotels being established. That use of the river was significantly impacted by the construction of the dam, however, prompting a significant, but unsuccessful campaign to preserve the Falls (McCallister 2013).

The dam at Tallulah Falls is one of six dams comprising the North Georgia Hydroelectric Project (NGHP). Traveling downstream on the river are six reservoirs: Burton, Seed, Rabun, Tallulah Falls, Tugaloo, and Yonah. Significant residential development surround the upper three reservoirs, while only small and isolated pockets of houses, set in state, federal, or utility-owned land, characterize the lower three. Yonah and Tugaloo are especially inaccessible.

The term "interbasin transfer" has been used a great deal in recent water politics to describe the act of taking water from one river basin and transferring it to another. The practice is controversial: water is an important resource, not just for the river ecosystems, but also for downstream communities (Georgia Water Coalition 2010). In a way, the hydroelectric waterscape that connected Tallulah Falls to Atlanta was an interbasin transfer as well, but one that transferred energy. It took an important resource for the Tallulah Falls, the falling water of the river, and gave it to the citizens of Atlanta, along with the ability to determine how that water was used. That transfer of energy quieted not only a river, but also a booming tourism industry. It's worth considering whether or not greater economic development opportunities might be had in the area by removing some of these dams and restoring the Tallulah Falls landscape and river flow. By redirecting the energy of the river back into its channel, the river might be made to do a different and more subtle kind of work: generating tourism dollars for local businesses.

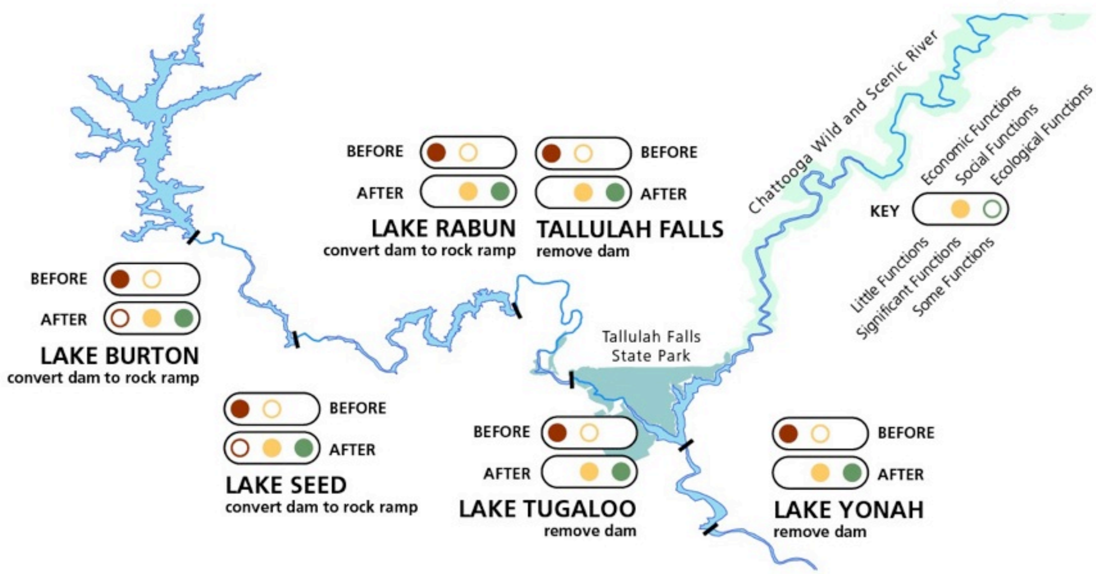

Figure 16. Balancing functions in the Tallulah system.

Aside from the dams all being nearly 100 years old, their power usage is relatively inconsequential. Hydropower makes a negligible contribution to the state's power needs, representing about 2% of the state's usage (Georgia Power). Likewise, the North Georgia Hydroelectric Project's six dams make a negligible contribution to Georgia Power's profits. In

2012, Georgia Power made $1.1 billion in net income out of almost $8 billion in revenue (Georgia Power 2013). In relicensing the project in 1996, it was estimated that the value of the power to Georgia Power for the entire six dam project was only $17.7 million, with operating costs of $12.8 million, a profit of only $4.7 million annually (Black, McKenney et al. 1998, p 3-16). Even allowing for inflation, decommissioning the entire system would barely represent a loss of 1% of Georgia Power's annual profits. Further, as the costs decrease to provide energy via other renewable sources such as wind and solar, maintaining these dams may be less appealing.

If the negligible power contributions of the NGHP are removed as a driving force of this waterscape, and instead recreation is prioritized, a number of opportunities emerge. With so many nearby reservoirs, including Hartwell to the south, removal of the lower three lakes is not likely to significantly negatively impact the recreational draw of the area. It would however, open up an opportunity for dramatically increasing ecotourism-style recreation.

The Tallulah already draws crowds on its aesthetic and whitewater release days. The nearby Chattooga, which merges with the Tallulah under Tugaloo Lake, is also a haven for whitewater enthusiasts. The cliffs of the gorge also attract climbers. Hiking and camping opportunities are provided in the State Park, as is a rail-to-trail. This is in addition to more general sightseeing occurring in the area. A more comprehensive approach to providing for adventure-based recreation at the confluence of these two rivers could benefit the area greatly.

Even the remaining lakes (Rabun, Seed, and Burton), with their significant residential development pattern, would have a more important role to play for flatwater recreation. If power were de-emphasized as a priority of the system and recreation instead made the focus, lake levels could be managed for the benefit of homeowners and flatwater boaters primarily, and downstream whitewater users secondarily. The tunnel between Mathis Dam and Tallulah Falls Lake could be decommissioned, restoring flows to the neglected section of the river that the tunnel currently bypasses. Rock-ramp style fish passage structures, as opposed to the current concrete dams, could even allow for greater connectivity of habitat between the lakes while maintaining the flatwater landscape.

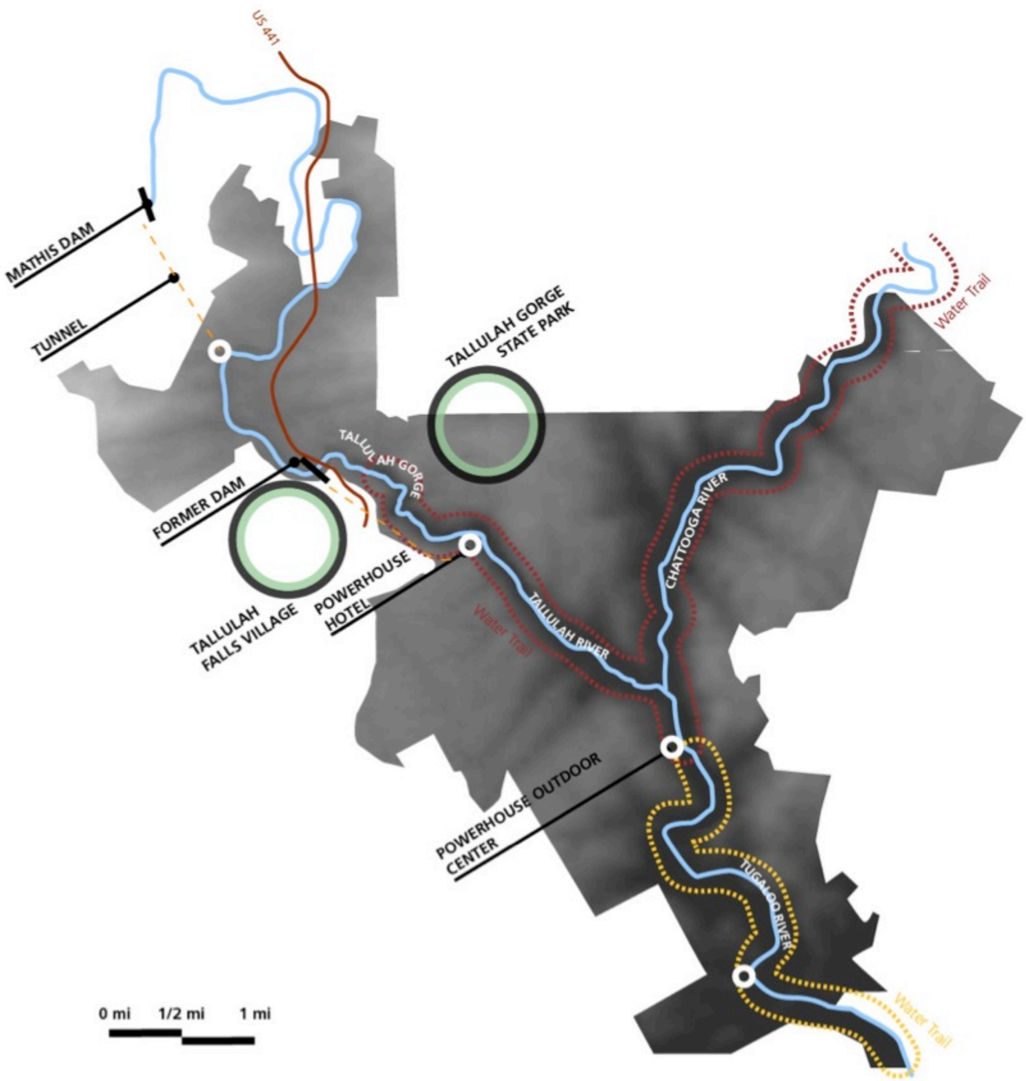

Figure 17. Conceptual diagram of an expanded Tallulah Falls State Park.

Perhaps at that point, the dams could be turned over to local municipalities or homeowners for long-term management, following the model of the MCD. These proposed changes could be further refined by focusing on the aesthetic experiences desired by users of each lake, as well as the infrastructural demands on each, a question which visual assessment approaches seem well-suited to answer.

The hamlet of Tallulah Falls, at the confluence of these two programs, and midway between Asheville and Athens on US 441 could grow rapidly, becoming an important tourism destination for the region while creating many more service-industry jobs than the handful of power-company technicians the river currently supports. The historic Beaux-Arts powerhouses could be repurposed to serve as outfitters, hotels, or community gathering spaces.

The design strategies offered by New Urbanists seem particularly applicable here. A compact footprint that can provide a strongly responsive restoration and expansion of the Tallulah Falls area to stimulate greater tourism while limiting sprawl is needed. The interest in regional and traditional architecture that New Urbanists often pursue is also particularly relevant to the design of this community.

When Georgia Power captured Tallulah Falls, a significant resource was lost. The dams also severed two mountain rivers, covering up a great deal of habitat and breaking important hydrologic linkages. At the time, this site was one of the most important power generation resources in the state; but even so, the decision was contested, and there was recognition that Tallulah Falls was a tragic loss, both for the community around it and the state. Since that time, the regional landscape has changed, rendering the dams here largely obsolete. Undamming the Tallulah River would not only be an ecological restoration, but a social and economic restoration, reviving a unique cultural site that has been depressed since the Falls were silenced a century ago. Its remaining lakes, formalized and reconnected through fish passages, would become part of a larger Tallulah waterscape, built around the unique culture of mountain recreation and historical interpretation, along with the river's rewilded course. The Tallulah would become a composite of natural and built spaces, comprising a unique retreat landscape for the region.

TROTTER'S SHOALS

The last of three Army Corps Reservoirs built on the Savannah (though physically located in the middle), Richard B. Russell Dam and Reservoir opened in 1985, masking some of the most dramatic shoals of the river and completing a half century long project to tame the Savannah River. The project was first approved by Congress in the 1966 Flood Control Act, and was intended for purposes including power and recreation, with incidental flood control and navigation benefits (US Army Corps of Engineers, n.d.). Though Russell was not intended to address flooding as directly as downstream Clarks Hill, it is significant for the lack of surrounding development and smaller scale, which make it a more ideal candidate for testing out new approaches to managing the region's water.

Initial evaluations of the region, following catastrophic floods in the first part of the 20th century, found that most of the potential purposes of a multi-purpose dam (flood control, power, navigation, and irrigation) were largely unnecessary (Manganiello 2010, pp 148-9), and were discouraged by engineers evaluating the river valley. Interest was kept alive however, and Clarks Hill was authorized in 1944 for flood control, navigation, and power (US Army Corps of Engineers). As noted previously, hydropower's contribution to Georgia's energy needs is negligible. Navigation is a need the structure has never truly provided, with boating on the lake primarily recreational, though there are some downstream benefits from reduced sediment. This leaves only flood control as the only primary purpose that these structures are essential to providing today.

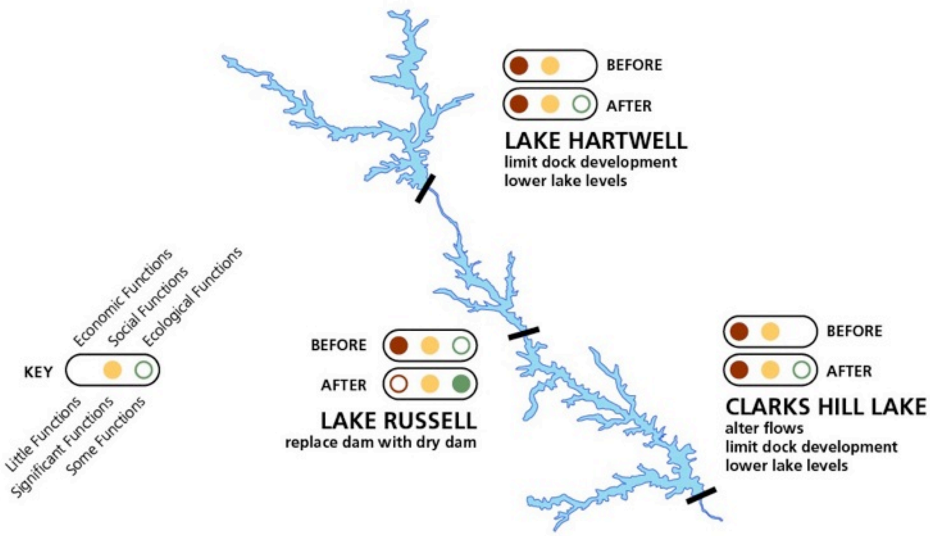

Figure 18. Balancing the functions of the Savannah River Basin Project.

There are other incidental benefits, however, such as real estate development and water supply. Though not specifically intended, it is an outcome and component of USACE's waterscape, and specifically of shoreline management policies for Hartwell and Clarks Hill. This lakefront real estate market is far from any major city, though, and is a suburban sprawl landscape, generating many of the social and ecological negatives associated with those spaces. Likewise, though these spaces provide water to communities, they also waste it. During the summer, 1,200 cubic feet per second evaporate from the surface of the reservoirs (US Army Corps of Engineers 2013). When downstream habitat and communities compete for use of 3,000 cfs of water at Augusta, this figure is startling.

In their *Forests to Faucets* analysis, the US Forest Service identified the Savannah watershed above Augusta as especially critical to protecting water supply. The project's purpose was to identify the "areas most important to surface drinking water sources, as well as to identify forested areas important to the protection of drinking water and areas where drinking water supplies might be threatened by development" (Weidner and Todd 2011, p 4). Water, more than electricity, is the limiting factor for development in the South, and forests, with the various ecosystems that they provide might be a better use of the land currently devoted to operating Russell as a peak power and pump storage power plant. With increased production, improved technology, and declining costs in wind and solar power, hydropower's expansive landscape impacts need reconsidering.

The waterscape of the region was developed with specific goals in mind, and these goals may need to be reevaluated. Forests shading creeks, increasing infiltration, and improving water quality may be better for downstream Augusta than storing water in an open lake, far from the city, and managing growth that would negatively impact water quality.

Only a few crossings interrupt the nearly thirty-mile corridor. If the expansive corridor on either side of the river were restored, the area might be a candidate to become part of the Wild and Scenic River program (which also designates rivers for recreation) further cementing the protection of the river's waters in this reach. Criteria for designating recreational river areas through the program allow for areas that "have undergone some impoundment or diversion in the past" (National Wild and Scenic Rivers System, n.d.). It could be that the best way to develop Augusta's water needs is to create wilderness upstream. Because the reservoirs were platted based on contours, which are generally shaped by watercourses, the footprint of Richard B. Russell is already well-geared to the establishment of a water-quality oriented forest, with wide buffers protecting all of the Savannah's tributary streams in this reach. Infrastructure development could be limited to a single dry dam and small areas for recreation access. Trotters

Shoals and Cherokee Shoals comprise one of the steepest gradients of the entire Savannah River. From McCalla Island, working upstream to near Gregg Shoals is a comparatively broad and gentle floodplain. The current flood storage capacity of Russell is 140,000 acre feet (US Army Corps of Engineers, n.d.). A dry dam at McCalla Island roughly 55 to 60 feet tall could provide a similar level of flood storage.

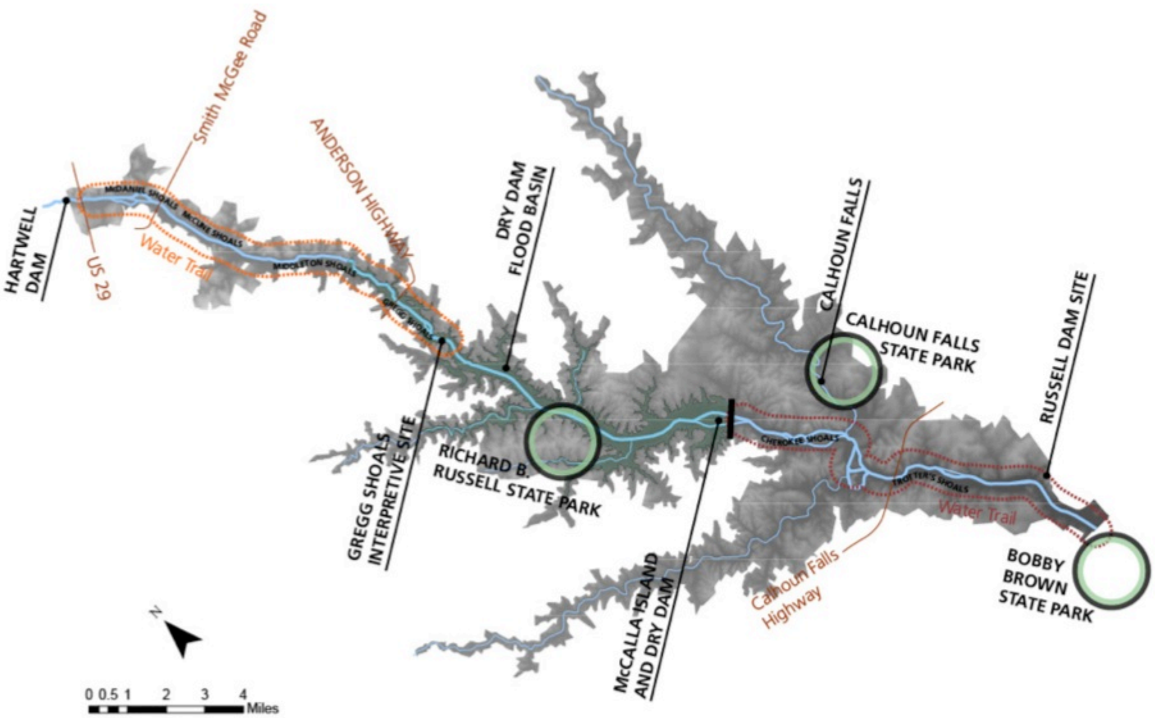

Figure 19. Conceptual diagram of a National Recreation Area on the site of Lake Russell.

Surrounding lakes would likely absorb the recreation programs currently provided by Russell. A study of the economic impacts of Hartwell during drought conditions suggested that many of these large lakes are in competition with one another (Allen, Carey et al. 2010). A recreational function of the area could still be maintained through the creation of water trails. And though most dams would impede such a use, if appropriately designed, the dry dam's conduits could allow boats to travel through along with the river's natural flow. The 50,000-acre forest would also provide a national-park-scaled setting for low-intensity recreation linking three state parks on either side of the river. Another compatible recreational possibility is the expansion of adjacent Wildlife Management Areas for public hunting.

Such a restoration effort would be significant, requiring the wholesale recreation of riverine, riparian, and upland habitats. The effort, which would begin with the bare lake bottom, would likely require a careful blend of approaches to ecosystem restoration and novel ecosystems to achieve the desired trajectory over many decades.

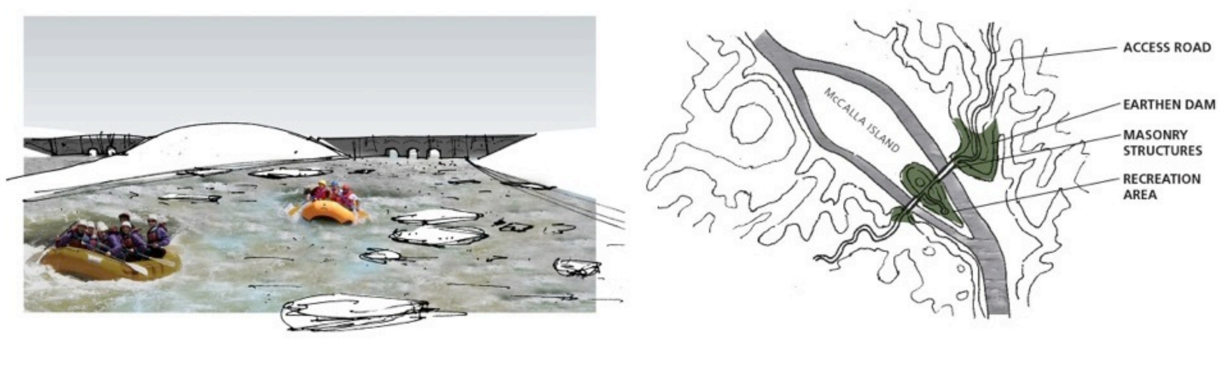

Figure 20. Concept for a dry dam at McCalla Island.

Russell is a waterscape oriented toward the provision of important economic capital for the region in the form of electricity. But electricity is becoming more abundant in the area, with two additional nuclear reactors under construction downstream at Plant Vogtle, below Augusta, which would dwarf the contributions of Russell to the region's energy needs. Clean water, however, is only growing in demand, with few obvious solutions. Ownership of almost the entire Savannah River corridor by USACE is a huge opportunity for managing and protecting that water. Rewilding the Savannah where Russell sits today would not only improve the ecology of the region by restoring miles of lost shoals habitat, it would also be an important step towards securing a sustainable clean water supply for Augusta.

Russell is the least developed of the three USACE lakes, and so it is an easier target for reconfiguration. There are strategies that could be undertaken, without removing the other two structures, which might improve their ecological value, while also weaning surrounding communities off of the lakefront lifestyle. Disallowing new docks on Hartwell and Clarks Hill would be a first step. Existing docks, as they aged, could be removed rather than replaced, resulting in a slow reestablishment of a public shoreline through attrition, with alternative benefits from the newly created buffer, such as larger woodland and greater opportunities for hiking trails along the shore. Lowering the full pool of these lakes would discourage further dispersed residential development and improve water quality through increased buffers. Allowing lake access only in exchange for clustering in new developments would further incentivize the reestablishment of a public shoreline. Management of those buffers and the lakes themselves could also be more carefully evaluated, to create a new, stable Piedmont lake ecology. The expanded buffers and wetland shorelines, and accreting deltas might provide a network of unique habitats which provide some level of connectivity for birds and terrestrial fauna, even if the lakes do not provide hydraulic connectivity for fish.

Finally, increases in downstream flow from Clarks Hill would ensure that the extant shoals near Augusta had enough water. This is another instance, like the sites on the Tallulah, where the value of aesthetic flows could be weighted against other demands on the water using visual assessment strategies, with USACE managers weighing the relative value of a full lake to suburban homeowners to rushing shoals for urban Augustans.

NINETY-NINE ISLANDS

The Augusta Canal is an integral part of the city, both as a cultural feature and as a component of the city's infrastructure. Lying on a bluff above the Savannah River, the canal diverts the flow of the river around the sensitive shoals habitat. Some of that water is returned to the river after passing through several sets of turbines, but this occurs below most of the shoals. In the past, the canal had captured almost the entire flow of the river, historically reducing flows to the shoals and endangered species that inhabit them to as low as 65 cfs (American Rivers 2014). Planning in the area has begun to address these issues by increasing flows from the Clarks Hill dam upstream, and mandating that a minimum level of water go over the spillway, rather than into the canal. But these efforts can only do so much to restore the river's function. Channel restoration, and management that allows for more variable flows are needed (Duncan and EuDaly 2003).

The Augusta Canal landscape is designated as a National Heritage Area, and provides a number of recreational opportunities, including paddling both on the river and in the canal, as well as biking, walking and running along the towpaths. The seven mile route also serves as a greenway, linking downtown Augusta with suburban Columbia County.

Figure 21. Historic Survey of Savannah River (Carter 1889) overlaid on contemporary map (Source: USGS Martinez 7.5 minute quadrangle) .

Currently, the diversion dam’s reservoir covers much of the Ninety Nine Islands reach, extending upstream to the foot of the Stevens Creek Dam, a minor hydroelectric facility. The solution proposed here is to actually extend the canal back to the site of Stevens Creek dam, to be replaced by a new rock ramp diversion structure. A much smaller pool would be created at this site for the purpose of splitting flows between the canal and the river. In addition to uncovering the Ninety-Nine Islands reach, Stevens Creek Falls, and many miles of upstream habitat would be revealed. Sedimentation is a major issue in the area, however, and a great deal of fill material would need to be removed, though some of this material might be suitable for reuse onsite in the construction of the new canal.

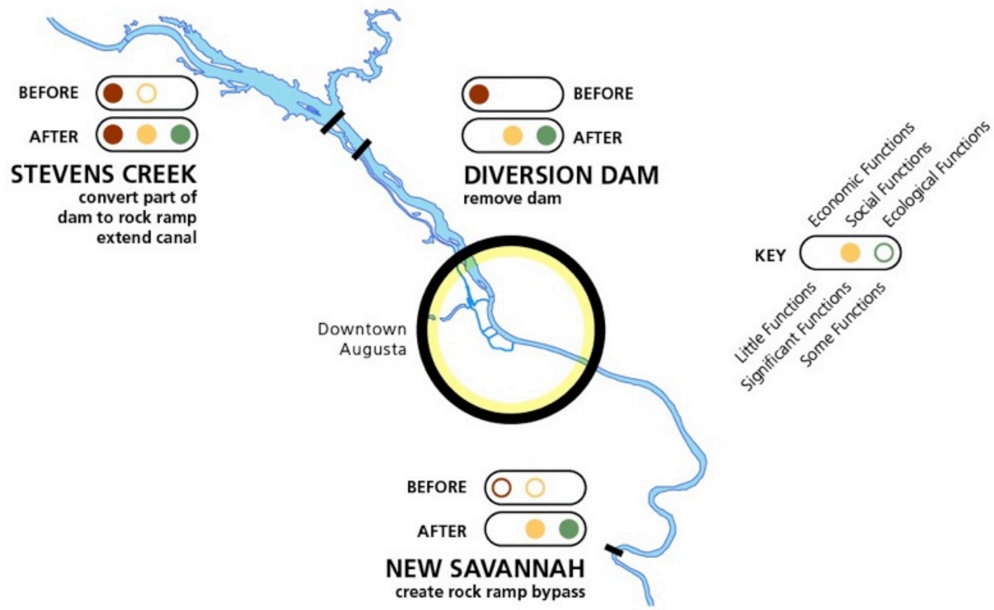

Figure 22. Balancing river functions around Augusta.

Repurposing of industrial landscapes is a theme in this area. New land opened up in the former reservoir pools would become available to expand the network of greenway trails along the Savannah and open up other suburban neighborhoods to alternative transportation routes. A granite aggregate quarry adjacent to the canal could be adapted, upon decommissioning, to serve as a reservoir for Augusta and other nearby communities. The reuse of the Vulcan Quarry in Atlanta for a similar purpose provides a precedent of this reuse of a derelict, manufactured site (Pond & Company and Carol R. Johnson Associates 2009).

With a dedicated storage facility that could be filled during high flows, and withdrawn from when flows are lowest in the river, these communities could feel more secure in their access to a stable water supply, without needing to take directly from the river when it is at its most fragile. Land surrounding the quarry would provide a buffer for the drinking water supply, while also contributing to the contiguous park system along the canal. The smaller pool at the

Stevens Creek would also allow for relocation of intake structures for other suburban communities that draw water from the river in this area.

An expansion of this area's interpretive programs could occur as part of this intervention. A number of currently inaccessible archaeological sites, ranging from earlier dam structures to pre-historic fish weirs and pottery middens, could be incorporated into the expanded canal's trail system, with opportunities to educate and engage the public about the area's rich ecological and human history. With sites spread across many islands, interpretation of cultural and ecological features could be interpreted in some areas, and others could remain isolated.

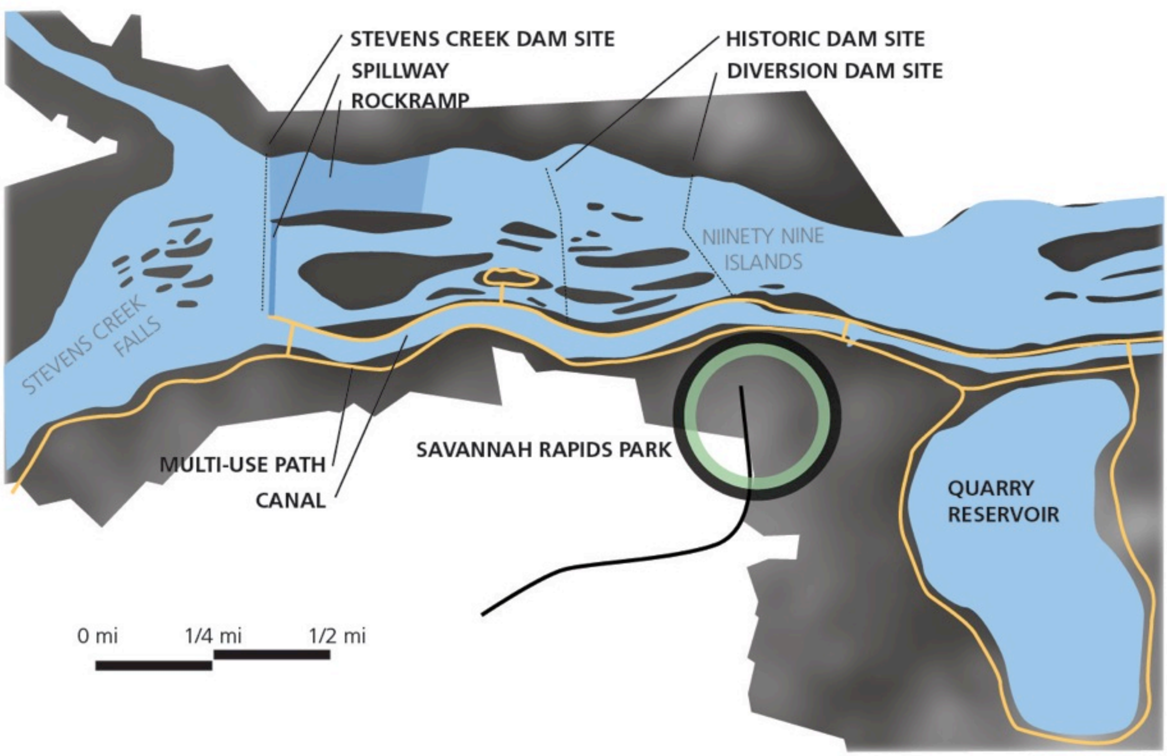

Figure 23. Conceptual diagram of an expanded Augusta Canal National Heritage Area

The site also presents several opportunities, with regards to paddling. In addition to opening up many miles of shoals to paddling, there is also the potential to create a paddling loop. Visitors could paddle upstream along the canal, into the pool, and down to the bottom of the shoals. An elevator or ramp at the site would allow paddlers to return easily to their vehicles, with no need for extra vehicles for shuttling. Such a feature is a rarity, and might contribute significantly to the area's attractiveness as a regional tourism destination. The US National Whitewater Center in Charlotte, North Carolina features a purpose-built artificial whitewater course that provides a similar looping experience, though on a much smaller scale (US National Whitewater Center 2014).

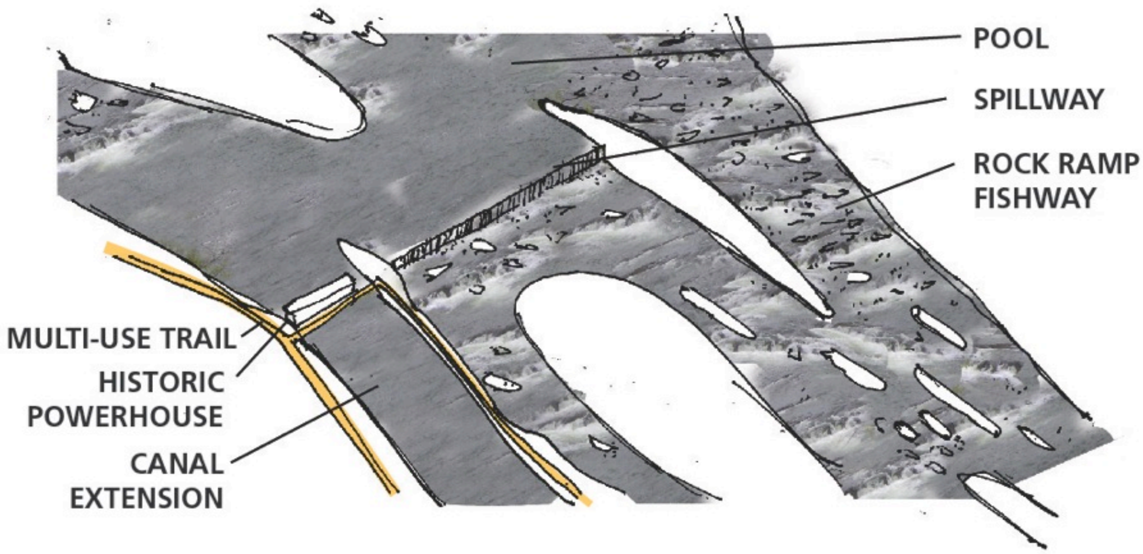

Figure 24. Overview of a rock ramp fish passage at Stevens Creek Falls.

Finally, the lower levels of the canal system, as they weave through Downtown Augusta, present opportunities for the introduction of new, soft stormwater infrastructures and park spaces that the design strategies pursued by Landscape Urbanists, and described as Green Infrastructure, are particularly well suited to address.

The reestablishment of the river's historical course from Clarks Hill down to the canal also provides an opportunity to interpret historic river travel. Already, a recreated Petersburg boat is used on the Canal. Those kinds of boats could once again navigate the river for which they were designed, providing a compelling illustration of early American transportation. In Lynchburg, Virginia, on the James River, a similar boat existed historically called the “Batteau.” Historians and enthusiasts have revived that boatbuilding and navigation tradition, conducting reenactments and hosting a festival that creates new opportunities for engagement with rivers far beyond typical conceptions of paddle sports (Virginia Canals & Navigation Society, n.d.).

The rich history of the Augusta Canal and shoals landscape, combined with the many active infrastructure uses in the vicinity has the potential to create a fascinating and dynamic landscape. As modifications were carried out, this waterscape could become a living, growing, and evolving infrastructure, with significant or nonfunctional elements replaced by newer, more resilient components. Layers of engineering combined into a unique assemblage would weave together the ecological and urban fabrics and provide a unique vision for the region that connects Augustans and visitors to history and ecology, and makes more apparent the vital connections between city and river.

CONCLUSION

The solutions outlined above are by no means innovative, when considered individually. The structures proposed and tactics suggested have been executed elsewhere, providing useful precedents. The examples in Chapter 4 show the benefits that can occur for ecological and human communities when they are blended together into multi-purpose projects. These three site investigations are intended to suggest how similar multi-functional infrastructure might be developed on the Savannah, resulting in a healthier, more accessible, and more sustainable river. In cases where more substantial intervention is not possible, suggested improvements aim for a more incremental approach to balancing the many competing demands on these spaces. These design elements and management recommendations also suggest alternative partnerships that might be necessary or possible, should surrounding communities decide to question the status quo of the river's infrastructure.

But that investigation requires an identification of the river's infrastructure as a malleable space, and an understanding of the relationships inherent in that infrastructure. What the notion of waterscape offers is a way for designers to begin to frame those sites. Once the river is seen for the organic machine that it is, it becomes easier to evaluate which parts can be removed, modified, and replaced, or where new pieces might go. By mobilizing the critical concepts of waterscape, designers aiming for the production of sustainable cities, landscapes, and infrastructure can begin to develop a language and a shared body of tactics for the repair of these sites, which are so significant ecologically, socially, and economically.

CHAPTER 6

DOWNSTREAM

Vocabulary can both limit and expand possibilities. The profession of landscape architecture is an industry like any other, preoccupied with delivering certain kinds of products, like designs for parks and residential communities. This Euclidean language of sites is inadequate to describe the kinds of multi-functional landscapes being developed in the 21st century, landscapes that blend spaces for people with those designed to provide ecosystem services, or meet key infrastructure demands. This simple vocabulary, which describes single-use outcomes, also fails to capture the character of complex and problematic sites, which have been the subject of much recent inquiry by designers. New approaches to site typology, illustrated in the development of concepts like "brownfield" and "greyfield," hint that a richer vocabulary is possible.

This new vocabulary of sites highlights relationships inherent in sites that, though now obvious, may not always have been apparent. The new terms not only describe site use, but also conditions and outcomes. For instance, when Gasworks Park in Seattle is described as an urban park, certain sets of ideas are brought up about how that space is used. But when described as a former brownfield, a richer understanding of the site's history and modifications is revealed. And though brownfields are the most familiar, they may be only the beginning of this richer approach to site typology.

Just as more general approaches to sustainable design do not address the particular needs of brownfield remediation, an activity that is itself an environmental good, and which facilitates other sustainable goals, such as the reuse of urban underutilized land, the vocabulary of sustainable design does not yet effectively respond to the challenges of riverine spaces.

As outlined in Chapter 3, rivers present a number of unique challenges and characteristics that are not shared by terrestrial sites. There are extremely variable flow regimes, unique infrastructure systems, and human activities that only occur in these places. An analysis of the contemporary approaches to the production of sustainable spaces, outlined in Chapter 2, shows that prominent approaches to sustainable design do not, individually, effectively address the challenges of river spaces explicitly, suggesting the need for a more holistic approach focused directly on the question of rivers.

This thesis has dwelt upon a proposed addition to the vocabulary of sites: the waterscape. Described in a critical context as a hybrid infrastructure of hydrologic infrastructure and natural flows, the term is also exciting for designers, as it frames a range of projects that seem at first to be only superficially related, and opens the door to a broader analysis of their challenges, and of potential solutions. By providing a name for previously distinct sites, a dialogue can be sparked that allows for greater investigation, and the development of a more specific range of design tactics that are appropriate to these sites, as explored in Chapter 4.

The Savannah River, between Georgia and South Carolina, is dominated by a number of overlapping waterscapes, developed over the last 150 years. The original river is long gone, replaced by a new landscape of dams and reservoirs, tunnels and canals. Even as these structures were being built, surrounding communities were aware of the negative impacts, protesting the loss of important natural resources like the river’s valuable fishery and the spectacular Tallulah Falls. The systems of the Savannah were ineffective at balancing the needs of the river’s varied users when created. The disparities these systems created have certainly not been addressed over time, but with many of them reaching the end of their useful lives, or being made obsolete by changing technologies, now is a good time to question whether the original harms caused by these infrastructures. Chapter 5 considered modifications to these infrastructures that might begin to undo those negative impacts, and once again make the river a more socially, ecologically, and economically sustainable waterscape for all the communities that share it, and offered holistic visions for our relationship to the rivers that sustain us.

FUTURE QUESTIONS

The section of the Savannah River considered in this thesis is located in the Southeastern Piedmont. There are particular behaviors and conditions characteristic to a Piedmont river that do not apply even to the Lower Savannah, as it passes through the Coastal Plain. The kinds of problems attributed to river management are also framed by the current uses of the Savannah River. Similar explorations of other rivers would likely yield other potential design challenges and strategies. For instance, on the Lower Savannah, navigation for Post-Panamax ships is a current challenge. How might the need for deep water be balanced with concerns over saltwater intrusion, or storm surge management? Future investigations of other rivers through the lens of waterscape may yield potential answers to this question.

Likewise, rivers are only one particular kind of waterscape. Water is obviously much more abundant, and takes many other forms, where designers and restorationists are also at work. A vocabulary that links these other kinds of spaces provides opportunities to compare strategies and outcomes, be they rivers, estuaries, lakes, or coastlines. What else would we call these spaces, as disparate as New York Harbor, the Louisiana delta, or Oceanic atolls; what else do they have in common but water? Perhaps future investigations will develop a fuller language of water-oriented spaces, capable of capturing the dynamic confluence of forces at play in manipulated sites like the Savannah River Harbor or Tybee Roads, where dredging is modifying ecosystems and other patterns of social value and economic use are at work. The sooner an inclusive language for water systems is developed, the sooner we can begin to collaborate on addressing these challenges.

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