

Eco-Cultural Greenways: Reclaiming Post-Industrial Sites for Climate-Responsive Cities

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Abstract

This paper explores eco-cultural greenways as a transformative approach to adaptive reuse of post-industrial sites along urban waterways, focusing on their potential to address climate adaptation while preserving cultural identity.

The ‘greening’ of former industrial sites is not new; such spaces can enhance urban nature, expand recreational areas, or support commercial development. However, green space conversion risks erasing history and may lead to green gentrification, displacing vulnerable populations. Eco-cultural greenways, guided by water, offer a strategy that regenerates rivers, mitigates urban heat islands, and prepares for increased precipitation and flooding.

The James River in Richmond, Virginia (USA), serves as a case study. Historically, the river supported the city's industry, recreation, and commerce, shaping its growth. While early industries fueled development, today's redevelopment often prioritizes property value over historical contamination and climate concerns. Severe flooding has led to the construction of a flood protection wall, but more adaptive, long-term approaches are required.

By connecting key post-industrial sites along the river into a cohesive eco-cultural greenway system and emphasizing the adaptation of landscapes over time, the author proposes an alternative vision for the James River in Richmond. This vision integrates these sites into a broader urban strategy that enhances the river as a unique ecological corridor. The approach fosters transformative riverine processes that intertwine the landscape with its inhabitants, while providing an adaptive strategy to mitigate urban flooding in Richmond. Ultimately, this eco-cultural greenway balances environmental and social needs, preserving Richmond's post-industrial heritage while promoting urban resilience.

Introduction

Since the 1980s, transforming derelict industrial sites into new urban developments has become a common strategy for accommodating population growth in cities while regenerating urban environments. This process often carries positive connotations, influencing the social, economic, and environmental contexts (de Sousa 2008; Berger 2007; Kirkwood 2000; Loures & Burley 2012). The term "post-industrial" reflects the countless number of such areas worldwide and the variations in how they are defined, ranging from, ‘drosscape’ (Berger 2007), to ‘edgeland’ (Farley et al. 2012), from ‘brown fields’ (Hasse 2000) to ‘terrain vague’ (de Solà-Morales 1995), and beyond.

In 2002, Gilles Clement introduced the concept of “Third Landscape”, highlighting the potential of post-industrial sites to preserve biodiversity while appreciating the cultural and heritage values they embody (UNESCO 2001). A pioneering example of this concept is the Coulée Verte René-Dumont (1988), more commonly known as the Promenade Plantée in Paris. Designed by landscape architect Jacques Vergely and architect Philippe Mathieux, it was one of the first urban greenways realized by transforming a former railway. A few years later, in Germany, the

revitalization of the Emscher Park began under the direction of the IBA organization (1988-2010). This included the project for the Duisburg Nord Landscape Park, designed by Peter Latz, which established new green corridors networks that remain integral currently to the area today.

These projects illustrate the growing shift toward multi-functional green spaces, aligning with the broader evolution of greenways as an urban landscape form, as defined by Searns (1995). He identified three distinct ‘generations’ of greenways: the 1st generation (Pre 1700s-1960) is characterized axis, boulevards and parkway; the 2nd generation (1960-1985) focus on trail-oriented recreational greenways; and the 3rd generation (1985 and beyond) is a multi-objective greenway addressing diverse needs such as habitat conservation, infrastructure integration, besides urban beautification and recreation. This paper focuses on the latter two generations, where greenways function as physical armatures or infrastructure (Ahern 1995) that integrate cultural heritage and climate adaptation goals, contributing to their complexity. Greenways in this context are conceptualized as carriers of aesthetics, history, and memory, connecting and reflecting the unique characteristics of their settings and their interfaces with nature. They also act as tools for raising awareness about the interplay between human activities and the surrounding environment. In these terms, greenway design facilitates a sense of "remaking" and "placemaking" while preserving, restoring, or interpreting nature. These same attributes resonate strongly in the reuse of abandoned industrial sites, where transformations often reflect a blend of the "decadence" of artificial, human-made work (the industry) and the "wild" qualities of nature (Herrington 2008; Fabris et al. 2023). Moreover, the concept of greenways inherently supports the safeguarding of history. Greenways frequently develop along abandoned railway lines, towpaths, utility corridors, and other pre-existing structures, minimizing the need for entirely new constructions.

This paper examines how the reuse of post-industrial areas along urban waterways can serve as armatures for climate-adaptive greenways, emphasizing their ecological potential while preserving their cultural identity.

Goals, Objectives and Methods

To address the issue outlined above, I will adopt the case study methodology, focusing on the industrial areas along the James River in Richmond, Virginia. The *Background and Case Study* section will outline strategies for transforming dismissed industrial sites and examine the selected case to identify its problems, challenges and opportunities for eco-cultural greenways. The *Results* section will detail these findings and their implications within the broader context of complexity of contemporary multi-purpose greenways. The *Discussion and Conclusion* section will explore the potential of eco-cultural greenways as adaptive strategies for climate change, emphasizing their ability to preserve the cultural and ecological values of post-industrial landscapes. Finally, I'll summarize key considerations for eco-cultural greenways and their role in addressing climate challenges, encouraging further nuanced research.

Background and Case Study

The rehabilitation of industrial areas typically addresses two key aspects: ‘necessity,’ involving the reclamation of polluted soil through pragmatic engineering solutions, and ‘resource,’ emphasizing the social and environmental potential of these areas to enhance urban identity and memory, while adopting process-based remediations.

Building on this foundation, urban design strategies for transforming dismissed industrial sites often seek to create cohesive, attractive spaces by integrating physical and functional elements into unified scenarios. Landscape design supports this approach, producing green public spaces/parks

that are ‘beautiful,’ ‘safe,’ and ‘playful,’ blending seamlessly with the city or natural surroundings. However, contemporary landscape designs also explore the physical, cultural, and experiential qualities of these sites, shifting the focus toward post-industrial landscape aesthetics. These designs challenge traditional pastoral imagery, by introducing alternative narratives and incorporating an ‘ethical agenda’ that imbues sites with deeper meanings (Meyer 2007). This approach broadens the scope of design, encouraging landscapes that not only rehabilitate but also engage with cultural and ecological complexities.

According to Fabris and Li (2023) the transformation of post-industrial landscapes over the past 50 years can be categorized into four evolving historic phases: soft, firm, structural and merging. These phases reflect the progression from the initial rise of ecological concerns to the use of ‘landscape’ as a structural tool for renewal, culminating in innovative concepts of urban resilience and metabolism within the framework of sustainability. These phases also represent varying interactions between design tactics and remediation methods, resulting in diverse landscape typologies (Erdem Kaya 2023) that integrate contaminated materials and can address climate-related challenges in different ways. In fact, engineering methods can lead to the development of topographically manipulated landscapes, providing setting for multi-layered and topo-landscapes, while process-based remediation methods present an opportunity for the integration and development of living systems into the spatial design, leading to the emergence of adaptive and process-based landscapes (Erdem Kaya 2023). The latter approach can be translated into ecologically active areas, such as wetland parks, ecological parks, and habitat restoration, which prioritize ecological remediation and sustainability.

Expanding on this framework, post-industrial areas can also play a strategic role in addressing the contemporary landscape fragmentation caused by urbanization and human activities. While these sites are often perceived as ‘gaps’ that disrupt land cohesion, they also hold potential as untapped resources for initiating landscape integration, ecological restoration, and regeneration (Curulli 2014). Their boundaries offer significant opportunities for integrative landscape approaches, rethinking edges as places of complex overlaps, interaction and connection to existing spatial networks of natural or semi-natural elements that surround them. This concept aligns within ‘generation 3’ of greenways described by (Searns 1995), whose multi-purpose objective go beyond the adaptive response to the negative impact of urbanization; they also pursue mitigation processes at a wider scale, favoring habitat protection, flood hazard reduction, water quality, historic preservation and education (Searns 1995). Functioning as linear parks/corridors, these greenways can enhance urban habitat connectivity, and their effectiveness is confirmed by research in the field of ecology (Lynch 2018). Thus, greenways address habitat objectives alongside human infrastructure needs, and by adopting such adaptive responses, they enhance land stewardship values, ensuring the preservation of natural habitats and cultural environments.

The eco-cultural greenway associated with the industrial areas along the urban section of the James River in Richmond, Virginia, is a case in point. Rivers, along with canals and rail lines, have played a key role in the settlement and development of cities and industries, and nowadays, they are the ‘natural’ setting for multi-purpose greenways.

The James River: its industrial and flooding history

The James River, Virginia’s largest waterway, has been the driver of so much cultural history, from the earliest settlements to early industry and trade. Serving as a transportation corridor, it powered

grist mills, hydroelectric systems, and facilitated tobacco exports from colonial plantations. In the 19th and early 20th centuries, the city became the world's largest tobacco production center due to its proximity to the river and the falls, which provided waterpower for factories; this led to the development of "Tobacco Row," (Bluestone 2012) a collection of cigarette factories and warehouses lining the riverbanks, making tobacco processing and export a major part of Richmond's industrial identity. Batteaux workboats transported cargo until the Kanawha Canal (1785–1873) and later railways replaced them. The Manchester neighborhood on the south bank of the river is a key site of the city's industrial heritage as well as historic buildings and landmarks like the Fulton Gas Works and the Southern

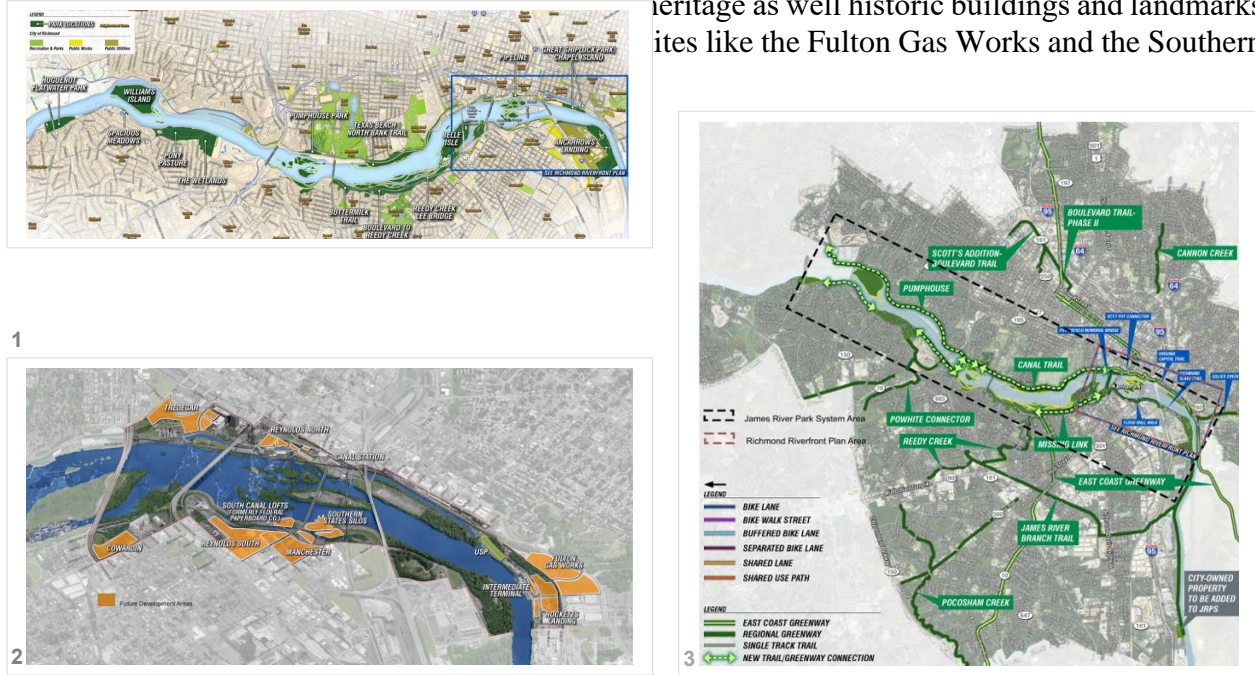


Figure 1. The James River Park System (JRPS) map; Figure 2. Richmond Riverfront Plan (RRP) indicating (industrial) areas for future development; Figure 3. Greenways and trails within the JRPS.

However, Richmond's relationship with the James River is not only shaped by the industry, but also by a story of flooding that led to the construction of protective infrastructure like the 1995 floodwall. In fact, catastrophic events, including Hurricane Camille in 1969, underscored the city's vulnerability and prompted improvements in disaster planning. The floodwall now serves as a critical barrier, dividing the city from the river, while reflecting the city's evolving efforts to manage natural disasters, adapt to changing climate risks, and improve the riverine ecological health.

Green corridors: integrating Richmond Riverfront Plan and the James River Park System

In 2019, the city adopted the James River Park System (JRPS) master plan designed by VHB and Hargreaves Associates (see Figure 1). This 600-acre linear park spans the city from west to east along both sides of the river, with more than 20 miles of trails, some of which lead to the Virginia Capital Trail, connecting Richmond to Jamestown, respectively the current and former capitals of Virginia.

The JRPS master plan spans 10 years and include recommendations for trails and greenway connectivity, river-based activities, multi-modal transportation access, natural resources protection, accessibility, cultural and historical resources, park buildings, infrastructure, and concept plans for underutilized infrastructure within the park (City of Richmond 2019).

The continuity of paths, the identification of the 'missing link', and connectivity with neighborhoods and other regional greenways are priority within the master plan (see Figure 3).

Furthermore, the plan aims to establish two new greenways -The Pump House Greenway (4 miles upriver) and the Reedy Creek Greenway (3,5 miles to the south)- to expand circulation options and reduce pressure on the JRPS by dispersing recreational activity across a much larger network.

The master plan recognizes the hydrologic connection between the James River and its floodplain, highlighting its ecological importance for floodwater retention, groundwater recharge, carbon sequestration, and nutrient filtration (City of Richmond 2019). Within the city limits, the river and floodplain are largely considered environmentally sensitive resources. Furthermore, the plan provides the flood elevation references that include the 100-year and 500-year floodplains, and the sea-level rise projections of 1.5 feet by 2050, 3 feet by 2080, and 4.5 feet by 2100. Within these floodplains stand several dismissed industrial sites and several trails could develop along or cross them (see Figures 4 and 5).



Figure 4. The current string of industrial areas along the James River; Fig 5. Richmond's 50 and 70 year floodplain (drawings by C. Bonura)

The JRPS builds upon the 2012 Richmond Riverfront Plan (RRP), which outlines the city's vision and ambitions for the riverfront (see Figure 2). Since the 1960s, the city has developed several plans (1977 and 1980) demonstrating its efforts to transform the riverfront and establish the river as a central element of the city's identity (Hambrick 2020). Encompassing both sides of the James River—described as Richmond's “great, wet Central Park”—the RRP aims to establish a comprehensive network of natural spaces along the river to serve dual purposes: offering recreational opportunities while mitigating flood risks. Furthermore, green corridors will connect these new spaces with the city's existing parks. The document highlights the importance of preserving the riverfront's history and protecting significant viewsheds (City of Richmond 2012).

Results

The relationship between the two master plans and the dismissed industrial sites along the James River is multifaceted, revealing both opportunities and challenges in integrating these areas into sustainable urban strategies. While some industrial remnants are preserved as “objets trouvés”—standing as ruins within an untamed natural setting—others are earmarked for demolition. Examples like the Southern States Silos (1957) and the Fulton Gas Works (1856–1972), which symbolize Virginia's industrial and agrarian heritage, are at risk of demolition despite their potential to contribute to Richmond's identity and sense of place (Historic Richmond 2021). This tension between preservation and redevelopment reflects a limited perspective that views industrial heritage as either ornamental or obsolete, neglecting its potential role in fostering sustainable landscape solutions. Furthermore, this duality raises questions about the value of these sites in

creating multifunctional (ecological and cultural) greenways that move beyond mere recreational functions and act as a planning strategy that promotes landscape synergy.

The loss of these landmarks not only erodes Richmond's industrial identity but also poses broader urban challenges. Overdevelopment reduces public access to the river, and diminished cultural significance are pressing concerns raised by community members. They advocate for meaningful engagement to preserve sites within historic viewsheds as public amenities rather than relegating them to commercial or residential development. Richmond's lack of a comprehensive preservation plan exacerbates this issue, leaving its architectural and cultural resources vulnerable to erasure.

Despite its ambitious scope, the Richmond Riverfront Plan (RRP) reveals critical gaps in sustainable and inclusive planning:

1. **Southern Riverbank:** Active and dismissed industrial zones on the southern bank of the James River are conspicuously absent from the plan's vision. This exclusion limits the potential for a cohesive and integrated greenway network that bridges the river's two banks.
2. **Flood Risk and Resilience:** The plan fails to adequately address the implications of the 100-year floodplain, which poses significant risks to many industrial areas. By overlooking these risks, the plan undermines long-term resilience and jeopardizes future development along the riverfront.
3. **Integration:** The RRP anticipates future access to additional river-facing parcels once industrial activities like aggregate extraction and petroleum transfer diminish. However, this vision lacks a clear strategy for integrating these areas into the existing greenway network in a manner that prioritizes ecological and cultural functions over commercial development.

Discussion and Conclusion

Most greenway plans and their implementation reflect the traditional philosophy of recreational routes, aiming at reshaping the city-nature relationship and create integrated green networks. Recreational greenways, such as those in Richmond, differ from ecological greenways in configuration, often featuring more mowed and paved area with less green space (Lynch 2018). However, different segments of a single greenway can be managed to meet diverse goals, thereby increasing their capacity to support landscape connectivity.

Expanding on this idea, the concept of multipurpose eco-cultural greenways integrates ecological and cultural resources, such as dismissed industrial areas, into a unified system. This approach generates landscape synergy among components, enabling accessibility and/experience for diverse users, and fostering placemaking with reconnection with industrial and natural heritage.

Both the JRPS and the RRP overlook the untapped landscape potential of existing dismissed industrial areas as integral components of eco-cultural greenways for the city. These sites could play a strategic role in climate adaptation if thoughtfully integrated. When incorporated into green-blue eco-cultural greenways, these sites could become key components of a comprehensive planning strategy, offering a range of interconnected benefits, including:

1. *Landscape Connectivity:* unmanaged industrial sites and brownfields provide ecological opportunities that can support connectivity (Lynch 2018). Research demonstrates that greenways and stepping-stones are essential for creating functional habitat connectivity in urban and suburban areas (Lynch 2018). Incorporating these spaces into eco-cultural greenways enhances connectivity and linking them into a network promote higher biodiversity and mitigate landscape fragmentation (Ahern 1995; Lynch 2018)

2. *Community Identity and Heritage Preservation*: integrating industrial heritage into multi-purpose greenways foster a strong sense of identity and belonging. Preserving historical structures and stories tied to the riverfront bridges Richmond's industrial past with its future, enriching cultural experiences for residents and visitors alike.

3. *Climate Adaptation*: repurposing industrial sites can address flood risks and water management challenges. Establishing water retention zones and reservoirs can help mitigate the impacts of river rising water levels and extreme weather events, while contributing to the city's broader climate resilience goals.

4. *Adaptive-ecological landscapes*: adopting process-based remediation methods for transforming dismissed industrial sites creates opportunities to integrate and develop living systems within spatial designs. This approach facilitates the emergence of adaptive, process-based landscapes. For example, wetland areas or green spaces can be designed to filter pollutants, improve water quality, and enhance river health. These initiatives not only restore ecological balance but also provide spaces for public engagement with nature, fostering a deeper connection between people and the environment.

5. *Biodiversity Enhancement*: viewing abandoned industrial sites as strategic components of greenways positions them as "green buffers" between the river and adjacent residential or commercial areas where new habitats can emerge. The greenways function as ecological corridors and they can filter sediments, control erosion, regulate water temperature and improve air quality. Ultimately, they enhance the city's overall livability and environmental health.

6. *Legibility to the landscape*: greenways can provide a visible structure and legibility to the landscape (Ahern 1995) and viewing eco-cultural greenway as regional scale designs can profoundly influence the spatial character of the landscape. In Richmond's JRPS, the ambition to link-extend the trails to a regional scale, such as the 'regional greenway' and the 'east coast greenway', offers opportunities to enhance legibility of natural and manmade feature, including industrial heritage sites.

The James River and its industrial heritage landscapes exemplify the transformative potential of multipurpose greenways to integrate water-related heritage into climate change adaptation strategies. These strategies can provide ecological opportunities that support connectivity, creating habitat corridors that promote biodiversity and mitigate landscape fragmentation. To enhance this, policies should incentivize landowners to repurpose brownfields, introduce zoning regulations to maintain connectivity, and encourage adaptive remediation initiatives. Funding programs can support the preservation and reuse of industrial heritage sites within greenway networks, while public-private partnerships can finance projects that strengthen cultural identity. Integrating climate resilience criteria into municipal planning codes and establishing environmental grants can encourage developments that incorporate flood management strategies, such as retention ponds, wetlands, or bioswales. Additionally, guidelines promoting native planting strategies and creating "green buffer zones" can further enhance biodiversity and improve air quality. To improve landscape legibility, signage and educational programs should highlight cultural and ecological narratives, fostering engagement with the city's heritage and reinforcing Richmond's greenway connectivity goals.

By recognizing dismissed industrial sites as valuable assets and integrating these policies recommendations, Richmond has an opportunity to create a resilient and inclusive riverfront that bridges historical preservation with future sustainability. Incorporating these sites into the JRPS would create a comprehensive greenway network that not only safeguards their cultural significance but also highlights the critical role of water heritage in maintaining the river's eco-cultural complexity.

This approach demonstrates how greenway planning can effectively negotiate spatial and functional uses, reflecting social and cultural values alongside environmental protection. The regeneration of dismissed industrial sites through a process of "green conversion" opens new avenues for sustainable land development, resulting in multi-layered landscapes (Fabris et al. 2023). By embedding these landscapes into an interconnected strategy, Richmond can set an example, balancing cultural identity with ecological stewardship in response to climate challenges.

The concept of the eco-cultural greenway extends the recognized benefits of greenways to a broader spatial scale. Drawing inspiration from the 2018 European Industrial Heritage Network (ERIH)—a pan-European initiative that promotes the preservation and appreciation of significant industrial sites—this model integrates industrial heritage into future spatial planning. Eco-cultural greenways connect networks of anchor points, transnational theme routes, and regional routes, providing a framework for strategic multidisciplinary collaboration across urban, regional, and transnational contexts.

By adopting this model, Richmond's greenway network could not only honor the historical and cultural significance of these landscapes but also positions them as critical assets in shaping climate-responsive cities that balance preservation with resilience and sustainability.

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