Richmond Green Infrastructure Assessment

Produced by the Green Infrastructure Center and E^2 Inc. for the City of Richmond, Virginia
December 2010

Acknowledgements

The Richmond Green Infrastructure Assessment project has been made possible by the contributions, creativity and generosity of many individuals and organizations. The Green Infrastructure Center and E² Inc. would like to thank the partners and participants, as well as the project sponsor, who made the project possible. We also wish to recognize the state agencies that provided important data, models and technical support. Without the work of these dedicated organizations, our work would not be possible.

Project Sponsor

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Project Team

Green Infrastructure Center Inc.
E² Inc.

Project Partners

City of Richmond
Richmond Redevelopment and Housing Authority
Richmond Regional Planning District Commission
Virginia Department of Forestry
Virginia Department of Environmental Quality

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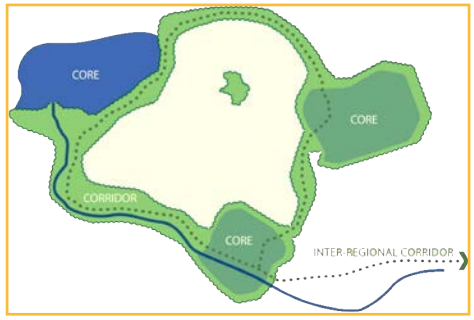

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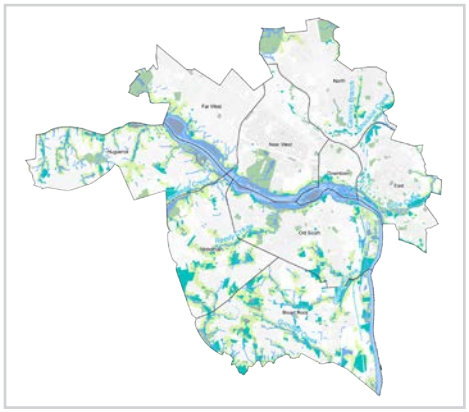

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Foreword

Former industrial communities often suffer from the cumulative effects of multiple vacant and underutilized properties. Reuse of these properties offers a strategic opportunity for integrating community resilience, economic revitalization and ecological restoration.

Since 2006, the Green Infrastructure Center (GIC) and E^2 Inc. have assisted local communities in evaluating their natural assets to inform comprehensive planning and development. This landscape-based approach to revitalization is based on the idea of weaving together the social and ecological infrastructure necessary to foster resilient communities. Successful cities have demonstrated that an interconnected landscape system provides a unique sense of place that attracts people, jobs and both public and private investment. The community benefits of a restored green infrastructure network include active living, neighborhood pride, improved air and water quality, and increased property values.

The purpose of the Richmond Green Infrastructure Assessment is to identify vacant parcels that could add significant value to the city's open space portfolio in the form of a green infrastructure network. This report presents the results of the assessment: a potential citywide green infrastructure network and strategies that can be applied at the neighborhood scale to improve habitat, recreational access and water quality. This report provides a tool that can be used to:

- Inform future planning,
- Leverage public and private development,
- Prioritize acquisition, conservation and restoration,
- Target sustainability pilots,
- Secure implementation funding,
- Enhance the tree canopy,
- Increase pedestrian and bicycle connections,
- Improve stormwater management strategies, and
- Promote Richmond as a sustainability model for other municipalities.

(Top): The James River corridor as seen from downtown, looking downstream.

(Bottom): An abandoned rail corridor in the Old South Planning District is an opportunity for green infrastructure expansion.

Figure 1. Retrofitting an Urban Green-Print.

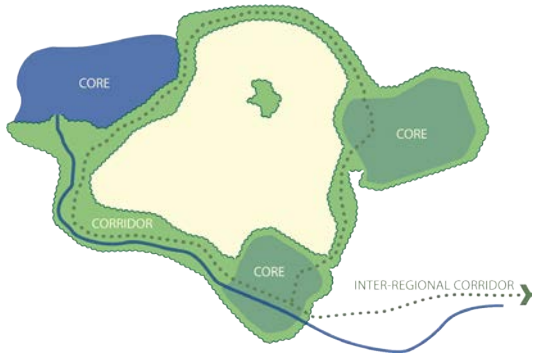
As traditional patterns of urban development have been replaced with urban sprawl, vacant and abandoned parcels in urban neighborhoods have diminished community life. These vacant sites can be viewed as opportunities to retrofit a green infrastructure network back into the urban landscape, providing recreational venues, community gardens, outdoor classrooms, and habitat.

I. Introduction

As traditional patterns of urban development have been replaced with urban sprawl, holes of disinvestment in urban neighborhoods have diminished community life. These vacant sites can be viewed as opportunities to retrofit a green infrastructure network back into the urban landscape, providing recreational venues, community gardens, outdoor classrooms and habitat.

Green infrastructure consists of the natural resources and green spaces that provide the city's clean water and air, enhance residents' quality of life and support the city's economy. The City of Richmond's green infrastructure includes the connected natural systems and ecological processes that provide critical functions, such as water filtration, clean air, wildlife habitat and migration corridors, and recreational opportunities. Green infrastructure planning identifies and prioritizes natural assets for preservation and connectivity.

Protecting and restoring green space also provides economic benefits. Certain business sectors are more likely to locate in communities with ample recreation and open space opportunities. In addition, research demonstrates that business districts that have a healthy tree canopy encourage shoppers to visit more often and to spend up to 12% more than districts lacking in trees. Likewise, residential land values are higher in neighborhoods with greater tree canopy and open space amenities.



I. Introduction

Project Background

In 2009, the GIC and E² Inc. developed a GIS-based assessment of green infrastructure assets for the Richmond Region and facilitated a community workshop to identify opportunities to connect a green infrastructure network across jurisdictional boundaries. The Richmond Region Green Infrastructure Project revealed that the region's green infrastructure assets have significantly declined over the last decade due to sprawling development patterns outside of the city.

The City of Richmond includes over 9,000 parcels which are identified as vacant. Many of these vacant sites can be viewed as natural assets for the city – a resource for expanding the green infrastructure network and enhancing neighborhoods.

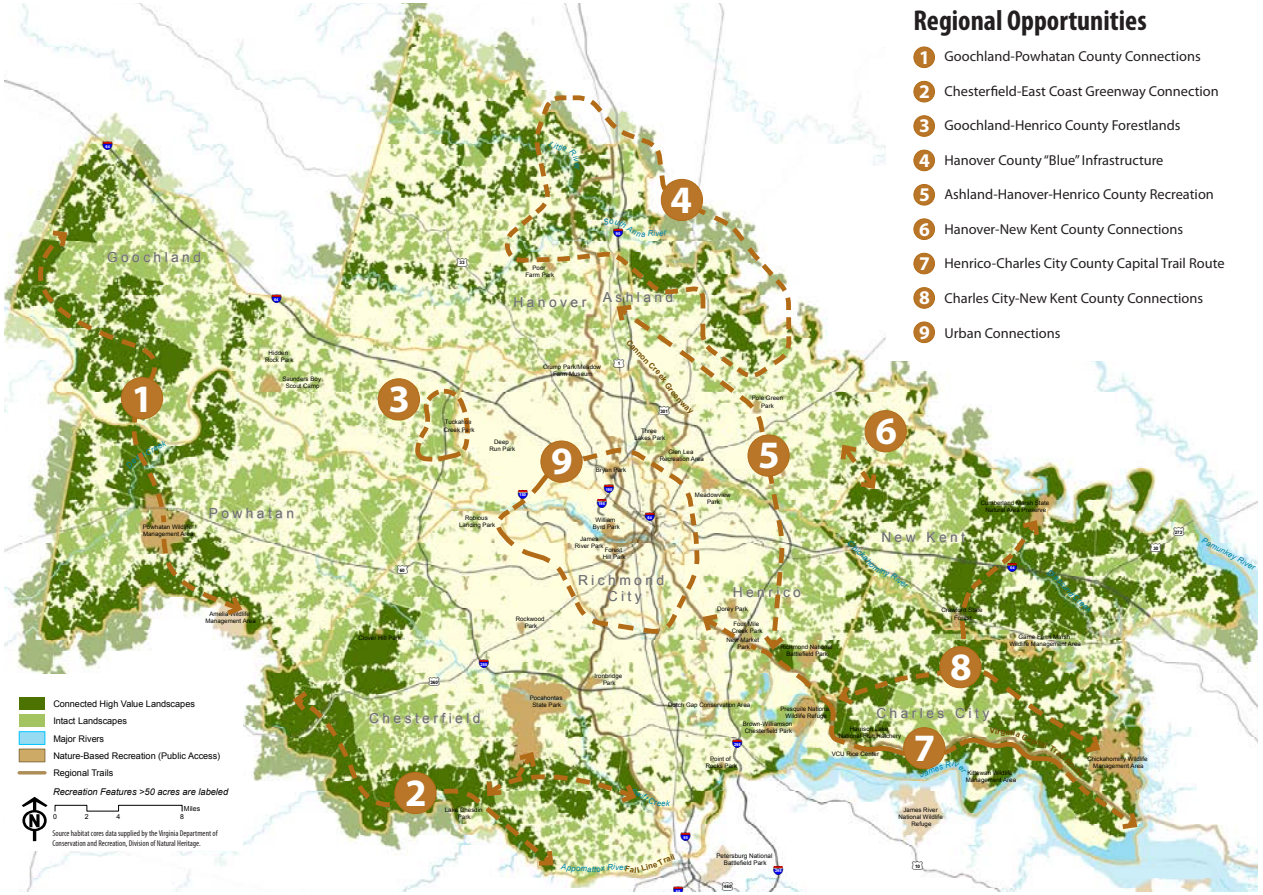


Figure 2. Richmond Region Strategic Green Infrastructure Map.

The Richmond Region Green Infrastructure Project resulted in a prioritized set of opportunities to preserve and expand the region's green infrastructure network.

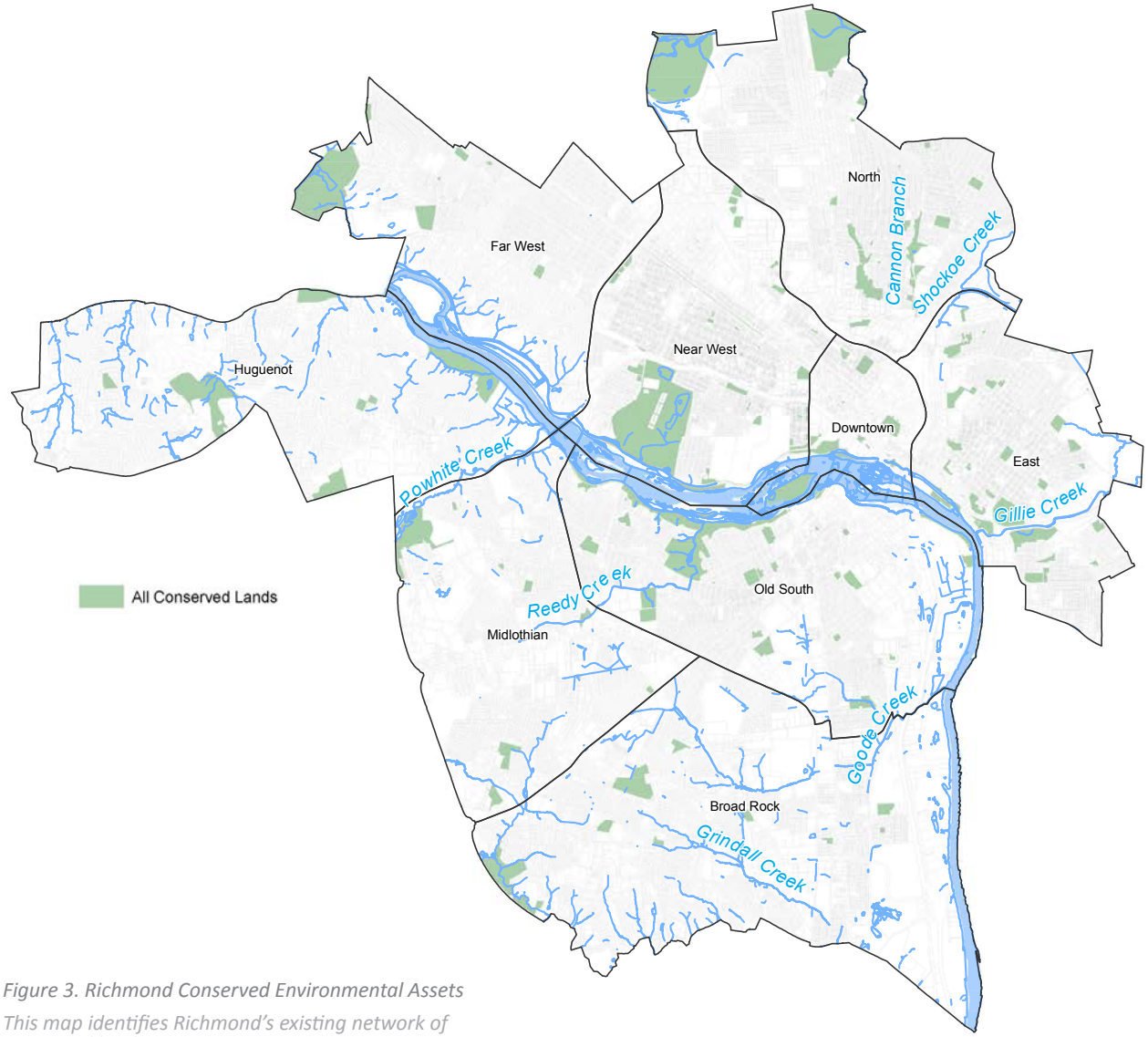


Figure 3. Richmond Conserved Environmental Assets

This map identifies Richmond's existing network of conserved lands.

Project Overview

The goal of the Richmond Green Infrastructure Assessment is to evaluate the potential for these vacant parcels to contribute to a citywide green infrastructure network.

Phase I, led by the Richmond Regional Planning District Commission (RRPDC), identified the city's existing green assets (the Green Print). The results of the Phase I assessment are compiled into a report titled "A Green Print Pilot Program for Richmond." The report features maps of citywide green infrastructure assets and an analysis of the benefits of green infrastructure for a smaller pilot area within the city. The Virginia Department of Forestry also contributed a tree canopy evaluation for the city. (See Tools: Project Data Resources on page 33).

Phase II, the focus of this report, identifies the vacant and underutilized properties in the city, evaluates the inventory of vacant properties for suitability to contribute to the city's green infrastructure network, and provides green infrastructure concept plans to connect the green infrastructure network at the neighborhood scale.

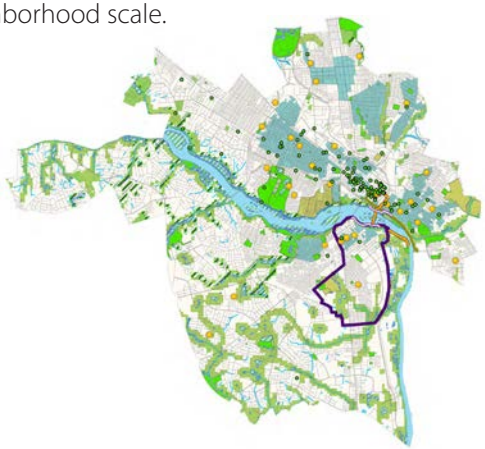


Figure 4. Richmond Composite Green Analysis Map.

The Richmond Green Print identifies Richmond's natural and cultural assets. A larger map is located in the Tools section. (Source: RRPDC)

I. Introduction

Project Goals

The purpose of the Richmond Green Infrastructure Assessment is to map existing green assets and evaluate underutilized properties for their potential to contribute to the city's green infrastructure network.

The Green Infrastructure Assessment creates a replicable methodology for green infrastructure planning at a variety of scales in the City of Richmond. The project outcomes at the city, planning district, and neighborhood scale along with tools for implementation at the project scale are listed below:

- City: Provide a potential citywide green infrastructure network based on the ecological suitability of vacant parcels.
- Planning District: Create an interactive database for use in evaluating the suitability of vacant parcels to improve water quality, expand the network of existing conserved lands, and serve as parks, community gardens, outdoor classrooms, and trail connections.
- Neighborhood: Develop neighborhood concept plans and identify potential catalyst sites for connecting neighborhoods to the city's green infrastructure network.
- Project: Provide case studies and a green infrastructure toolkit of strategies that can be implemented to enhance Richmond's green infrastructure network.

City of Richmond Master Plan Goals

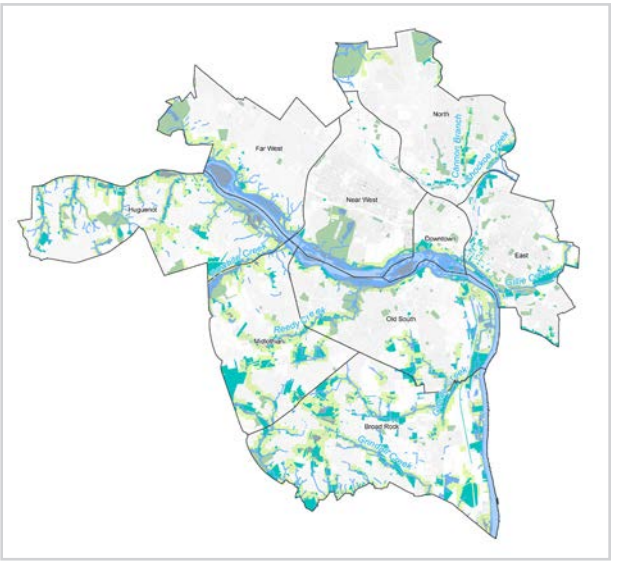
The Richmond Green Infrastructure Assessment provides a tool to help pursue the following goals outlined in the City of Richmond 2000-2010 Master Plan:

- Transform obsolete structures into productive uses.
- Fill critical gaps in park inventory.
- Acquire underutilized property to provide access to the James River.
- Ensure high quality water resources.
- Protect environmentally sensitive lands.
- Increase citizens' appreciation for and access to the natural environment.
- Protect critical natural resources.
- Protect pedestrian and bicycle movement.
- Increase collaboration between Richmond Public Schools and the Dept. of Recreation and Parks.
- Increase role of the Dept. of Recreation and Parks in economic development and neighborhood revitalization.
- Ensure quality of life for all residents.

(Above): The Tricycle Gardens Urban Farm is one example of the community members of Richmond working together to pursue citywide goals.

II. City

Citywide Green Infrastructure Network Opportunities



Many of the approximately 9,000 vacant parcels in the City of Richmond offer the potential to provide significant ecological or open space benefits. This section outlines the development of the vacant parcel database and presents a potential green infrastructure network based on vacant parcels with high ecological value.

(Above): Downtown Richmond, Hollywood Cemetery, and the Falls of the James River.

Vacant Parcel Inventory Database

Database Assembly

As a first step in identifying a potential green infrastructure network, the Richmond Green Infrastructure Assessment created a comprehensive dataset of Richmond parcels which are vacant or have a vacant structure on them.

The vacant parcel inventory was created by integrating multiple datasets from several city departments and entities. These separate datasets were integrated into a single GIS database based on parcel identification numbers. This represents the first consolidation of available citywide vacant parcel data, and can be updated as new information becomes available. Departments and agencies that contributed data included:

- City Assessor's Office
- Dept. of Parks and Recreation
- Dept. of Planning and Development Review
- Dept. of Economic and Community Development
- Richmond Redevelopment and Housing Authority

The next section evaluates which of these vacant parcels may be candidates for expanding Richmond's green infrastructure network.

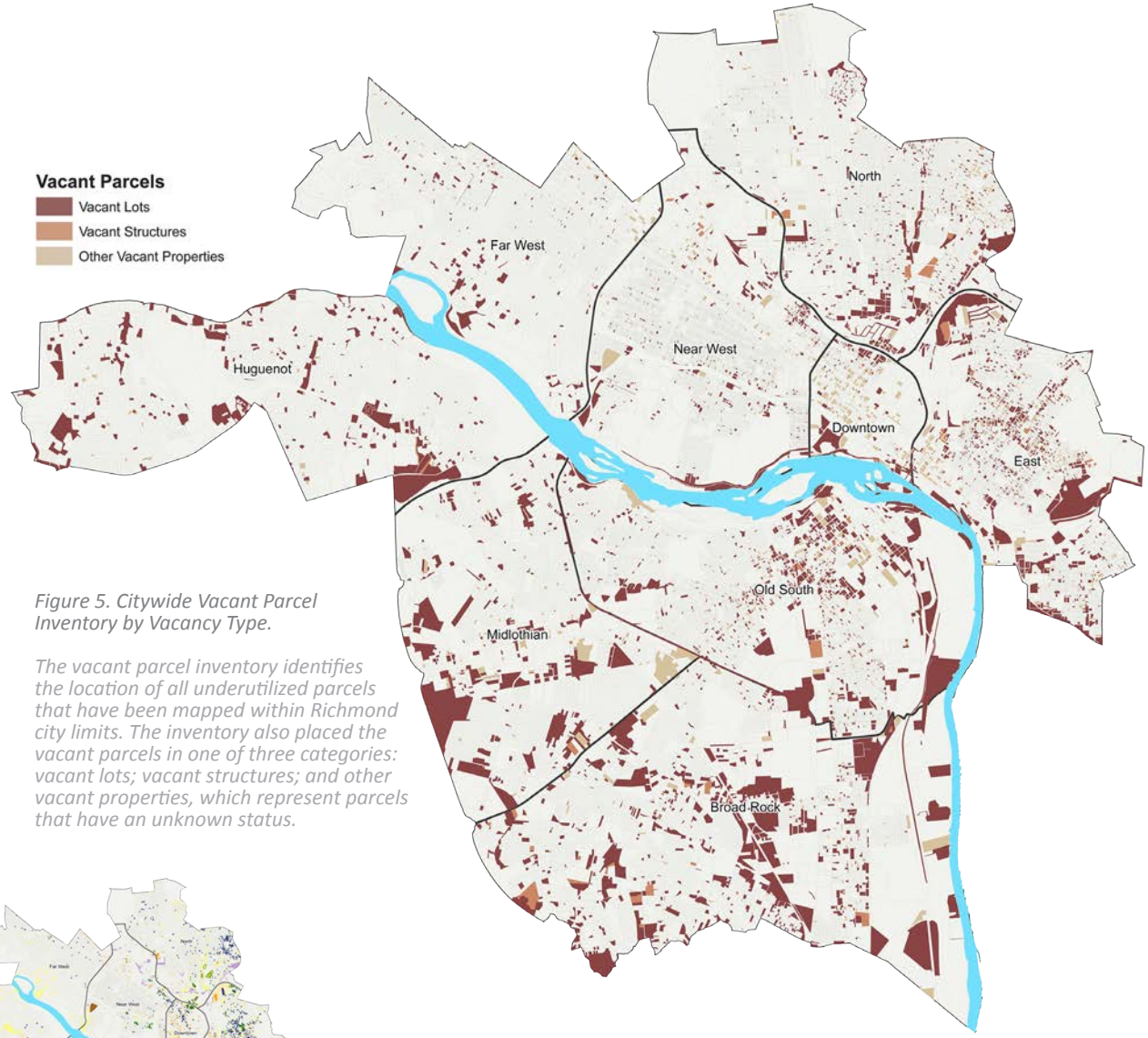


Figure 5. Citywide Vacant Parcel Inventory by Vacancy Type.

The vacant parcel inventory identifies the location of all underutilized parcels that have been mapped within Richmond city limits. The inventory also placed the vacant parcels in one of three categories: vacant lots; vacant structures; and other vacant properties, which represent parcels that have an unknown status.

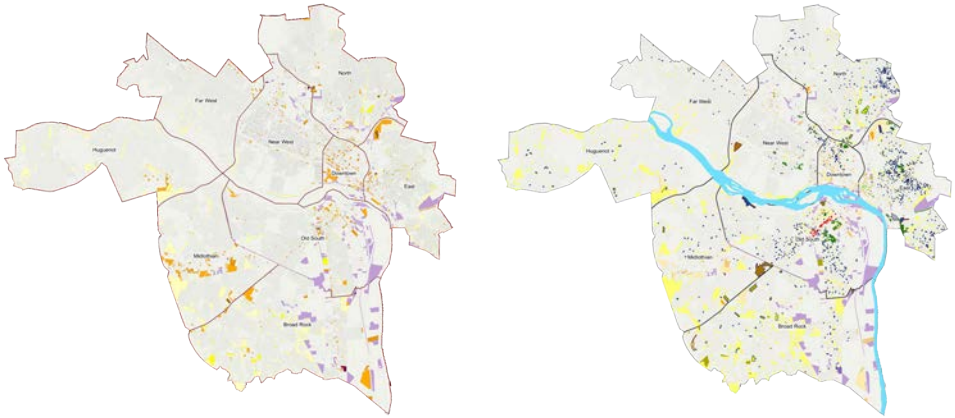


Figure 6. Citywide Vacant Parcel Inventory by Source.

These two thumbnail maps illustrate the City Assessor's Office vacant parcel data (left) and the vacant parcel databsase (right) that incorporates datasets submitted by other city departments and agencies. To view larger maps, see the Tools section on page 31.

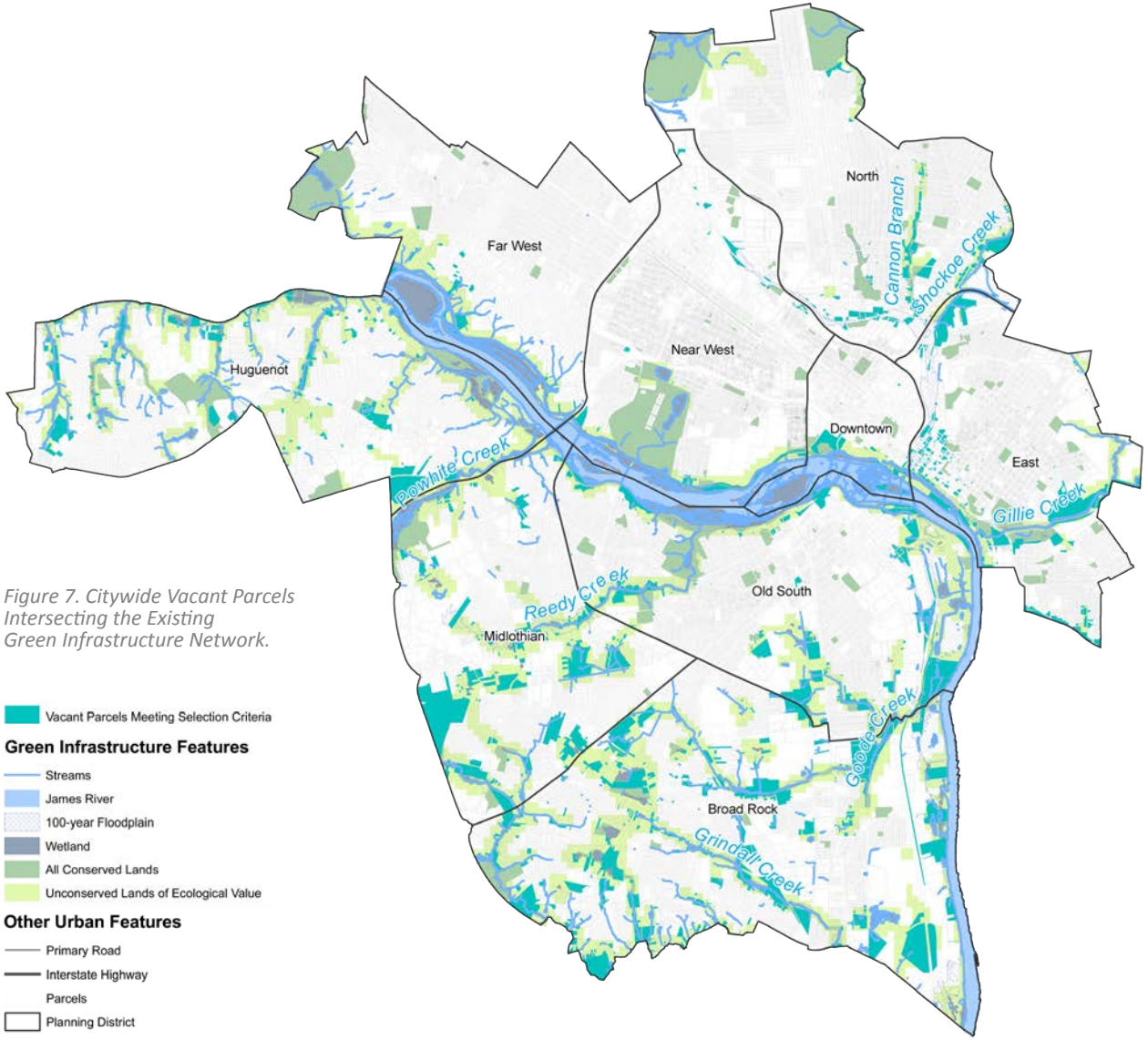


Figure 7. Citywide Vacant Parcels Intersecting the Existing Green Infrastructure Network.

Citywide Green Infrastructure Network

The vacant parcels identified provide an opportunity to enhance desired green infrastructure functions and features in Richmond, such as improving water and air quality, walkability, equal access to recreational activities, community safety and health, and surrounding property values.

Figure 7 outlines a potential green infrastructure network based on the ecological suitability of vacant parcels throughout the city. These parcels have been selected based on the following set of goals:

1. Protect Priority Conservation Areas[1]
2. Improve water quality and stormwater management
3. Increase park access
4. Support greenway development
5. Identify network opportunities

Methodology

Vacant parcels that meet one or more of the following criteria were selected for the potential green infrastructure network:

- Location within Priority Conservation Area (unconserved lands of ecological value)
- Intersection with a stream corridor
- Intersection with a wetland
- Location within a floodplain
- Includes a Natural Resource Heritage area (protects endangered and protected species)

[1] Priority Conservation Areas (PCAs) are landscapes of significant conservation value in the Commonwealth of Virginia. The PCA dataset was developed jointly by Virginia Department of Conservation and Recreation (DCR), Virginia Department of Game and Inland Fisheries (DGIF), and Virginia Commonwealth University's Center for Environmental Studies (VCU-CES). The PCA dataset evaluates conservation sites and natural landscape networks, wildlife diversity conservation areas, and water resource integrity.

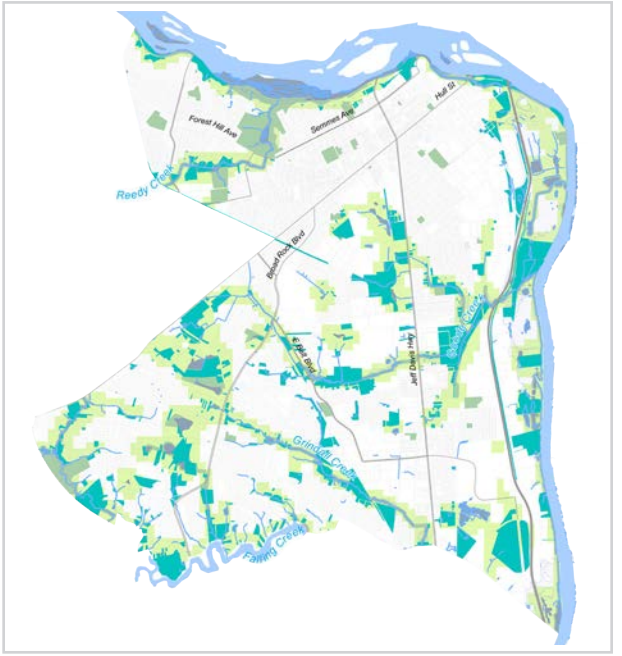
Images of Vacant Parcels

The following images represent existing vacant green spaces in the Old South and Broad Rock Planning Districts (June 2010) that could potentially contribute to the city's green infrastructure network.

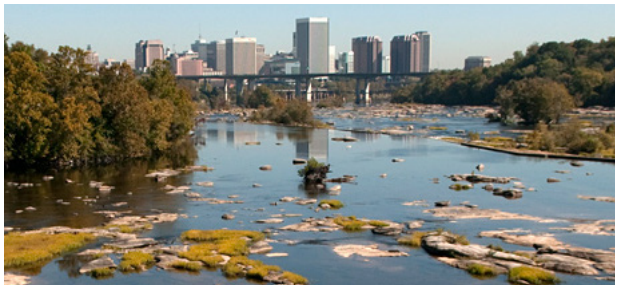
1. Abandoned rail corridor between Maury Cemetery and Jefferson Davis Highway.
2. Vacant lot in Blackwell neighborhood.
3. Vacant lot adjacent to the Bellemeade tributary stream in Bellemeade neighborhood.
4. Vacant lot in Windsor neighborhood adjacent to Commerce Road.
5. Two adjacent vacant lots with mature canopy trees on Bainbridge Avenue in Manchester neighborhood.

III. District

Planning District Suitability Assessment



This section presents the method used to select two planning districts for more focused analysis (the Broad Rock and Old South Planning Districts, shown above). The district-scale analysis presents a series of maps highlighting vacant parcels that may be suitable for green infrastructure functions, including stormwater management, parks, outdoor classrooms, community gardens, conserved land, and trail access.



(Above): The Richmond skyline and the James River.

Planning District Suitability Assessment

Based on analysis of the vacant parcel inventory and input from city staff, the Project Team selected the Broad Rock and Old South Planning Districts to demonstrate how to restore green infrastructure at a neighborhood district scale. These two planning districts offer the greatest potential for expanding the green infrastructure network and can demonstrate how the approach taken in these two districts could be replicated in other city districts. These planning districts currently have:

- Significant acreage of Priority Conservation Areas,
- Some of the least acreage of park land,
- Extensive acreage of vacant properties, and
- The highest watershed priorities for the city.

In addition, these two planning districts offer an opportunity to:

- Leverage city efforts with the Broad Rock, Bellemeade, and Oak Grove Elementary Schools and Bellemeade Community Center,
- Leverage community efforts to develop the James River Trail and enhance the Jefferson Davis Corridor, and
- Offer planning assistance to historically underserved neighborhoods.

Table 1 provides a quantitative comparison of Priority Conservation Area, park land, and vacant properties by planning district. Table 2 shows an evaluation of the planning districts based on seven criteria, including Priority Conservation Areas, priority watersheds, existing park land, amount of vacant parcels, community leadership capacity, related city initiatives, and neighborhood equity.

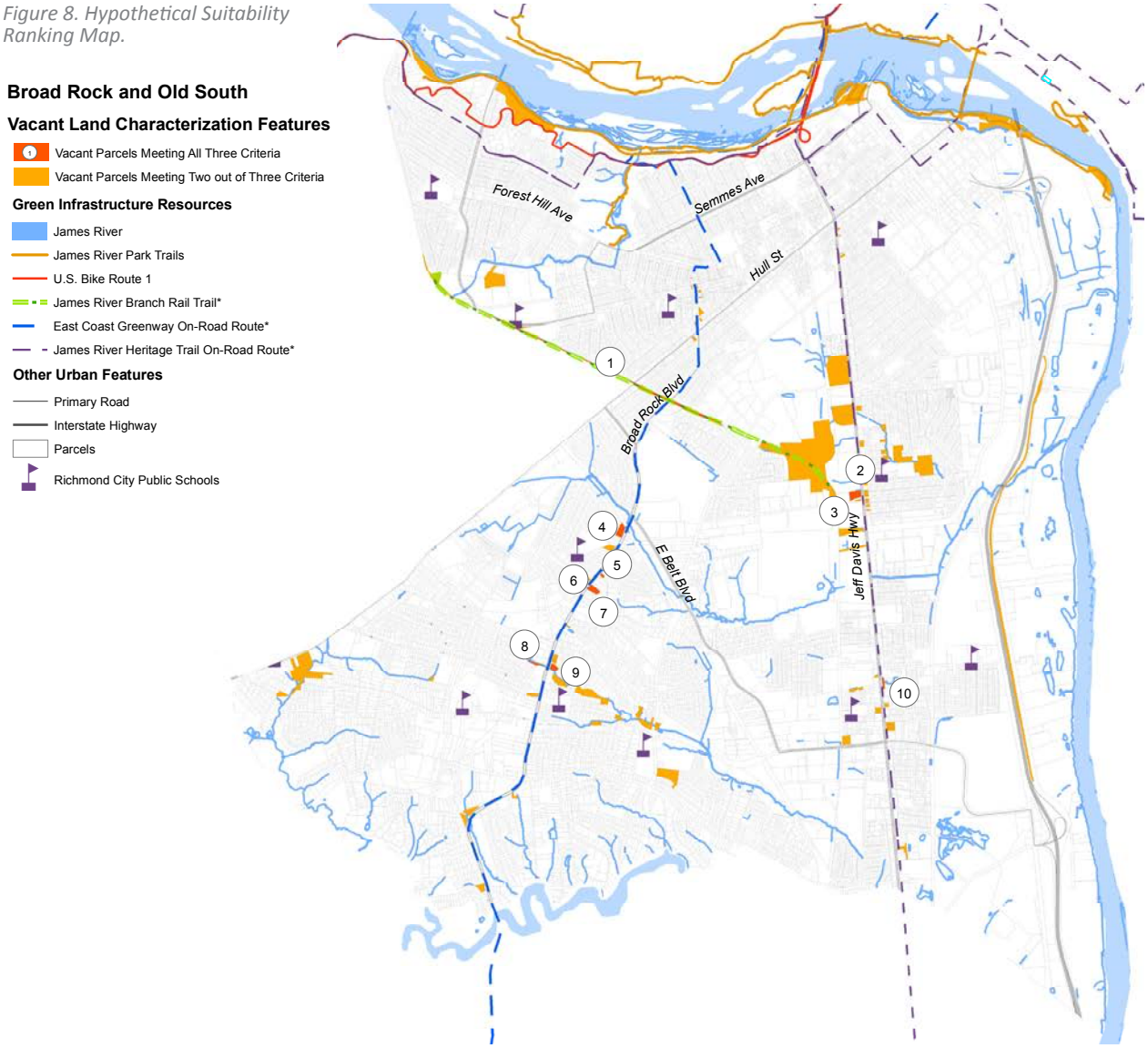
	Total Area *(acres)*	**Priority Conservation Areas**		**Park Land**		**Vacant Lots**	
		Total Area (acres)	*Percent*	*Total Area (acres)*	*Percent*	*Total Area (acres)*	*Percent*
Broad Rock	7939	2891	36%	154	2%	1087	14%
Downtown	1128	396	35%	98	9%	76	7%
East	3434	492	14%	215	6%	457	13%
Far West	3989	852	21%	246	6%	108	3%
Huguenot	5342	1897	36%	301	6%	465	9%
Midlothian	4369	1369	31%	128	3%	569	13%
Near West	4267	68	2%	472	11%	154	4%
North	4684	531	11%	538	11%	263	6%
Old South	5257	1797	34%	351	7%	552	11%
Downtown Master Plan Area	2201	739	34%	106	5%	229	10%

Table 1. Summary of parkland, Priority Conservation Areas, and vacant parcel acreage by planning district.

Planning District Selection Considerations	Broad Rock	Downtown	East	Far West	Huguenot	Midlothian	Near West	North	Old South	Downtown Master Plan
Which districts have significant Priority Conservation Areas?	✓				✓				✓	
Which districts contain high priority watersheds?	✓								✓	*t*
Which districts are lacking existing parkland (by percent area)?	✓	✓				✓				✓
Which districts offer a critical mass of vacant parcels that could offer network opportunities?	✓		✓		✓	✓			✓	✓
Which districts offer greenway leadership capacity?*	✓							✓	✓	
Which districts have other City initiatives to consider?**	✓									
How might neighborhood equity factor into district selection?	✓								✓	

Table 2. Focus area selection criteria by planning district.
**James River Trail, Jefferson Davis Corridor, and Cannon Creek Greenway*
***Broad Rock, Oak Grove Elementary School, and Bellemeade Community Center*

Figure 8. Hypothetical Suitability Ranking Map.



Programmatic Suitability

The vacant lands inventory for the two planning districts was further analyzed to evaluate the suitability of vacant parcels for several types of green infrastructure programming, including:

- Supporting watershed health
- Expanding conserved lands network
- Increasing public park access
- Supporting outdoor classrooms for public schools
- Expanding access to community gardens
- Supporting urban trails and greenways

Hypothetical Suitability Ranking

The vacant lands inventory can be used to rank parcels suitable for specific land use goals, as illustrated in Figure 8. In this hypothetical scenario, the school district or supporting community organization has decided to acquire a new property for use as an outdoor classroom. The selection criteria include a walkable distance (0.25 miles or less) from a school and trail access as well as proximity to a creek.

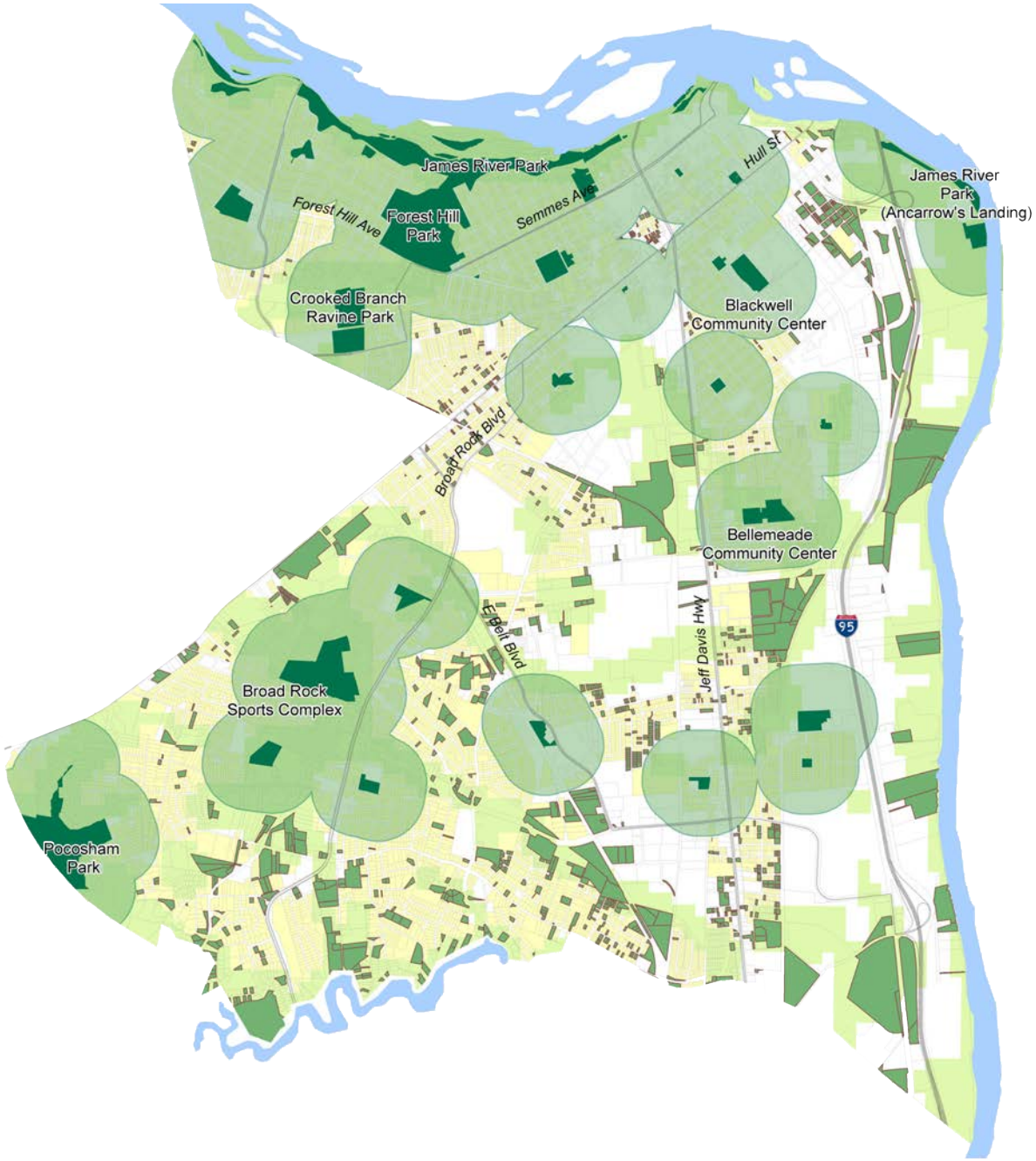
Using the vacant parcel inventory, 10 potential parcels meeting all three criteria and 289 potential parcels meeting two out of the three criteria were identified. Parcels meeting all three criteria are identified in Figure 8 in red. Parcels meeting two of the three criteria are identified in orange.

Enhancing Watershed Health

Reedy Creek, Goode Creek and the James River are all designated as impaired waters by the state. The city is currently prioritizing these watersheds for water quality planning and improvements. Figure 9 identifies vacant parcels that have increased potential to improve stormwater runoff due to their location within a designated Resource Protection Area (RPA)[2] or within 100 feet of a stream. Tree canopy, conserved land and natural drainage projects, such as rain gardens, are strategies that could be implemented on these vacant parcels to improve water quality. Watershed restoration would not only improve water quality in the city's rivers, streams, and in the Chesapeake Bay, but would also enhance the quality of life for residents and visitors by providing opportunities for swimming, fishing, scenic wildlife viewing and boating.

Figure 9. Watershed Health Suitability Map.

[2] *RPAs are designated under the Chesapeake Bay Protection Act to protect environmentally sensitive lands alongside waterways. Only a portion of the city is covered by the Bay Act.*



Increasing Access to Public Parks

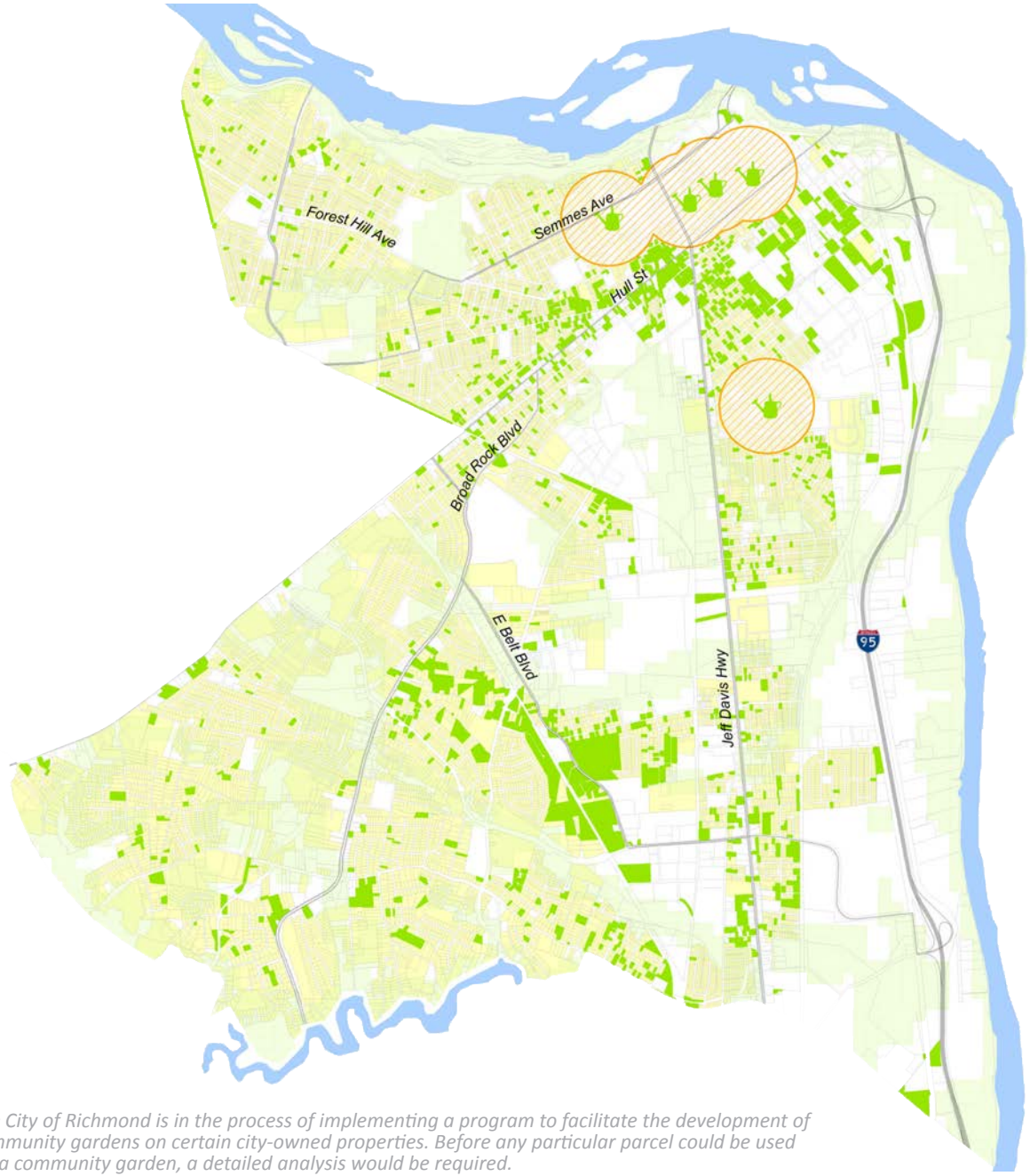
Figure 10 identifies vacant parcels that may be suitable candidates for increasing access to public parks for city residents. A quarter mile is generally considered a walkable distance in an urban setting. Therefore, residential areas located within the quarter mile areas may be considered to have good park access. Access could be improved for residential areas outside of these areas. Vacant parcels located outside of these areas and with proximity to residential areas may be good candidates for land acquisition to expand park access.

Figure 10. Public Parks Suitability Map.

Connecting the Conserved Landscape

Conserved lands include public and private lands that are conserved and managed either for their ecological or social value. These lands include City of Richmond public parks, state and federal conservation lands, and privately conserved lands. In addition, this analysis of conserved lands includes Resource Protection Areas (RPAs) – a regulatory extension of the Chesapeake Bay Preservation Act that limits development within 100 feet of streams. Conserving land adjacent to these properties can help to build a connected green infrastructure network. Figure 11 identifies vacant parcels adjacent to conserved lands that have a strong potential to contribute to the existing conservation network due to their high ecological value.

Figure 11. Conserved Lands Suitability Map.



The City of Richmond is in the process of implementing a program to facilitate the development of community gardens on certain city-owned properties. Before any particular parcel could be used for a community garden, a detailed analysis would be required.

Growing Community Gardens

Community gardens can provide a catalyst for neighborhood and community development. Community gardens beautify neighborhoods; produce nutritious food; encourage self-reliance; create opportunity for recreation, exercise, therapy, and education; stimulate social interaction; reduce crime; and reduce the urban heat island effect.

Figure 12 highlights vacant parcels located within walking distance (0.25 miles) from existing community gardens. Vacant parcels located beyond the quarter-mile buffers of existing community gardens have a high suitability for reuse as community gardens. This possibility is strengthened when a vacant parcel is located in or near residential areas.

Regardless of their distance from existing community gardens, vacant parcels that intersect with Priority Conservation Areas were excluded due to their high ecological value. For such parcels, a conservation reuse strategy is generally more appropriate than a productive agricultural use like a community garden.

Figure 12. Conserved Lands Suitability Map.

Creating Outdoor Classrooms

Vacant parcels within walking distance (0.25 miles) of public schools may provide opportunities for creating outdoor classrooms. Hands-on learning activities related to ecology, gardening and green infrastructure engage students in active learning and can lead to improved test scores. Figure 13 shows vacant parcels located within a quarter mile of a public school building.

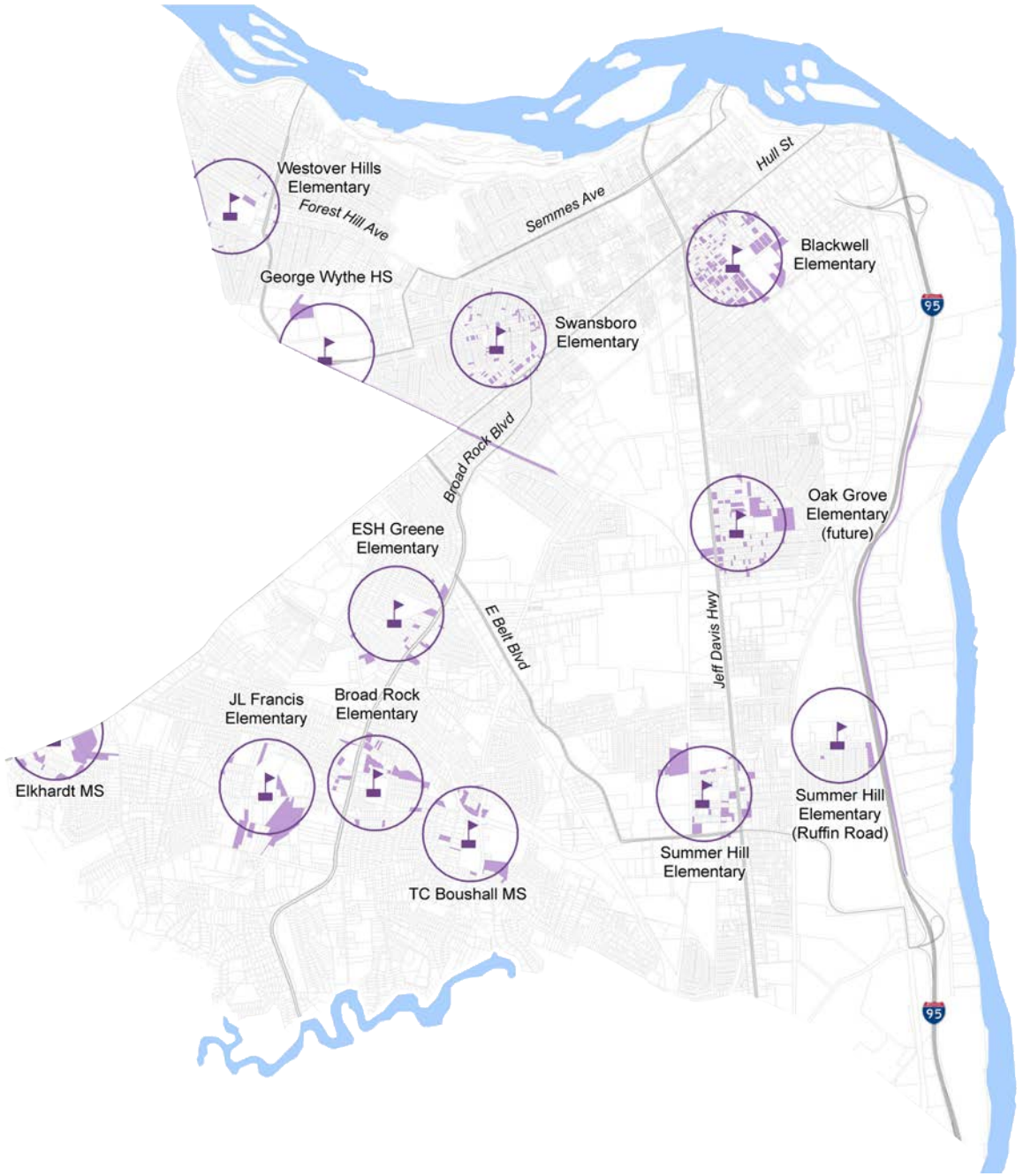


Figure 13. Public Schools Suitability Map.

Expanding Trail Access

Urban trails and greenways can provide opportunities for recreation as well as for multi-modal transit between destinations. Vacant parcels with proximity to these community assets may be well-positioned to support trails and greenways. These parcels could also expand the tree canopy or enhance the scenic urban landscape.

All trail routes mapped with a solid line in Figure 14 are officially designated and are currently in use. All trail routes mapped with a dashed line are still in planning stages, with varying degrees of progress:

- The James River Branch Rail Trail is a potential multipurpose trail corridor that would provide recreational reuse of abandoned rail lines. This project is proposed by the Southside Richmond Rail-Trail Project Team.
- The East Coast Greenway (ECG)[3] is a national multi-purpose trail in various stages of implementation. In Richmond, the ECG is planned as an on-road bicycle-pedestrian trail.
- The James River Heritage Trail (JRHT)[3] is a planned multipurpose trail system following the entire James River. In Richmond, the JRHT is planned to be a network of on-road bicycle and pedestrian routes.

Figure 14. Trail Access Suitability Map.

Broad Rock and Old South

Vacant Land Characterization Features

- Vacant Parcels within 100' of any Trail Route
- Existing Residential Land Use

Green Infrastructure Resources

- James River
- James River Park Trails
- U.S. Bike Route 1
- James River Branch Rail Trail*
- East Coast Greenway On-Road Route*
- James River Heritage Trail On-Road Route*

[3] *This map depicts the planned route, as approved by Virginia Dept. of Conservation and Recreation.*

A Connected Green Infrastructure Network Strategy

Green Infrastructure Opportunites at the Planning District Scale

This section began by prioritizing Broad Rock and Old South as planning districts with incredible potential for expanding the green infrastructure network. Together, Broad Rock and Old South contain over 1600 acres of vacant property - over 40% of the city's total vacant acreage. However many of these properties have significant ecological value that could contribute to a vibrant green infrastructure network offering a range of community assets. The map series presented in this section highlights vacant lands with potential to enhance water quality, increase access to parks and community gardens, expand conserved lands, provide outdoor learning opportunities, and enhance trail access.

The final map in this series, figure 15, highlights the potential of vacant parcels to create a green infrastructure network connecting the James River Branch Trail to the James River Park System. This proposed loop trail prioritizes vacant parcels with significant ecological value in the Reedy and Goode Creek corridors to complete a green infrastructure loop for the neighborhoods south of the James River. The neighborhood plans outlined in the following section explore options for implementing this connection at the community scale.

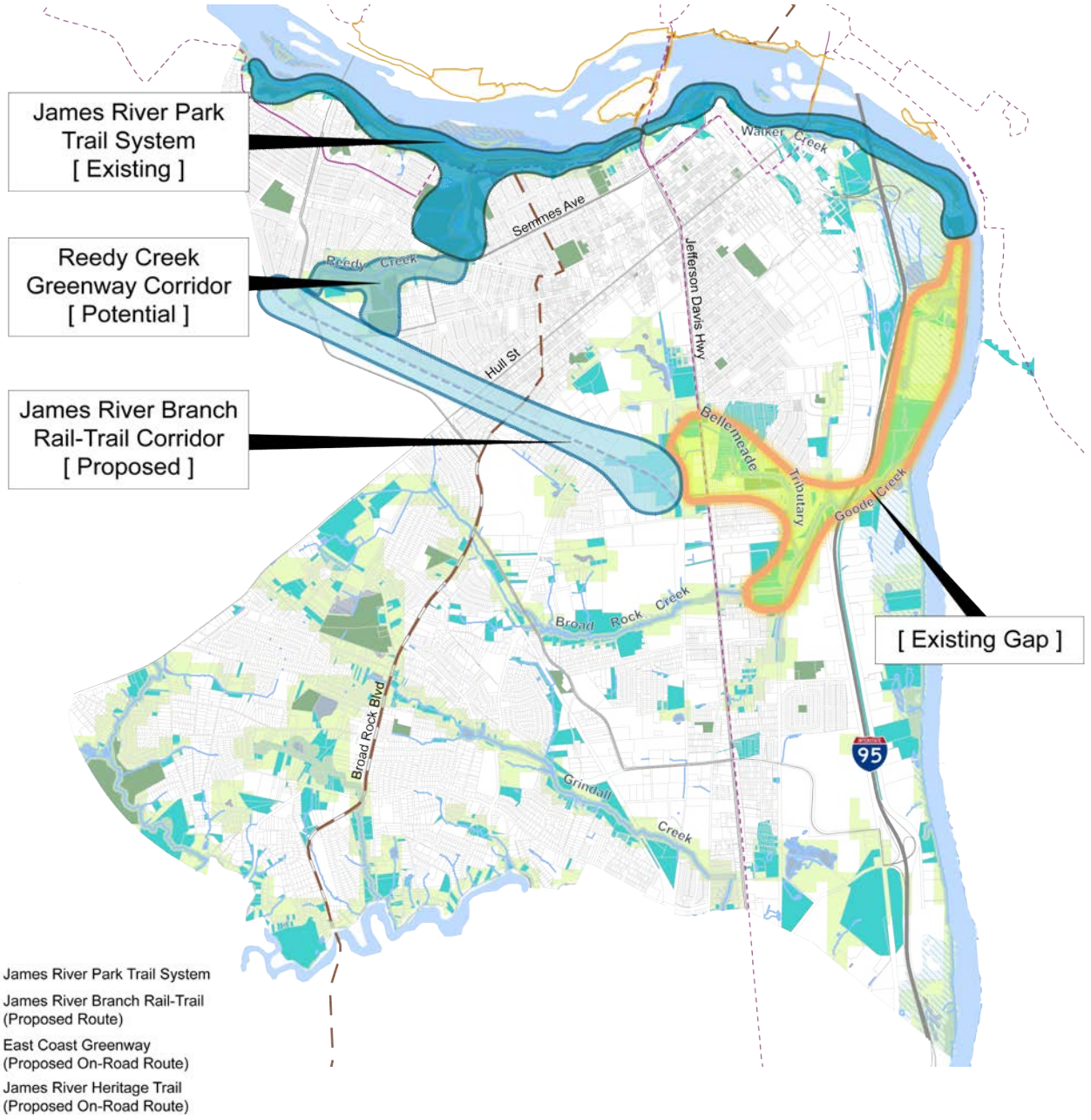


Figure 15. District-Scale Green Infrastructure Expansion Opportunities: A Vision for Comprehensive Connectivity.

IV. Neighborhood

Neighborhood Concept Plans

This section of the report outlines green infrastructure concept plans for two neighborhoods. The first concept plan, **Blackwell Green Links**, presents a green infrastructure strategy for a dense urban neighborhood in transition. The second concept plan, **Bellemeade Creek Corridor**, outlines a green infrastructure strategy for a more informal neighborhood in a watershed. Both concept plans offer examples of how vacant parcels can be used as catalyst sites, along with green streets, to connect neighborhoods to the citywide green infrastructure network.

A working session with the project partners was held in October 2010 to refine the strategies based on city priorities and initiatives. Recommendations from the working session are included for each concept plan as a framework for initiating the green infrastructure network for these neighborhoods. Additionally, these concept plans were designed as prototypes that can be applied to other neighborhoods in the city.

Blackwell Green Links Concept Plan

The Blackwell Green Links Concept Plan outlines a strategy for an urban neighborhood in transition. The City of Richmond has designated Blackwell as a redevelopment and conservation area and has committed more than $16 million to improve homeownership opportunities and construct a new elementary school, build a new community center and refurbish a community park. Additional neighborhood assets include a community garden, a commercial corridor (Hull Street) and a regional trail system along Bainbridge Street.

Although plans are underway for significant private and public investment, the neighborhood lacks a framework for enhancing the community's natural assets and providing connectivity to the city's growing green infrastructure network. This concept plan identifies potential green streets along with vacant "catalyst" parcels to form a network connecting the neighborhood to the Belle Isle and James River trail systems.

Methodology

The methodology for the Blackwell Green Links Concept includes:

- Identify cultural assets and neighborhood amenities,
- Identify potential paths to connect ecological and cultural amenities,
- Identify potential catalyst sites that build on the path network,
- Develop a menu of green street treatments,
- Prioritize a set of strategies for implementation.

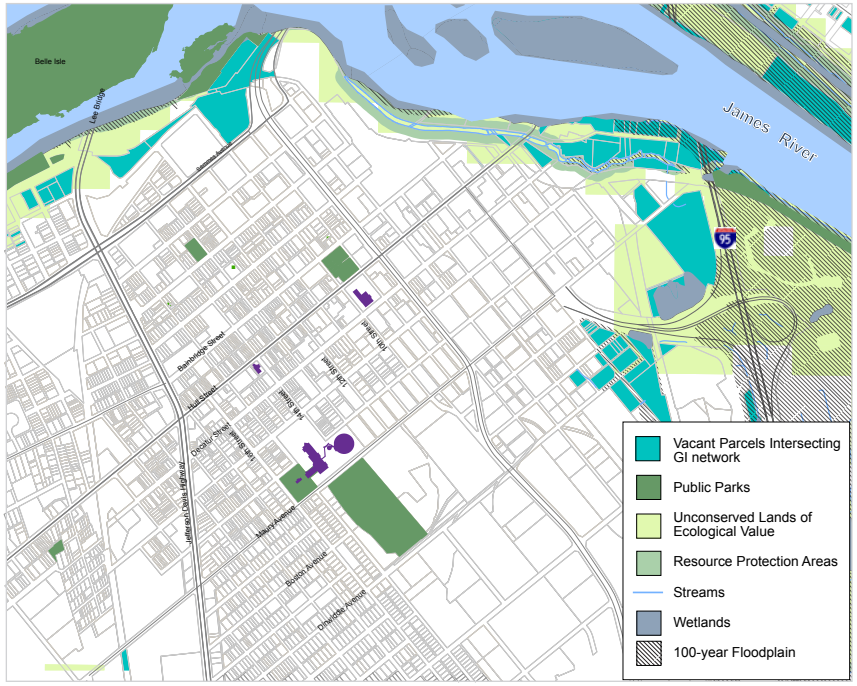


Figure 18. Vacant Parcels with Ecological Value.

Figure 19. Vacant Parcels with Urban Tree Canopy.

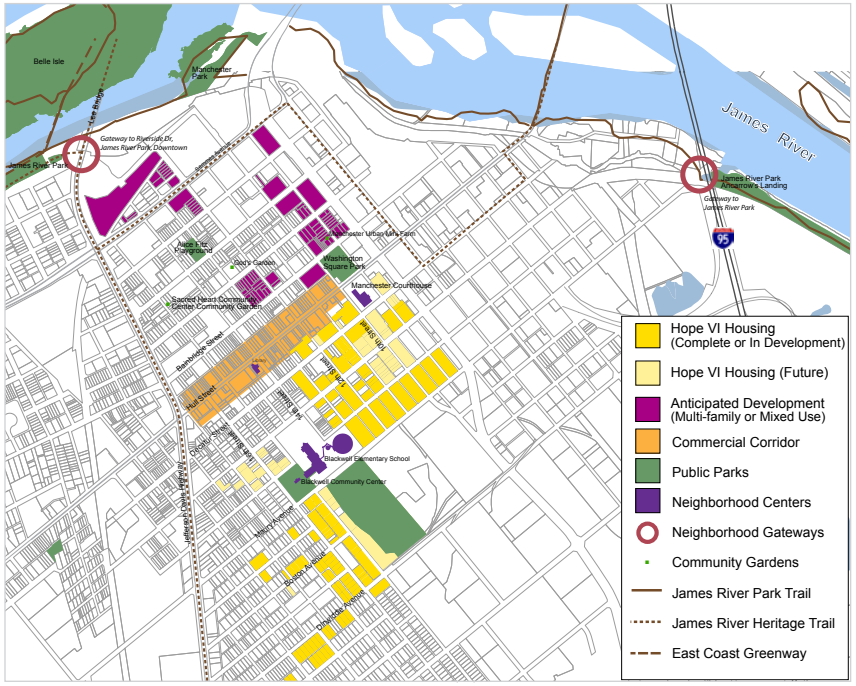


Figure 20.
Cultural Assets and Anticipated Development.

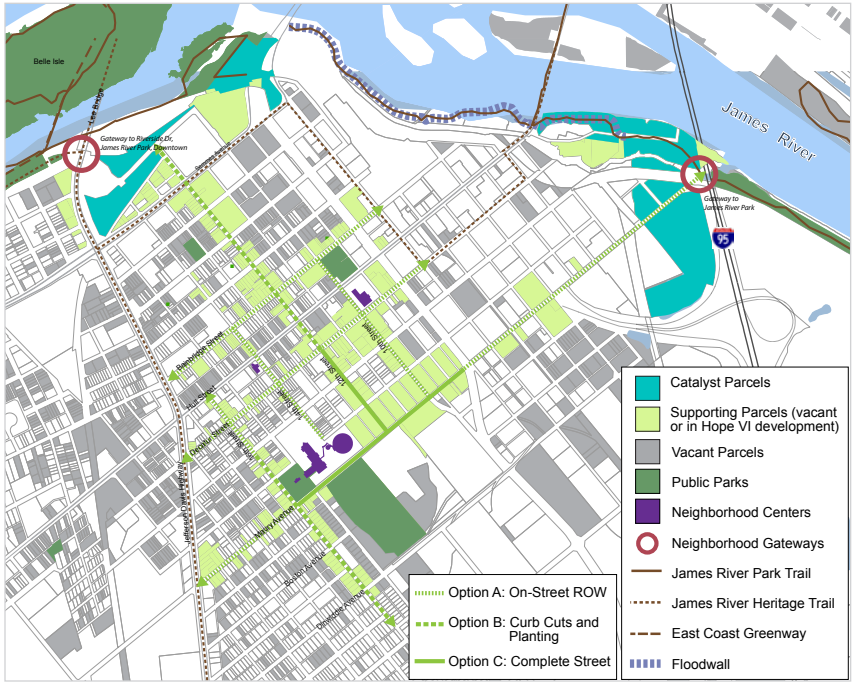


Figure 21.
Green Links Street Menu.

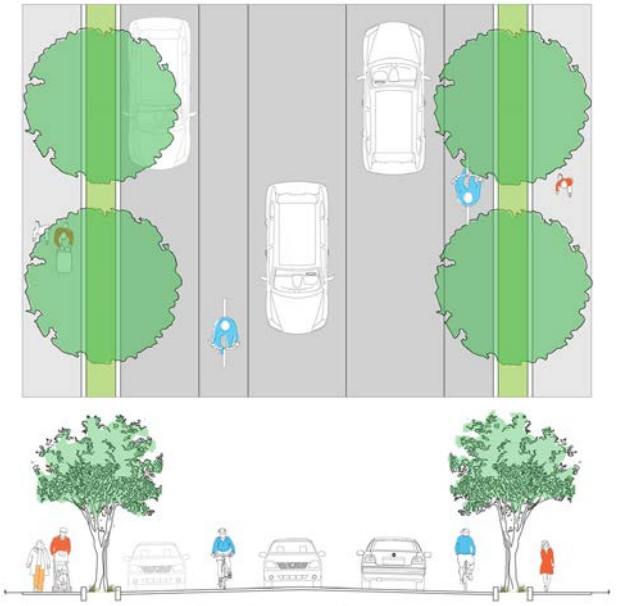
Blackwell Green Links Concept Plan

Proposed "Green Link" Street Treatments

The concept plan proposes a range of street treatments that can:

- Enhance pedestrian and bicycle connections,
- Improve storm flow and water quality,
- Increase tree canopy,
- Beautify the neighborhood,
- Connect neighborhood to the citywide green infrastructure network.

An example street treatment is shown below and the full street treatment menu is presented on page 28.



Option A: On-Street ROW

Blackwell Green Links Concept Plan

Opportunity Sites

In October 2010, the Project Team held a working session with the project partners to present the neighborhood concept plans and identify potential catalyst sites that could initiate the implementation of a neighborhood green-print that could grow and connect to the citywide green infrastructure network. The Blackwell-Manchester workgroup identified the following opportunities corresponding with Figure 22:

1. Increase accessibility to city-owned riverfront and trail network for the growing residential population east of Commerce Street.

2. Leverage Lee Bridge city-owned parcel and 12th Street as a gateway connecting the neighborhood to the James River and the Belle Isle trail network.

Examples of riverfont amenities (left, Dayton, OH; right, Guadelupe River Park).

3. Enhance park across from Blackwell Elementary School to increase use and provide an anchor site along the green street network.

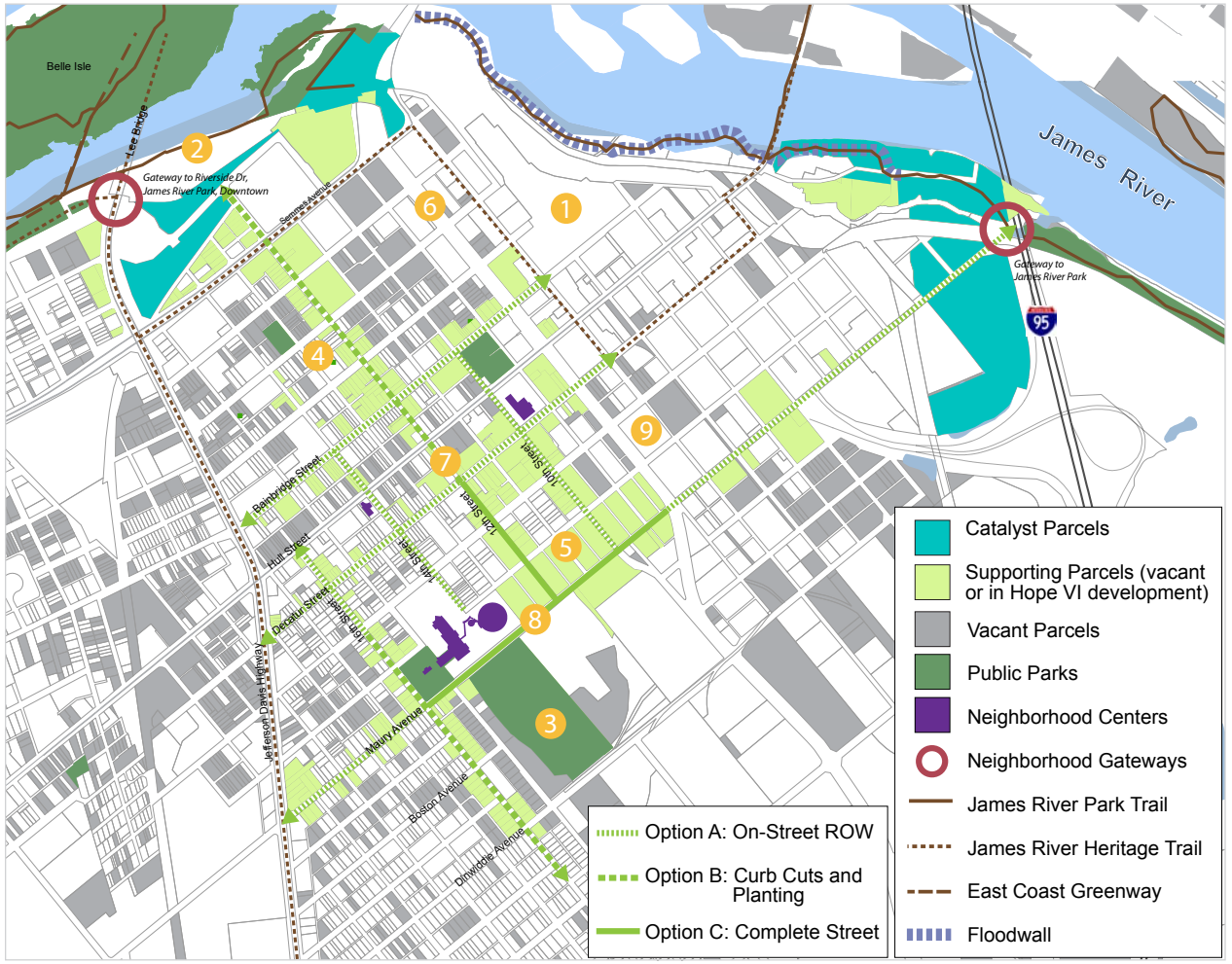


Figure 22. Opportunity Sites.

4. Collaborate with developers to develop and implement a shared green street vision north of Hull Street that leverages public and private investment.

5. Coordinate with Richmond Redevelopment and Housing Authority (RRHA) to integrate green infrastructure components into future developer bids, with potential interim community programming in the near-term.

6 Provide green street retrofits in strategic locations along Commerce Street to provide traffic calming and facilitate pedestrian movement.

Example of complete street retrofit in the new Hope VI housing development on 16th Street (right: before image and below: simulation of green street retrofit)

7 Develop a complete street concept plan for 12th Street to provide pedestrian connections between the park, RRHA development, Hull Street, private development and the river/trails network.

A network of green streets that include plantings, sidewalks and bicycle lanes can increase safety, connectivity and aesthetic value (examples, Portland, OR).

8 Implement green street retrofits on Maury Avenue between the school and park to provide safer pedestrian access and accommodate alternative transportation.

Example of a potential retrofit design for Maury Avenue to accommodate industrial traffic, pedestrians and bicycles safely.

9 Evaluate green infrastructure and community programming alternatives for surface parking lots on Commerce Road between Decatur Street and Maury Avenue.

Tricycle Garden, Manchester

Retrofit vacant parking lots and parcels to incorporate green infrastructure and sustainable stormwater management strategies such as infiltration swales, meadows, rain gardens, pocket parks, and community gardens.

Scuffletown Park, Richmond

Bellemeade Creek Concept Plan

The Bellemeade Creek Corridor Concept Plan outlines a green infrastructure strategy for a more informal neighborhood located in an urban watershed. The Bellemeade corridor is strategically located to complete the green infrastructure link between the James River Branch Trail and the James River at Ancarrow's Landing. The Bellemeade Concept Plan identifies both on-street and creek-side links to complete this larger green infrastructure loop, as well as support local stewardship and recreational access to the Bellemeade creek corridor. This concept plan includes recommendations to integrate watershed education with the Bellemeade Elementary School and Community Center, convert informal streets to green streets, connect the James River Branch Trail to the James River, and leverage public and private investment to improve water quality and enhance the riparian corridor. Case studies and green infrastructure strategies for implementation are further detailed in the Tools section of this report.

Methodology

The methodology for the Bellemeade Creek Corridor Concept Plan includes:

- Identify cultural assets and neighborhood amenities,
- Identify publicly-owned vacant parcels with green asset value,
- Identify vacant parcels with potential to connect cultural resources or natural assets,
- Identify right-of-ways that could establish green links,
- Identify potential network connectors to increase neighborhood access,
- Prioritize a set of strategies for implementation.

Figure 23. Vacant Parcels with Ecological Value.

Figure 24. Vacant Parcels with Urban Tree Canopy.

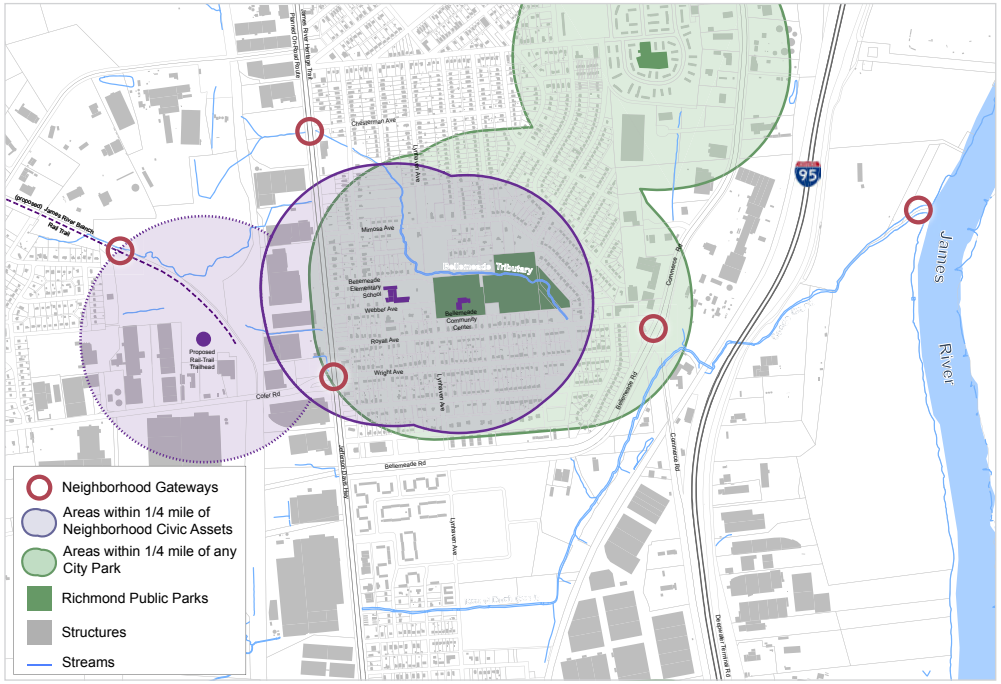


Figure 25. Cultural Assets.

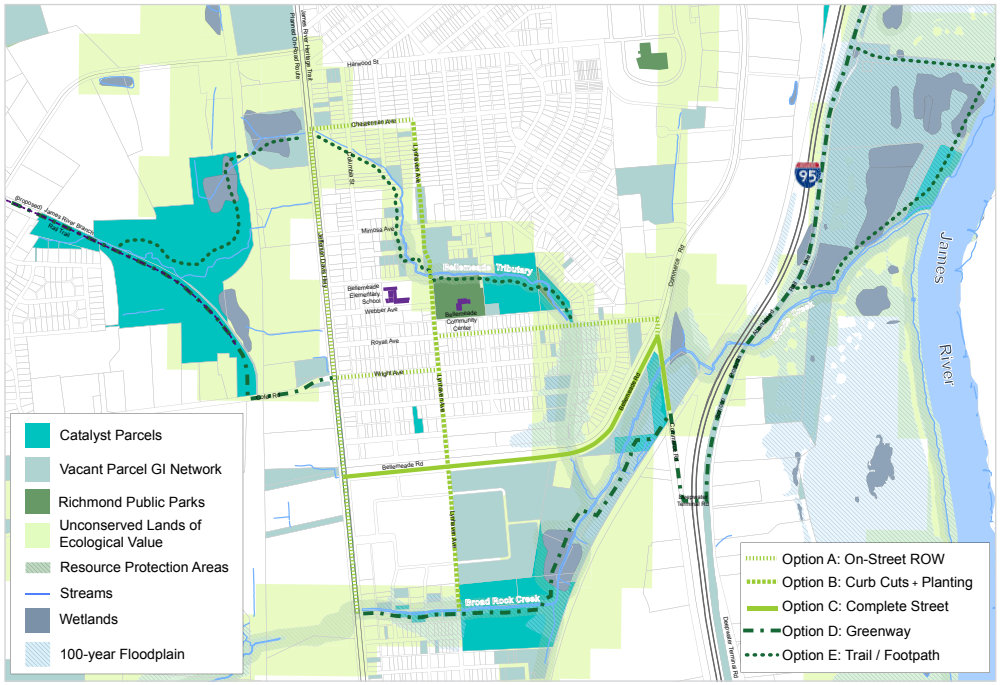


Figure 26. Street and Trail Treatment Prototypes.

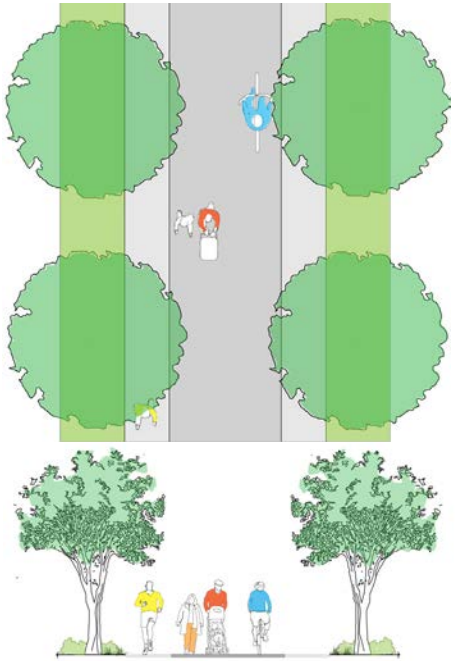
Bellemeade Creek Concept Plan

Proposed "Corridor" Connections

The Bellemeade Creek Corridor Concept Plan proposes a range of corridor connections, including on-street and creek-side trails, which can:

- Enhance pedestrian and bicycle connections,
- Improve storm flow and water quality,
- Increase tree canopy,
- Beautify the neighborhood,
- Connect the neighborhood to the citywide green infrastructure network.

An example trail prototype is shown below and the full connections menu is presented on page 28.



Option D: Greenway

Bellemeade Creek Concept Plan

Opportunity Sites

During the project partner working session held in October 2010, the Bellemeade workgroup identified the following potential opportunities that correspond to Figure 27:

1. Enhance the riparian corridor, strategic access and stewardship of the Bellemeade tributary through environmental education offered by the Bellemeade Elementary School and Community Center.

School parking lot retrofitted as rain garden (example).

Neighborhood riparian planting project (example).

2. Convert select streets with drainage ditches to green streets with swales and enhanced pedestrian access.

Green street examples. Green streets can accommodate alternative transportation, increase aesthetic value and improve water quality.

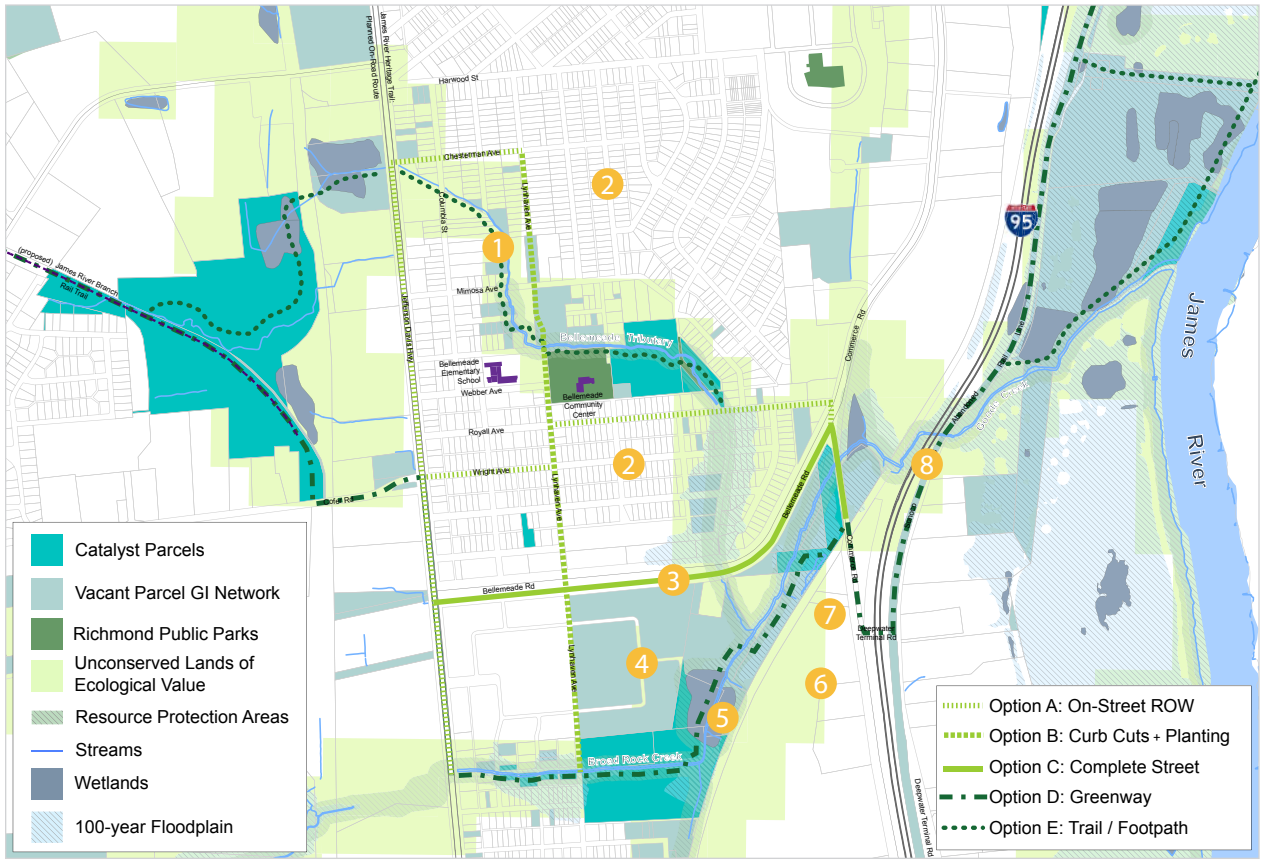


Figure 27. Opportunity Sites.

3. Evaluate a concept plan for converting Bellemeade Road to a green street to extend the proposed James River Branch Rail Trail.

Example of planted boulevard with pedestrian/bicycle path.

4. Coordinate the mixed-use development plan in the Windsor neighborhood with future use for adjacent city parcels to enhance Broad Rock Creek.

High Point development's natural drainage network improves water quality and provides recreational amenities.

5 Leverage city-owned land along Broad Rock Creek with interested private landowners to enhance Broad Rock Creek and provide alternative access to Bellemeade Road.


Property along Broad Rock Creek might be transitioned to a wetland mitigation program that includes stormwater wetlands (example, left) and protected riparian buffers (example, right).

6 Evaluate the feasibility of potential connections from Bellemeade under I-95 to the James River Trail to complete a greenway loop south of the James River.

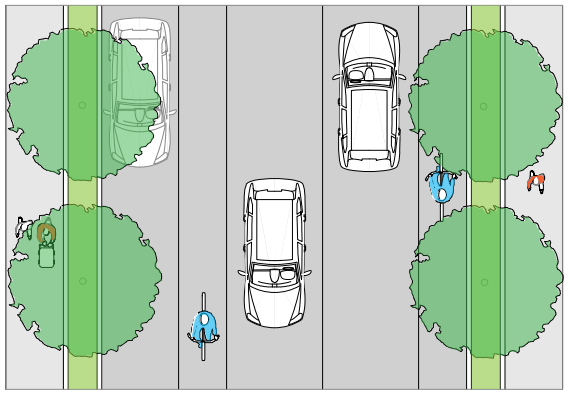

A pedestrian- and bicycle-friendly underpass would provide safe access from the neighborhood to the James River Trail system (example on left, Chicago; right, Washington D.C.).

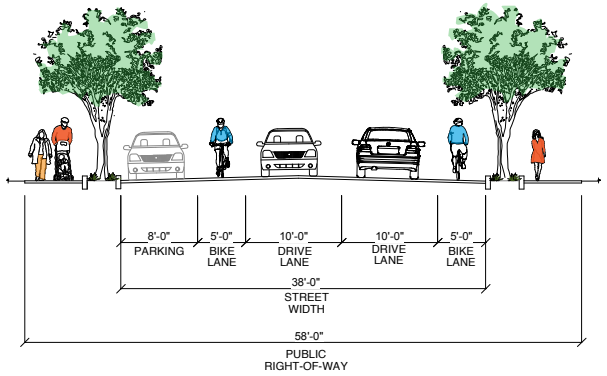
7 Evaluate the feasibility of open space and water quality improvements on the city-owned parcel located at the confluence of Goode Creek and the James River as an anchor for open space and park expansion in Old South and Broad Rock Planning Districts.

Example of neighborhood greenway.

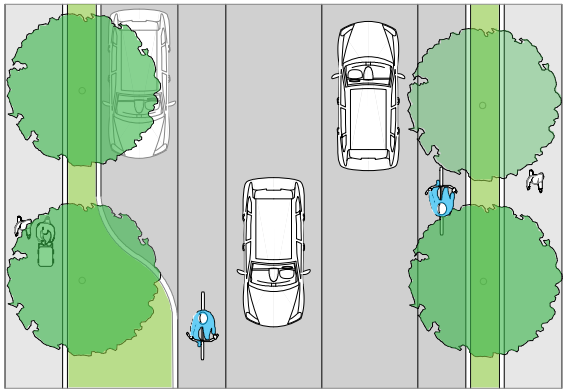
Green Links Treatment Options

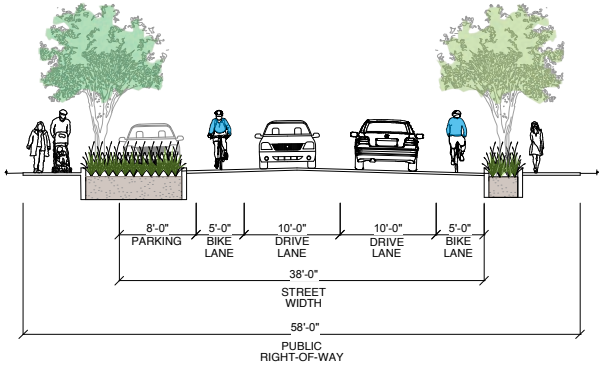
Option A: On-Street ROW



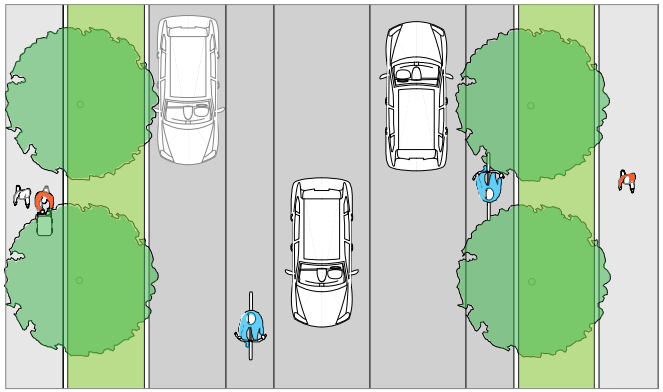


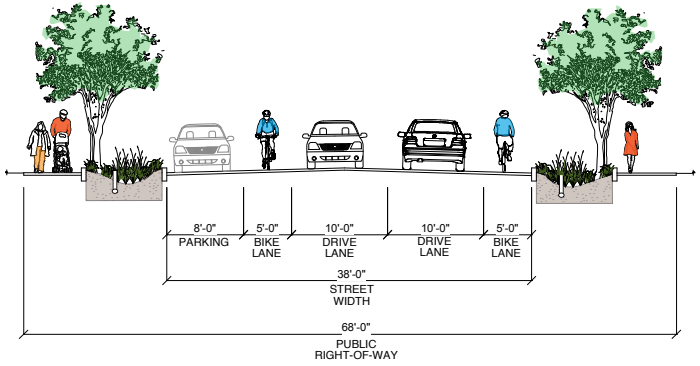
Option B: Curb Cuts and Planting



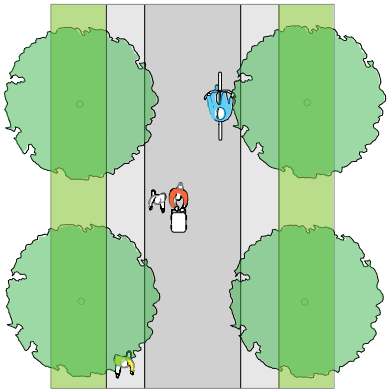


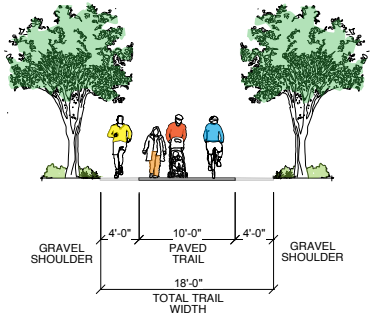
Option C: Complete Street



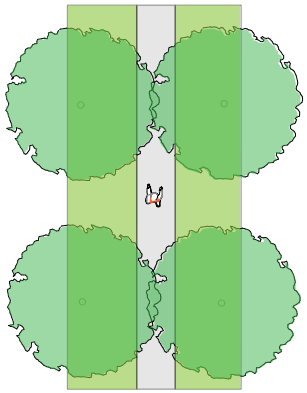


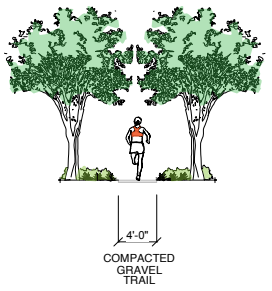
Option D: Greenway





Option E: Trail / Footpath





V. Summary

Summary and Recommendations

(Above): The James River Trail provides access between downtown Richmond and Belle Isle.

V. Summary

Summary and Recommendations

Richmond's exploration of a potential citywide green infrastructure network places it in the vanguard of communities nationwide seeking innovative opportunities to strengthen local economies, enhance quality of life, and protect natural resources.

Past project efforts have identified the region's significant green infrastructure assets as well as the impacts of sprawling development patterns on these assets over time. The Richmond Green Infrastructure Assessment Project has explored how vacant parcels could contribute to a citywide green infrastructure network. The opportunities are promising. At the citywide scale, vacant parcels across Richmond could enhance the city's green infrastructure network. Analysis of the Broad Rock and Old South Planning Districts indicates that a phased approach could address areas offering the most potential for expanding the green infrastructure network. Finally, the Blackwell Green Links and Bellemeade Creek Corridor concept plans illustrate how green infrastructure strategies can be tailored to different settings, using vacant lands as catalyst sites to link neighborhoods with the city's green infrastructure network.

Looking forward, project partners identified the following applications for the Green Infrastructure Assessment to help the city fulfill and advance its priorities and initiatives:

- Inform the city's future decision-making and enable the city to be more proactive in planning.
- Identify opportunities to improve the city's urban forest canopy and its stormwater management capacity and function.
- Expand and connect the city's recreational areas.
- Establish alternative transportation connections throughout the city.
- Help create strategies to enhance the economic well-being of the city's neighborhoods.
- Help to strategically target lands for restoration and redevelopment funding.
- Serve as a tool and foundation for future fundraising efforts.
- Promote Richmond as a green infrastructure planning model for other municipalities.

The project team also identified the following actions which could build on the analysis and concepts provided in this report:

- Evaluate the feasibility of adopting a proposed citywide green infrastructure network based on the green print identified in the potential Green Infrastructure Network map.
- Continue cross-department coordination to revisit how the vacant parcel inventory database can support and inform the city's goals and initiatives.
- Further evaluate the feasibility of acquiring green infrastructure catalyst sites within the Blackwell and Bellemeade neighborhoods.
- Identify a set of pilot projects, such as green streets or trailhead connectors, to propose for grant funding and early actions in the two neighborhoods.

Tools

Green Infrastructure Toolkit
Urban Water and Site Planning

Low impact development (LID) features that help manage stormwater can be incorporated into almost every section of urban environments including open space, rooftops, streetscapes, parking lots, sidewalks, and medians. This versatile approach can be applied to new development, urban retrofits, and redevelopment / revitalization projects. These features are more environmentally and economically sustainable ways to address the adverse impacts of urbanization. By managing runoff close to its source through intelligent site design, these green infrastructure tools can enhance the local environment, protect public health, and improve community livability.

Urban water

Vegetated swales/bioswales
Rain gardens/bioretention areas
Vegetated filter strips
Stormwater wetland

Site planning

Street design
Reducing impervious surfaces
Vegetated landscaping
Urban forestry
Urban stream restoration
Riparian buffers

Source for LID practices: Low Impact Development Center, Inc.

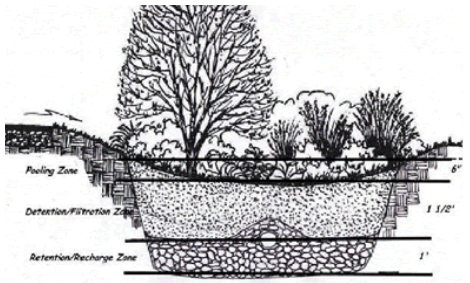
Vegetated swales/bioswales

Vegetated swales, sometimes referred to as bioswales, are broad, shallow channels designed to convey and infiltrate stormwater runoff. Swales reduce stormwater volume and improve water quality through infiltration and vegetative filtering. They also reduce runoff velocity by increasing flow path lengths and channel roughness.

Swales can be planted with grasses, perennials, shrubs and trees to provide a neighborhood amenity with aesthetic and habitat value.

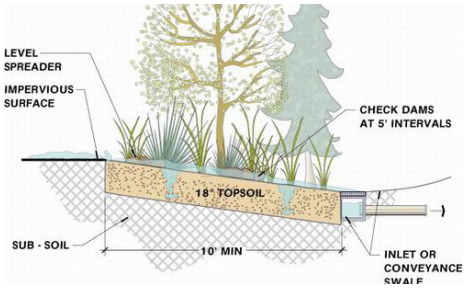
Rain gardens/bioretention areas

Rain gardens, also known as bioretention cells, are vegetated depressions that store and infiltrate runoff. Rain gardens are designed to encourage vegetative uptake of stormwater to reduce runoff volume and pollutant concentrations. A well designed rain garden has engineered soil which maximizes infiltration and pollutant removal, while avoiding stormwater ponding for longer than 24 hours.



Vegetated filter strips

Filter strips are linear vegetated areas that treat sheet flow and increase water quality from adjacent impervious areas. Filter strips function by slowing runoff velocities and filtering out sediment and other pollutants, and providing some infiltration into underlying soils. Filter strips were originally used as an agricultural treatment practice, and have more recently evolved into an urban practice. With proper design and maintenance, filter strips can provide relatively high pollutant removal.

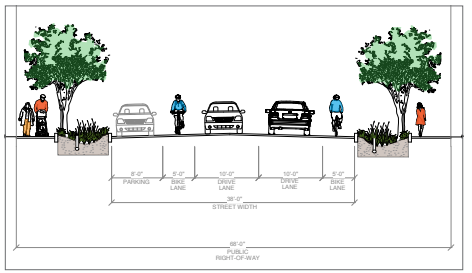


Stormwater wetland

Stormwater wetlands are constructed wetland systems designed to control stormwater volume and facilitate pollutant removal. These wetlands generally have less biodiversity than natural wetlands, but still provide habitat. They require a base flow through the wetland to support the aquatic vegetation present. Pollutant removal in these systems occurs through the settling of larger solids and coarse organic material and also by uptake in the aquatic vegetation.

Street design

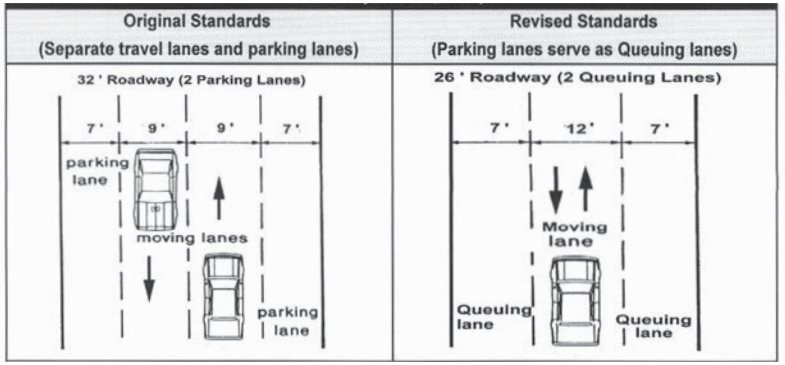
"Complete" streets are streets designed to safely accommodate all users - pedestrians, bicyclists, motorists, transit riders and drivers of motor vechicles, and people of all ages and abilities, including children, older adults, and people with disabilities. In addition to supporting neighborhood sustainability through alternative transportation, innovative street design can include design mechanisms, such as curb cuts, tree plantings and adjacent bioswales, to manage stormwater and improve the health of urban watersheds.



Reducing impervious surfaces

This best management practice reduces the amount of impervious cover by narrowing streets where possible to one lane for parking and selecting porous materials for places that have been traditionally paved. The recommended width of a narrow street is 24-26 feet.

Porous concreate and permeable asphalt have proven viable alternatives to reduce stormwater runoff volume, rate, and pollutants.



Vegetated landscaping

Natural and reintroduced vegetation provides stormwater management and pollutant removal. Vegetated areas intercept and infiltrate rainfall, decreasing stormwater volumes. Plants, trees, and other vegetation remove pollutants from infiltrated stormwater through root zone uptake. Incorporating vegetation into the landscape is a stormwater management technique that utilizes environmentally beneficial mechanisms that occur naturally in the environment.

Urban forestry

Trees reduce runoff volume through evapotranspiration (ET) and interception and improve the infiltration capacity of the soil, thereby reducing runoff potential. Afforestation involves planting trees in an area where they were absent for a significant period of time (e.g. a riparian buffer). Reforestation is the planting of trees in an area that was forested in the recent past (e.g. an area that was cleared for residential development).

Many city tree planting programs have proven effective ways to increase the urban tree canopy and citizen involvement.

Green Infrastructure Toolkit: Site Planning

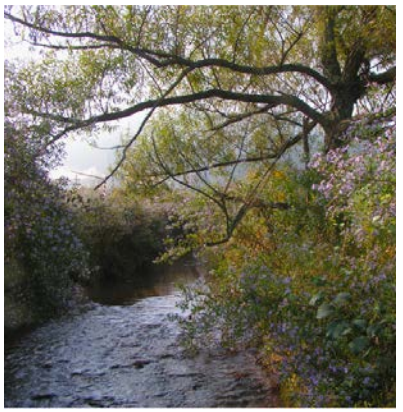
Urban stream restoration

Many urban streams and creeks have been neglected over the centuries, especially in older post-industrial cities. Development created heavy impacts on streams: many have been buried in underground pipes, and urban land uses have damaged the stream system through erosion and channelization.

Urban stream restoration projects transform these damaged and neglected places into healthy, resilient, and functional natural systems. These restoration projects also create a community asset, as they often occur as a part of a larger parks and open space plan or community development initiative. Restored urban streams provide a valuable asset to surrounding neighborhoods, increase property values, and can stimulate economic development and redevelopment.

Riparian buffers

Riparian buffers are vegetated areas on either side of a river, stream, or creek. These corridors of plants enhance watershed health by moderating water quantities and improving water quality.



Riparian buffers intercept, absorb, and infiltrate surface runoff. This replenishes the groundwater table, which ensures a more constant flow of water in the adjacent stream channel. This also moderates the peak runoff rates during rain events, which reduces erosion and sedimentation of the stream channel.

Riparian buffer plantings remove pollutants, contaminants, and sediments before surface water enters the stream. They also also mitigate the unnaturally high water temperatures that are common in urbanized areas.

Green Infrastructure Toolkit
Community Spaces

Cities, organizations, neighborhoods and community volunteers can transform vacant urban parcels into green spaces that increase the aesthetic, community and ecological values of the landscape. Cleveland's *Reimagining Cleveland Pattern Book** demonstrates several low cost ways to create neighborhood assets from vacant and underutilized properties.

Examples of community spaces include:

- Pocket park
- Informal recreation
- Meadow/native habitat
- Outdoor classroom
- Community garden

Design concepts for vacant land in *Reimagining Cleveland.*

* *Reimagining Cleveland Pattern Book* is accessible here: http://www.neighborhoodprogress.org/uploaded_pics/patternbookFINAL_lo-res_file_1241529170.pdf

Pocket park

Scuffletown Park, Richmond, VA

Overview

Pocket parks are small green spaces in neighborhoods that provide a safe area for residents to gather for play, quiet outdoor space or social interaction. Often too small for physical activities, pocket parks provide greenery, a place to sit outdoors, and sometimes a children's playground. They may be created around a monument, historic marker or art project.

How to

- A municipality may identify land to develop and maintain as a pocket park.
- A neighborhood group may initiate the formation of a pocket park as a citizens' project, often soliciting sponsorship from the city or other associations and volunteers for development and maintenance.
- Grants are often available to support these projects.

Benefits

- Improved aesthetic and ecological value of land
- Can stimulate social interaction and community building

Resources

- Enrichmond: http://www.enrichmond.org
- How-to-guide: http://www.kibi.org/pp_how-to

Informal recreation

Pickup soccer game, Maine

Overview

Vacant lots can be planted with low maintenance turf grass to provide space for informal recreation such as soccer, frisbee or neighborhood gatherings. Limited maintenance (mowing) could be provided by the city or neighborhood volunteers.

How to

- Community members work with landowner(s) to arrange interim use.
- Community members seek support from neighborhood, city, or grant programs for initial planting resources and ongoing maintenance.

Benefits

Creates opportunity for outdoor recreation and community interaction
Encourages exercise and fitness activities

Meadow/native habitat

Urban Meadow, Brooklyn, NY

Overview

Vacant parcels can be planted as meadows: low-maintenance plantings that bring verdant change and seasonal blooms during the spring, summer and fall.

How to

- Community members work with landowner(s) to arrange interim use.
- Community members seek support from neighborhood, city, or grant programs for initial planting resources and ongoing maintenance.

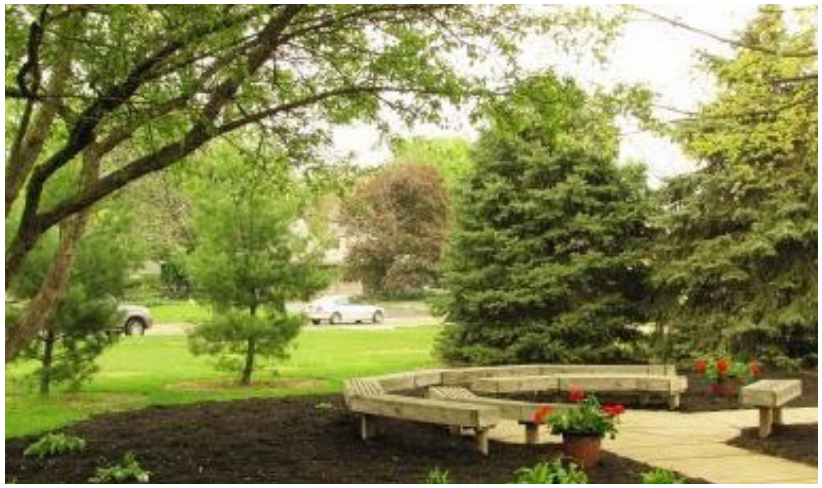
Benefits

- Neighbrohood beautification
- Stormwater infiltration
- Native habitat for plant and animal species
- Educational and social opportunities for the community

Resources

- Brooklyn Urban Meadow: http://urbanmeadowbrooklyn.blogspot.com/
- Virginia Department of Natural Resources: http://www.dcr.virginia.gov/natural_heritage/index.shtml

Outdoor classroom



Tremont School, OH

Overview

Outdoor classrooms can be created on vacant parcels close to schools to provide an extension of the classroom outdoors for a variety of environmental learning opportunities. Some outdoor classrooms may just consist of gardens, while others may include structures such as benches and pavilions.

How to

- Schools and landowners can work together to coordinate use of the vacant parcel.
- A school or parents organization may solicit volunteers, resources and sponsorships from local building supply and service businesses.

Benefits

- Hands-on education opportunities
- Increasing familiarity with native species of plants and flowers
- Alternative learning environment

Community garden

Tricycle Gardens, Bainbridge and 9th Street, Richmond, VA

Overview

Community gardens are plots of land cared for and cultivated by members of the community. The land, often owned in trust by local government or non-profit organizations, is typically open for the public involvement. Community gardens often provide fresh produce and plants as well as satisfying labor, neighborhood improvement, sense of community and connection to the environment.

How to

- Community members can work with landowners to plan a garden.
- Non-profit organizations, such as Tricycle Gardens in Richmond, often work with communities to form groups and develop resources to start and maintain community gardens.

Benefits

- Provide a catalyst for neighborhood and community development
- Stimulate social interaction, encourage self-reliance, beautify neighborhoods
- Produce nutritious food, reduce family food budgets, conserve resources
- Create opportunities for recreation, exercise, therapy and education

Resources

- Tricycle Gardens: http://tricyclegardens.org/gardens/community-gardens/
- American Community Gardening Association: http://www.communitygarden.org/

Green Infrastructure Toolkit
Community Stewardship

Changing industry and settlement patterns have led to an increase in vacant and underutilized properties in urban areas across the U.S. To confront the challenges to quality of life, property value and safety created by growing vacancies, many cities have developed neighborhood stabilization strategies directed at making vacant properties productive and safe assets for communities. Innovative policies and programs provide support, resources and/or guidance for organizations and community members to become stewards of vacant properties.

Examples of some of those policies and programs include:

- Green space grant programs
- Land banking
- Mow-to-own
- Adopt-a-block

Green space grant programs

Many cities have partnered with local corporations and organizations to sponsor grants and support programs for neighborhood volunteers. Indianapolis' *Keep Indianapolis Beautiful* program offers Greenspace grants to neighborhoods willing to transform blighted areas into community assets, from pocket parks to community gardens.

Resources

- Keep Indianapolis Beautiful: http://www.kibi.org/greenspace

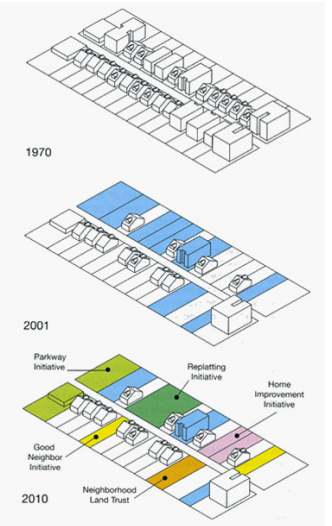
Land banking

A growing number of communities have created a dedicated public authority, known as a land bank, to streamline property reuse activities, assemble developable parcels, and manage the redevelopment process to serve the community's goals.

A land bank generally involves public acquisition of abandoned property; the land is then transferred to a nonprofit third party for redevelopment. Land banks attempt to unlock the potential value of properties and sites, with the goal of returning them to productive use.

Resources

- Housing Policy.org: http://www.housingpolicy.org/toolbox/strategy/policies/abandoned_properties.html?tierid=155#lb
- Detroit: http://kirwaninstitute.org/research/projects/vacpropreform/index.php



Detroit land banking diagram. Source, *Shrinking Cities*.

Mow-to-own

Vacant lots can be absorbed into residential neighborhoods by encouraging adjacent property owners to acquire and maintain these sites as an expansion of their own properties.

Cleveland's proposed Mow-to-Own program enables residents to earn the ownership of a neighboring or nearby property (from a landbank) in exchange for providing good maintenance of these properties according to city-established standards.

http://www.cudc.kent.edu/shrink/Images/reimagining_final_screen-res.pdf

Adopt-a-block

The Adopt-a-Block program created in Indianapolis provides a support structure, resources, and tools for neighbors who work together to keep a block clean and maintained in the city. A block leader coordinates the volunteer effort, and the city provides training, tools, trees and other plants to support the neighborhood's efforts.

http://www.kibi.org/adopt-a-block

Additional resources and references:

http://www.epa.gov/owow/NPS/lid/ - U.S. EPA website for Low Impact Development and Green Infrastructure. Numerous resources, references, and information are compiled at this extensive website.

"Catching the Rain: A Great Lakes Guide to Natural Stormwater Management." American Rivers 2004.

http://baltimorecity.gov/Government/AgenciesDepartments/RecreationandParks/TreeBaltimore.aspx

Davis, Lynn. "Urban forestry: Engineering cities into natural systems," Research Magazine, (Winter 2004). http://www.research.vt.edu/resmag/2004resmag/forestry.html.

Georgia Forestry Commission. "Tree Benefits: Environmental benefits of trees." http://www.gfc.state.ga.us/CommunityForests/TreeBenefits.cfm.

"Why Shade Streets? The Unexpected Benefits." Center for Urban Forest Research, (2006). http://www.fs.fed.us/psw/programs/cufr/products/cufr_673_WhyShadeStreets_10-06.pdf.

Akbari, H., M. Pomerantz, H. Taha. Cool surfaces and shade trees to reduce energy use and improve air quality in urban areas. 2001. Solar Energy, Vol. 70, No. 3.

Georgia Forestry Commission. "Tree Benefits: Environmental benefits of trees." http://www.gfc.state.ga.us/CommunityForests/TreeBenefits.cfm.

Georgia Forestry Commission. "Tree Benefits: Environmental benefits of trees." http://www.gfc.state.ga.us/CommunityForests/TreeBenefits.cfm.

"A Citizen's Streambank Restoration Handbook." Firehock, Karen and Doherty, Jacqueline. A publication of the Save Our Streams Program: Izaak Walton League of America, Inc. 1995.

"A Stream Corridor Protection Strategy for Local Governments." Institute for Environmental Negotiation, Department of Urban and Environmental Planning of the School of Architecture at the University of Virginia, 2002.

Green Infrastructure Case Studies

The following case studies demonstrate how the tools identified in the Green Infrastructure Toolkit have been implemented to revitalize and restore other communities.

Housing

High Point Development, Seattle, WA

Sustainable Stormwater Management

The Dell, Charlottesville, VA

Tree Planting Program

Tree Baltimore, Baltimore, MD

Green Streets Program

Portland, OR

Neighborhood Stream Restoration

Nine Mile Run, Pittsburgh, PA

Stormwater Infrastructure Retrofit

Fairfax County, VA

Land Bridge Projects

Vancouver, WA | Trenton, NJ | Duluth, MN

High Point Housing Development

Seattle, Washington

Seattle Housing Authority (SHA) planned a 1,600-unit subsidized/mixed income housing development along Longfellow Creek. In partnership with Seattle Public Utilities, SHA replaced tradiitonal drainage infrastructure with a large-scale natural drainage system, reducing stormater flow into the creek, increasing infiltration and bioremediation of polluntants, and providing a valuable landscape amenity for the neighborhood.

Overview

- 1,600 units includes subsidized and mixed income housing on 129 acres
- Implemented Natural Drainage System to reduce flow and improve water quality into adjacent creek
- Preserved 100+ trees; planted 3,000 new trees

Partnerships + Funding

- Local housing authority and public utiities worked together to develop goals and design the system to meet safety standards
- Seattle Public Utilities invested $2.7 million above traditional drainage infrastructure to pilot NDS

Results

Quality of life benefits

- Functional, aesthetic landscape network of trees, planted swales and grassy lawns
- Neighborhood education

Environmental benefits

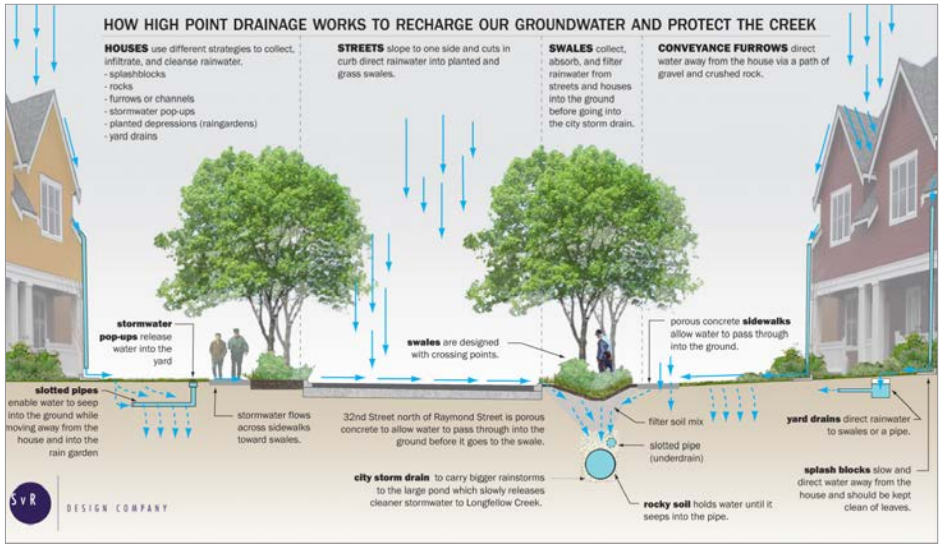
- Signficant water flow attenuation and bioremediation
- Pre-development runoff levels
- Reduced detention pond volume: just 20% of the volume required by traditional drainage projects

Economic benefits

- The SPU-funded natural drainage systems cost just 25% of the cost of a conventional drainage project
- Potential homebuyers indicated a willingness to pay 5% more to live in a sustainable neighborhood

Best Management Practices

- **Bioretention swales** with overflow drains along street provide filtration and bioremediation of pollutants
- **Rain gardens** and compost amended lawns capture stormwater on housing properties
- **Pervious materials** such as pervious pavement and crushed stone were used for some sidewalks and most off-street parking areas
- **Street width reduction** reduces impervious surface and calms traffic
- Street curb cuts allow water from streets to enter bioswales
- Piped conveyance for 25-year and larger storms ensures safety in storm events



Sustainable Stormwater Management Project

The Dell
University of Virginia

The Dell is an "artful stormwater management" solution, providing two types of benefits. It was designed as a functional system that reduces urban flooding and treats stormwater runoff; and it also serves as a place of natural beauty, wildlife habitat, and active and passive recreation for the community.

Image: Landscape Architecture Magazine

Overview

- Constructed to mitigate stormwater runoff impacts created by a major development project on University Grounds. This artful approach helped the University achieve regulatory compliance at a lower cost than if all stormwater had been managed through conventional systems.
- Stormwater functions of restored stream and retention pond have to be supported by conventional stormwater technologies. While the Dell effectively retains, infiltrates, and treats surface runoff through the tiered stormwater pond design, it does require large rain events to be partially conveyed through an underground pipe system connected to the pond.
- Site design includes a terraced stormwater pond that uses natural aeration to improve water quality and reduce sediment load; a restored stream and bioswale further contribute to the stormwater management.

Results

Quality of Life and Social Benefits

- Meadow Creek is a functional and beautiful community asset once again
- Usable open space increased due to the stormwater management success

Environmental Benefits

- The previously-piped Meadow Creek has been "daylighted" and restored with natural meanders and native plants - efforts that improve water quality and reduce urban flooding
- Wildlife habitat provides the entire community with opportunities to view wildlife in an urban context

Economic Benefits

- Downstream flooding, which had once been frequent, has been virtually eliminated from a major intersection
- Reduced infrastructure cost for the associated development project

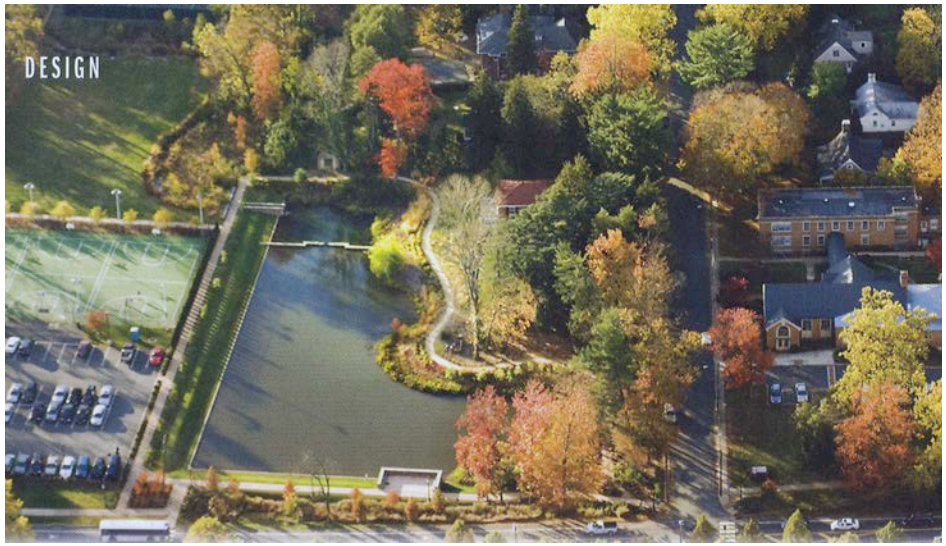
Partnerships, Community Involvement, and Funding

- **Proactive planning** allowed the University community to incorporate this sustainable stormwater management project into a large new University development project
- **Technical assistance** from a group of landscape architects, engineers, and environmental consultants guided the pursuit of multiple environmental, social, and economic benefits through one infrastructure project

Best Management Practices

- **Stream daylighting** and **riparian restoration** improve stormwater management and reduce the burden on gray infrastructure system
- **Multi-purpose stormwater pond** mitigates land development impacts while providing amenities
- **Bioswales** and **native plants** provide enhanced function and beauty

Images: Landscape Architecture Magazine



Urban Forestry Program

"Tree Baltimore"
Baltimore, Maryland

Tree Baltimore is a mayoral program that establishes a target for citywide urban tree canopy goals, as well as a strategy and programs to achieve that target. Guided by the City's Urban Forest Management Plan, Tree Baltimore intends to increase the urban tree canopy from 20% to 40% in the next 30 years.

Image: www.urbanitebaltimore.com

Overview

- Public-private partnership initiated by Mayor of Baltimore and spearheaded by the Baltimore City Department of Recreation and Parks
- A "call to action" program for widespread public participation in the establishment, management, and preservation of trees
- Goal of doubling the City tree canopy in 30 years would require 750,000 additional trees; approximately 2,600 trees have been planted during the first year of campaign

Partnerships + Funding

- Partnership of government agencies (Baltimore City Dept. of Recreation and Parks, Baltimore County, Baltimore Metro Council); Maryland Nursery and Landscape Association; the Chesapeake Bay Program; Baltimore Gas & Electric Company; and others

Results

Quality of Life and Social Benefits

- Increased pedestrian activity and increased public social interaction
- Program distributes free native trees at farmer's market during spring and fall

Environmental Benefits

- Increase in tree canopy creates improved stormwater management conditions: increased infiltration and localized retention
- Reduced urban heat island effect
- Enhanced habitat for beneficial wildlife

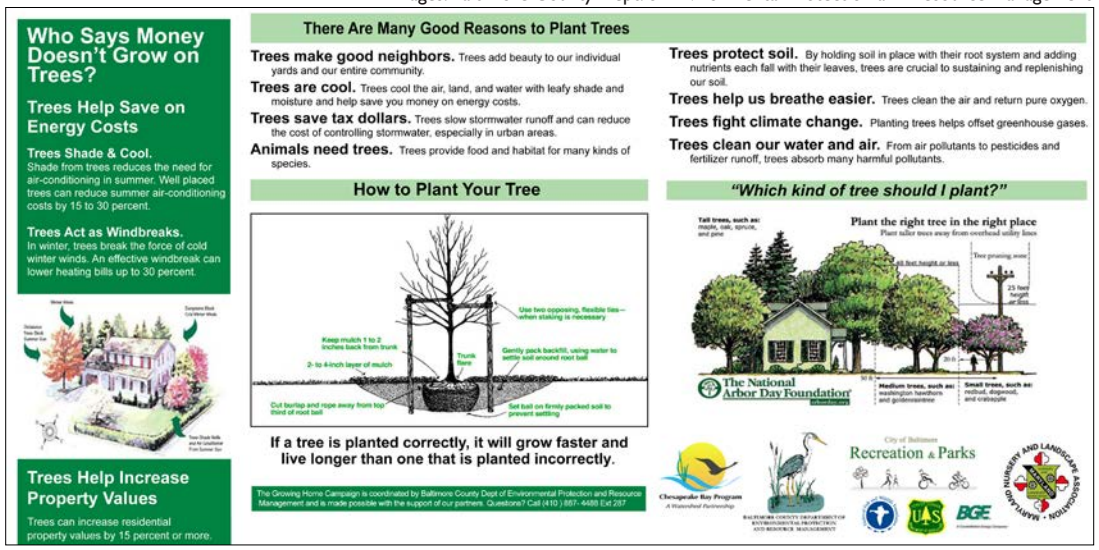
Economic Benefits

- Reduced heating and cooling costs for homes and businesses
- Increased private property values and increased tax revenue
- Reduced burden on aging stormwater infrastructure and reduced municipal cost for maintenance and replacement

Project Components

- **Public-private partnership** model successfully coordinates government initiative, public participation, and private enterprise
- **Native trees** are encouraged for lower maintenance and resiliency
- **Tree voucher program** provides property owners with an incentive: $10 coupons are redeemable at participating area nurseries for the purchase of approved trees or shrubs
- **Community education and outreach** occurs through the user-friendly Tree Baltimore website; through informational materials that describe how to properly plant and maintain trees; and through the Tree Baltimore marketing campaign, which is focused on facilitating personal involvement (*"One tree can make a difference: where will you plant yours?"*)

Images: Baltimore County Dept. of Environmental Protection and Resource Management



Green Streets Program

Portland, Oregon

Portland's green streets program focuses on retrofitting existing streetscapes and associated spaces (such as parking lots) to create functional spaces that manage stormwater runoff on-site. This localized approach allows nature to do its job: cleaning and absorbing stormwater where it falls. This in turn improves watershed health; and it ultimately reduces the impact that urbanized areas contribute to the municipal gray infrastructure system.

Overview

- In the 1990s, Portland increasingly focused on water quality issues with the Willamette River. The City placed a priority on reducing the frequency of combined sewer overflows - events where sewage-laced stormwater is released into the river after rainwater overwhelms the storm system
- To reduce combined sewer overflows, the city determined that replacing impervious surfaces in the urban landscape with carefully designed natural areas was a viable strategy

Partnerships, Community Involvement, and Funding

- The City of Portland Sustainable Stormwater Management Group and Bureau of Environmental Services have initially led the program
- Partners include the City of Portland Department of Transportation and the U.S. Environmental Protection Agency

Results

Quality of Life and Social Benefits

- Beautification of everyday spaces - lush native plantings were incorporated into sidewalks, parking lots, and streets
- Secondary amenities include traffic calming, improved street crossing, and community education and awareness

Environmental Benefits

- Stormwater runoff is cooled, cleaned, and infiltrated locally (or released more slowly into the storm system)
- Stormwater runoff is bring infiltrated between 2 and 5 inches per hour
- The stormwater runoff flow volume is reduced between 60 and 94 percent

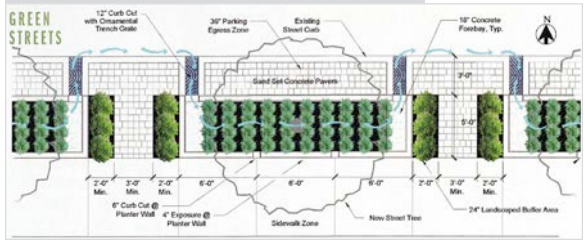
Economic Benefits

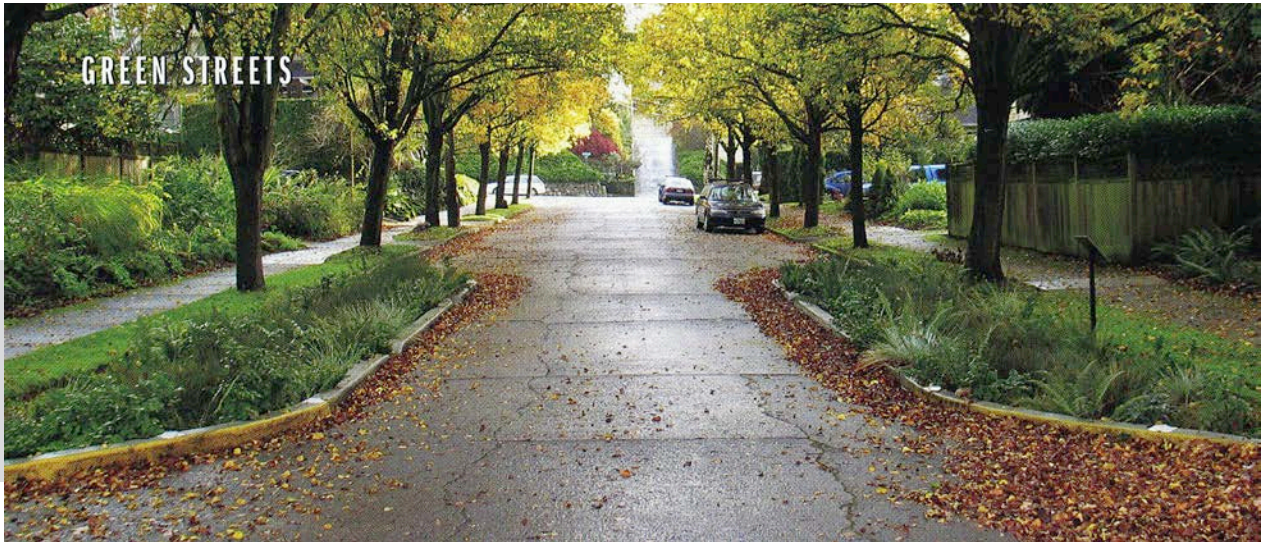
- Enhanced perception of the quality and market value of adjacent properties
- Reduced burden on aging stormwater infrastructure

Best Management Practices

- Three pilot projects were initially implemented; **project monitoring** quantified the effectiveness and value of the green streets program
- **Infiltration basins** have been designed to fit the form and scale of urban streetscapes
- **Curb cuts** and **bioswales** are used to capture, infiltrate, and treat runoff along streets; excess runoff passes through towards existing storm inlets
- **Rain gardens** have been implemented to mitigate stormwater runoff impacts from larger areas, such as parking lots
- The use of **engineered soils** in all systems ensures proper infiltration
- A **downspout disconnection program** reduces the amount of stormwater runoff entering the storm system from residential areas
- **Design principles** were developed to guide the program's expansion

All Images: Landscape Architecture Magazine





Top and middle: Sidewalk infiltration basins on SW 12th Avenue.

Bottom and right: Curb cuts and bioswales on Northeast Siskiyou.

Neighborhood Stream Restoration Project

Nine Mile Run Watershed
Pittsburgh, Pennsylvania

For decades, Nine Mile Run was a prototypical urban stream suffering from generations of industrial impacts. It had been buried in culverts, channelized, sedimented, and polluted. Through efforts of a strategic partnership, the watershed has been restored - providing new public parkland, re-establishing resilient ecosystem services, and facilitating economic redevelopment.

Images: Landscape Architecture Magazine

Overview

- Former industrial waste site targeted for cleanup/restoration/redevelopment
- Watershed restoration project was initiated due to the potential for neighborhood redevelopment: residential development plans required mitigation and stream restoration
- The 115-acre restoration of the Nine Mile Run riparian corridor creates a recreational and ecological connection between the city's riverfronts, ridgetop communities, and Frick Park

Best Management Practices

- **Streambank restoration** and earthwork projects re-established the natural shape of the stream, reducing water flows during storm events
- **Native plant palette** used in riparian restoration
- **Brownfield redevelopment** goals focus on environment and economy

Results

Quality of Life and Social Benefits

- Recreational greenway built to connect the Pittsburgh waterfront to residential communities and Frick Park

Environmental Benefits

- Urban flash flooding has been greatly reduced after the restoration of the natural stormwater functions
- Restored floodplains and natural stream meanders improve stormwater infiltration and water quality
- Native habitat restoration for aquatic and terrestrial species

Economic Benefits

- Occurred in conjunction with a new 700-unit mixed-income residential development on urban brownfield site
- Ecological and recreational amenity creates increased property values
- Reduced burden on aging stormwater infrastructure

Partnerships, Community Involvement, and Funding

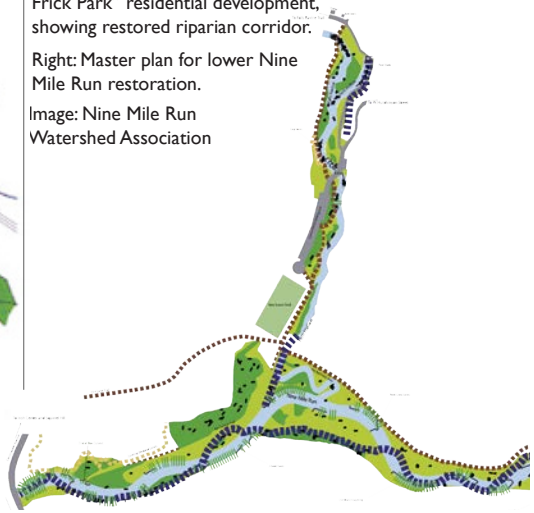
- Public-private partnership led by U.S. Army Corps of Engineers, the City of Pittsburgh, and Nine Mile Run Watershed Association
- **Public-private partnership** model successfully coordinated government entities at the federal and municipal levels with local non-profit leadership and assistance
- Extensive **public participation** re-directed the City's initial site plans, and guided the project according to residents' diverse values and objectives
- **Community education, outreach, and assistance** is maintained through a local non-profit group: the Nine Mile Run Watershed Association, whose scope includes involvement with residents and property owners in the watershed

Image: Summerset at Frick Park

Left: Master plan for "Summerset at Frick Park" residential development, showing restored riparian corridor.

Right: Master plan for lower Nine Mile Run restoration.

Image: Nine Mile Run Watershed Association



Stormwater Management Retrofit Projects

Fairfax County, Virginia

Fairfax County has been implementing various best management practice (BMP) retrofits to their existing infrastructure. The County is improving their stormwater management services by repairing, replacing, redesigning, and retrofitting various components of their infrastructure.

The retrofit projects detailed here include the Compton Heights regional stormwater pond and the Providence Fire Station 30 surface parking lot.

Overview

- Several retrofit projects have been implemented by the County with the goals of improving watershed health and complying with Chesapeake Bay regulations
- Projects detailed here include the parking lot retrofits implemented at Providence Fire Station 30, and the Compton Heights regional stormwater pond retrofit
- Retrofits are occurring in conjunction with the county's ongoing watershed planning efforts

Partnerships, Community Involvement, and Funding

- Fairfax County Maintenance and Stormwater Management Division have led the BMP retrofit projects

Results

Environmental Benefits

- Large formerly impervious surface area no longer contributes to stormwater runoff problems, and instead provides peak discharge rate control
- Water quality is enhanced as pollutants and sediments are filtered through soil and plant roots
- Increased infiltration of stormwater locally recharges groundwater table

Economic Benefits

- Improved services reduce the amount of resources being used / spent on low-performance or outdated systems
- Retrofitting existing infrastructure is more cost-efficient than implementing new infrastructure components
- Retrofits reuse existing infrastructure sites, allowing other real estate in the highly urbanized county be used for more profitable and productive uses

Best Management Practices: parking lot

- **Rain garden bioretention basin** detains and retains stormwater runoff
- The **porous pavement** area also contributes to increased infiltration
- **Native plants** - including trees, shrubs, and herbaceous plants - help with stormwater infiltration while providing nutrient uptake

Best Management Practices: regional stormwater pond

- **Wetland plantings** were established, including water-tolerant trees, shrubs, and herbaceous plants
- **Dredging** removed silt and increased storage capacity
- The regional pond was structurally retrofitted with **micro-pools** and a **gabion baffle**

Above: Before (top) and after (bottom) photos of Compton Heights regional stormwater pond retrofit project.

Right: Before and after photos of Providence Fire Station 30 parking lot retrofit project, including digital sketch of BMP components.

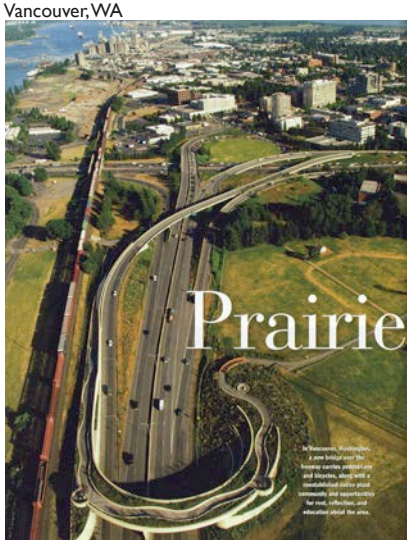
All Images: Fairfax County

Land Bridge Projects

Vancouver, Washington
Trenton, New Jersey
Duluth, Minnesota

These land bridge projects illustrate how communities can creatively enhance transportation, infrastructure, and capital improvement projects to efficiently achieve multiple goals. Specifically, land bridges create recreational and economic development benefits by re-connecting the urban fabric and community members to valuable environmental assets.

Vancouver, WA



Overview

- The average size of land bridges in the U.S.A. is approximately 9 acres, with an average linear coverage of 1,620'.
- Land bridges achieve much more than moving pedestrians and bicyclists across a linear barrier; they also can incorporate plants and green space, gathering places, and public art.
- Land bridges are legitimate economic development strategies; they stimulate market activity and create gateway sites for new or expanded commerce.

Project Components

- Land bridges are built using air rights, which are typically (1) created by the transportation agency before (2) being donated to the municipality
- This interagency coordination and support creates financial feasibility: the relatively high cost of construction is offset by the virtually non-existent price for the "land"

Results

Quality of Life and Social Benefits

- Reconnection of isolated communities with waterfronts or other amenities that were previously inaccessible

Environmental Benefits

- Improved stormwater management is possible by replacing impervious road surfaces with a land bridge that includes natural plantings
- The Vancouver land bridge includes 100+ native plant species arranged into grassland, prairie, and forest zones

Economic Benefits

- The Trenton land bridge project facilitated urban redevelopment, including significantly higher sale prices for adjacent properties and increased market activity for new development
- The Duluth project physically connects the downtown and the Lake Superior waterfront, linking cultural, commercial, and recreational destinations

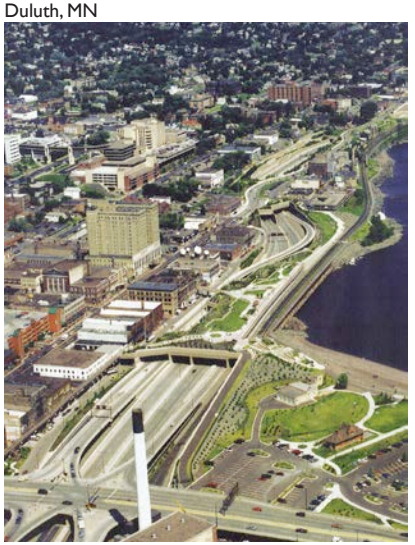
Partnerships, Community Involvement, and Funding

- The Vancouver Land Bridge project successfully utilized state and federal transportation funding, and was further supported by private donations
- Creative public involvement in Duluth led to an improved strategy and full funding for the I-35 federal transportation project: community members suggested the overall length of the highway be shortened, with those funds being re-allocated to the land bridge concept
- The Duluth project secured funding through a partnership of federal transportation officials and a supportive Congressman

Trenton, NJ

Van., WA

Duluth, MN



All Images: Landscape Architecture Magazine

Project Data Resources Overview

This section highlights new spatial information available for green infrastructure planning in the City of Richmond. This data can be used to support ongoing efforts to identify and protect environmental assets.

Citywide Vacant Parcel Database

- Comprehensive vacant parcel database includes vacancy type, land use and green infrastructure suitability for each vacant parcel

Green Print

- Composite base map of green assets

Urban Tree Canopy

- Updated citywide land cover and tree canopy data

Priority Conservation Areas

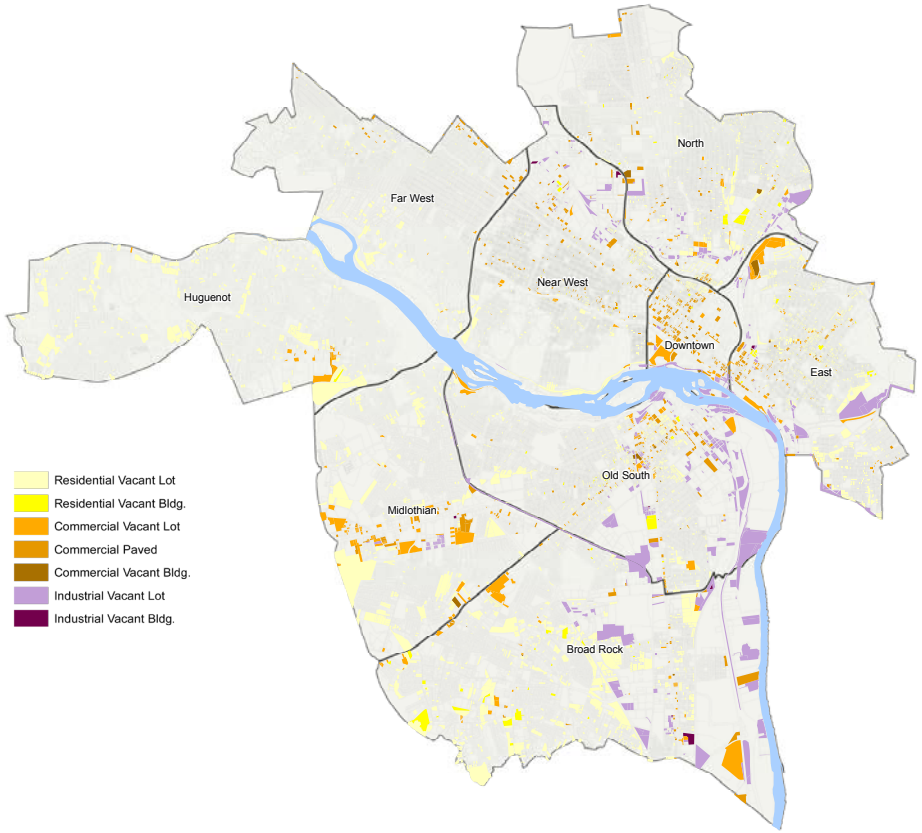
- Composite analysis to identify priority conservation areas within the coastal plain of Virginia.

Vacant Parcel Database

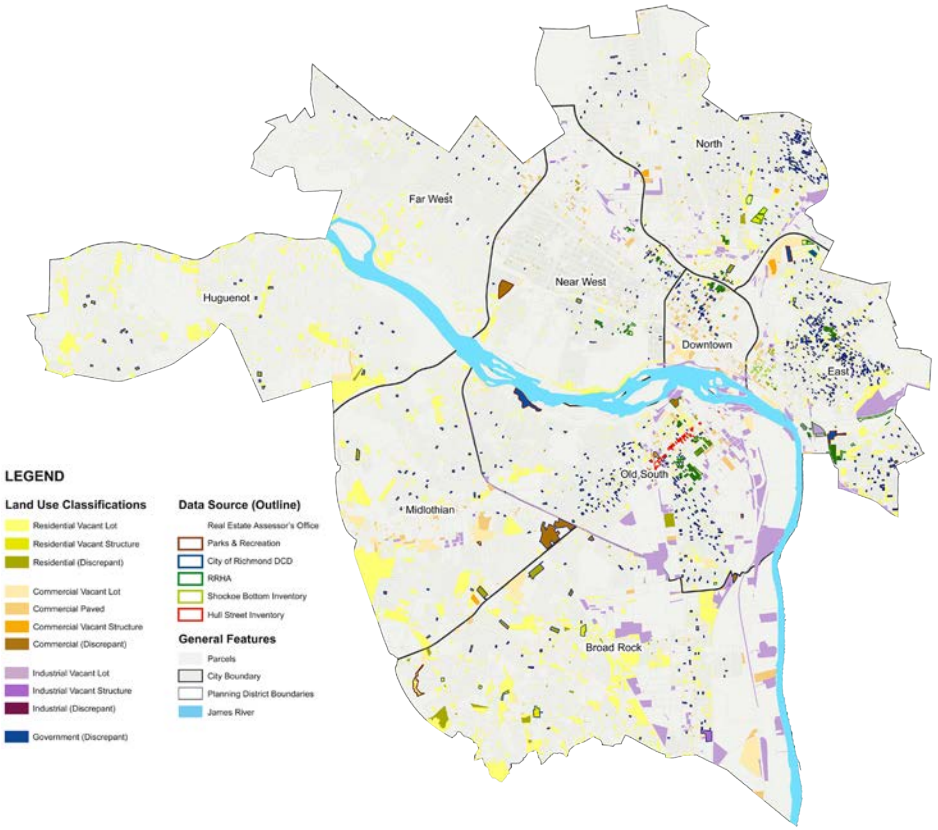
Abstract

The Richmond Vacant Parcel Database was created as part of Richmond's Green Infrastructure Assessment as a means of capturing all known vacant parcels into one comprehensive dataset. The database represents the set of City of Richmond parcels which are vacant or have a vacant structure on them. Parcels have been characterized by type of vacancy and by suitability for supporting various aspects of a green infrastructure network.

Combining and characterizing all tracked vacant parcels into one database provides the City of Richmond a new tool for evaluating parcels to support the city's green infrastructure network.



Vacant Parcels by Land Use from City Assessor's Office.



Vacant Parcels by Land Use from All Data Sources Combined.

Database Assembly

The vacant parcel inventory was created through integration of a number of datasets submitted by the following city departments and entities. For all datasets submitted, PIN numbers were used to select the appropriate parcels from the Richmond 2010 parcel shapefile. In instances where PIN numbers were not included with the data submitted, address matching was used to identify a PIN. In some cases, addresses were not available for the data submitted and these parcels were excluded from the final dataset.

The City Assessor's Office submitted 8,674 records which included vacant parcels, parcels with vacant structures and downtown parking lots with potential for redevelopment. These included properties identified by the following property class codes:

101 R Single Family Vacant (R1-R6)
109 R Single Family Shell
201 R Condo Vacant Land
209 R Condo Shell
301 R Multi-Family Vacant (R43/R48)
302 R Multi-Family Vacant (R53)
303 R Multi-Family Vacant (R73)
309 R Apartment Shell
401 B Commercial Vacant Land
406 B Paved Surface Parking
409 B Commercial Shell
501 B Industrial Vacant Land
509 B Industrial Shell

For more information, contact Parish Simmons, GIS Project Manager, City Assessor's Office.

The Parks and Recreation Department submitted 9 records which included Parks and Recreation properties that are vacant parcels without a planned future use. For more information, contact Larry Miller, Project Management Analyst, Richmond Department of Parks, Recreation and Community Facilities.

The Department of Planning & Development Review submitted 1,475 records which included parcels with vacant structures. For more information, contact Mark Bridgman, Property Maintenance Inspection Supervisor, Department of Planning & Development Review.

The Department of Economic & Community Development submitted two datasets based on recent windshield surveys of Hull Street and Shockhoe Bottom. The Hull Street Inventory, composed of 62 parcels, included vacant parcels and parcels with vacant structures. The Shockhoe Bottom Inventory, composed of 73 parcels, also included vacant parcels and parcels with vacant structures. For more information, contact Lisbeth Coker, Project Development Manager, Department of Economic & Community Development.

Finally, the Richmond Redevelopment & Housing Authority submitted 537 records from their Vacant Lots and Surplus Properties list which included vacant parcels. For more information, contact Garland Curtis, Director of Community and Real Estate Projects, Richmond Redevelopment & Housing Authority.

These six datasets were combined into one database and exported to create a shapefile of the vacant lands within the city. Spatial analyses in GIS were used to populate the attribute table with suitability criteria for supporting various aspects of a green infrastructure network. Parcels meeting a suitability criteria are indicated with a "1." These programmatic and green infrastructure suitability criteria are defined on the following page. Detailed metadata also accompanies the vacant parcel database shapefile submitted to the city as part of the Green Infrastructure Assessment project.

C. Project Data Resources

Vacant Parcel Database

Citywide Green Infrastructure Network Suitability Assessment

Vacant parcels that meet one or more of the following criteria were selected for the potential green infrastructure network:

1. Intersect the Priority Conservation Areas, as identified by VA DCR-NHP, VA DGIF, and VCU-CES. [Source: "pca.shp" from VA-DGIF]
2. Intersect stream [Source: "Streams.shp" from RRPDC]
3. Intersect the 100 year floodplain. [Source: "fema_FloodPlain100.shp" from City of Richmond website]
4. Intersect a wetland [Source: "Wetland.shp" from City of Richmond website]
5. Intersect a Natural Resource Heritage Area (protect endangered and protected species) [Source: "nhr_screen.shp" from RRPDC via VA DCR-HNP]

Citywide Green Infrastructure Network Programmatic Assessment

The vacant parcel database also includes an evaluation of vacant parcels for several types of green infrastructure programming. The methodology is described below.

Supporting Watershed Health

1. Vacant parcels which intersect a 100' buffer of the streams. [Source: "Streams.shp" from RRPDC]
2. Vacant parcels which intersect a designated Resource Protection Area (RPA). [Source: "ResourceProtection.shp" from City of Richmond website]

Expanding Conserved Lands Network

1. Vacant parcels which intersect a 100' buffer of Richmond's conserved lands, including public parks, state and federal conservation lands, privately conserved lands, PCAs, and RPAs. [Sources: "RichmondParks_March29_2010.shp" from RRPDC; "VAConservationLand_RichmondBuffert.shp" from RRPDC; "PrivateOwnedConservLand_VDCR3Q09.shp" from RRPDC; "pca.shp" from VA-DGIF; "ResourceProtection.shp" from City of Richmond website]

Increasing Public Park Access

1. Vacant parcels located outside of a .25 mile area of the public parks. A quarter mile represents a comfortable, five minute walking distance and is used as a proxy measure for expanding park access to Richmond residents with limited walkable access. [Source: "RichmondParks_March29_2010.shp" from RRPDC]

Supporting Outdoor Classrooms for Public Schools

1. Vacant parcels located inside of a .25 mile area of the public schools. A quarter mile, five minute walking distance is used as a proxy measure for identifying vacant parcels located close enough to schools to be utilized as outdoor classrooms. [Source: "ldmk_PublicSchoolView.shp" from City of Richmond]

Expanding Access to Community Gardens

1. Vacant parcels located outside of a .25 mile area of existing community gardens. A quarter mile, five minute walking distance is used as a proxy measure for expanding local food access to Richmond residents with limited walkable access. [Source: "CommunityGardens.shp" from RRPDC]

Supporting Urban Trails and Greenways

1. Vacant parcels which intersect a 100' buffer of Richmond's network of existing and planned local and regional trails. The following six trail routes were included:

   U.S. Bike Route 1
   [Source: "Bike1VDOTCntyMaps_Merge.shp" from RRPDC]

   James River Park Trails
   [Source: "James_River_Trails.shp" from RRPDC]

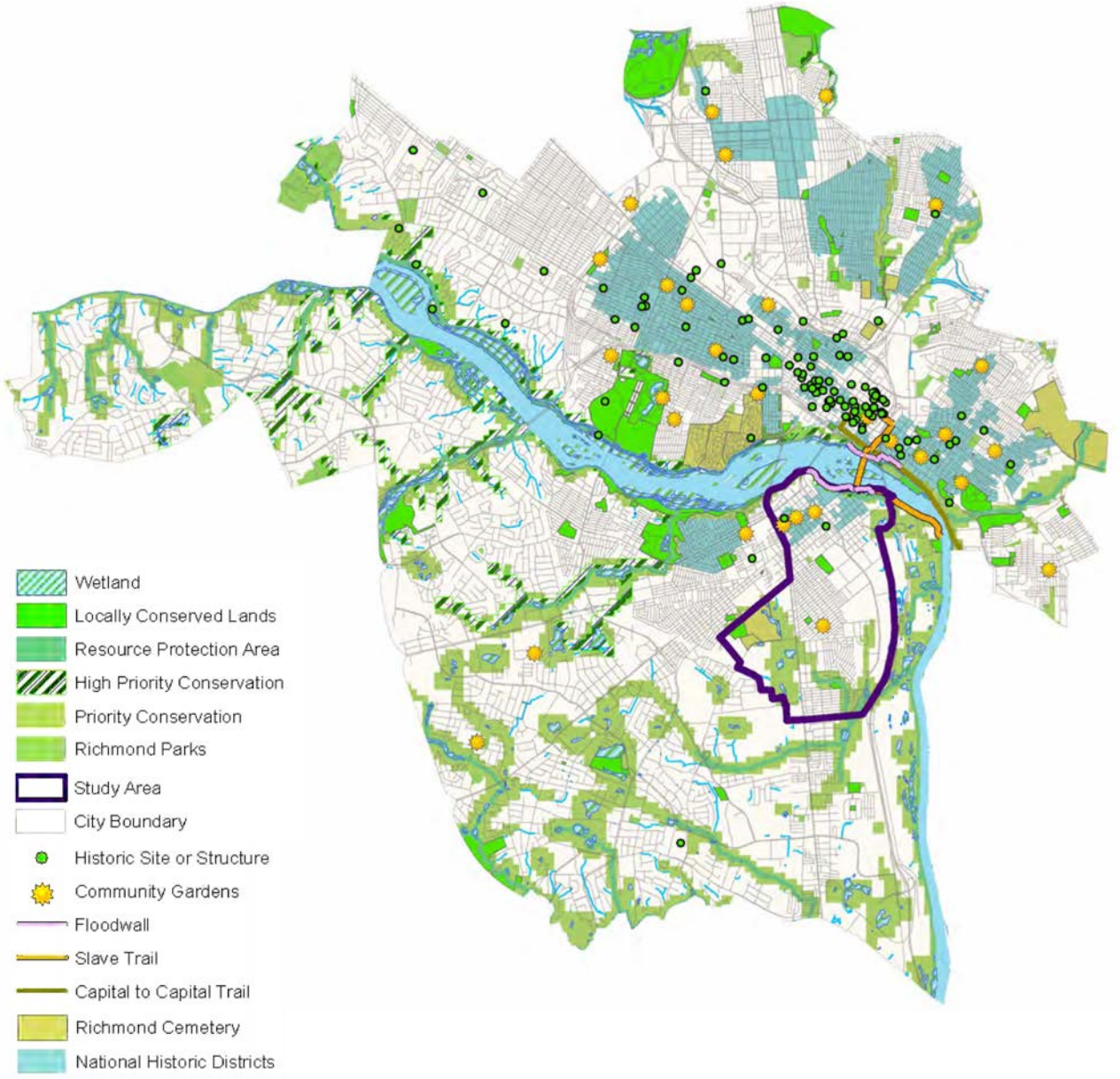
   James River Branch Rail Trail
   [Source: "JamesRiverBranch_RailTrail_Revised.shp" adapted from "Southside_Rail_Trail.shp" from RRPDC]

   James River Heritage Trail On-Road Route
   [Source: "JRheritagetrail_merge.shp" –adapted from original shapefile "On-Road_Bicycle_Route.shp" from VA-DCR]

   East Coast Greenway On-Road Route
   [Source: "VActr_kml_to_shp.shp" from RRPDC]

   Cannon Creek Greenway
   [Source: "Just_Cannon_Creek_Greenway.shp" from RRPDC]

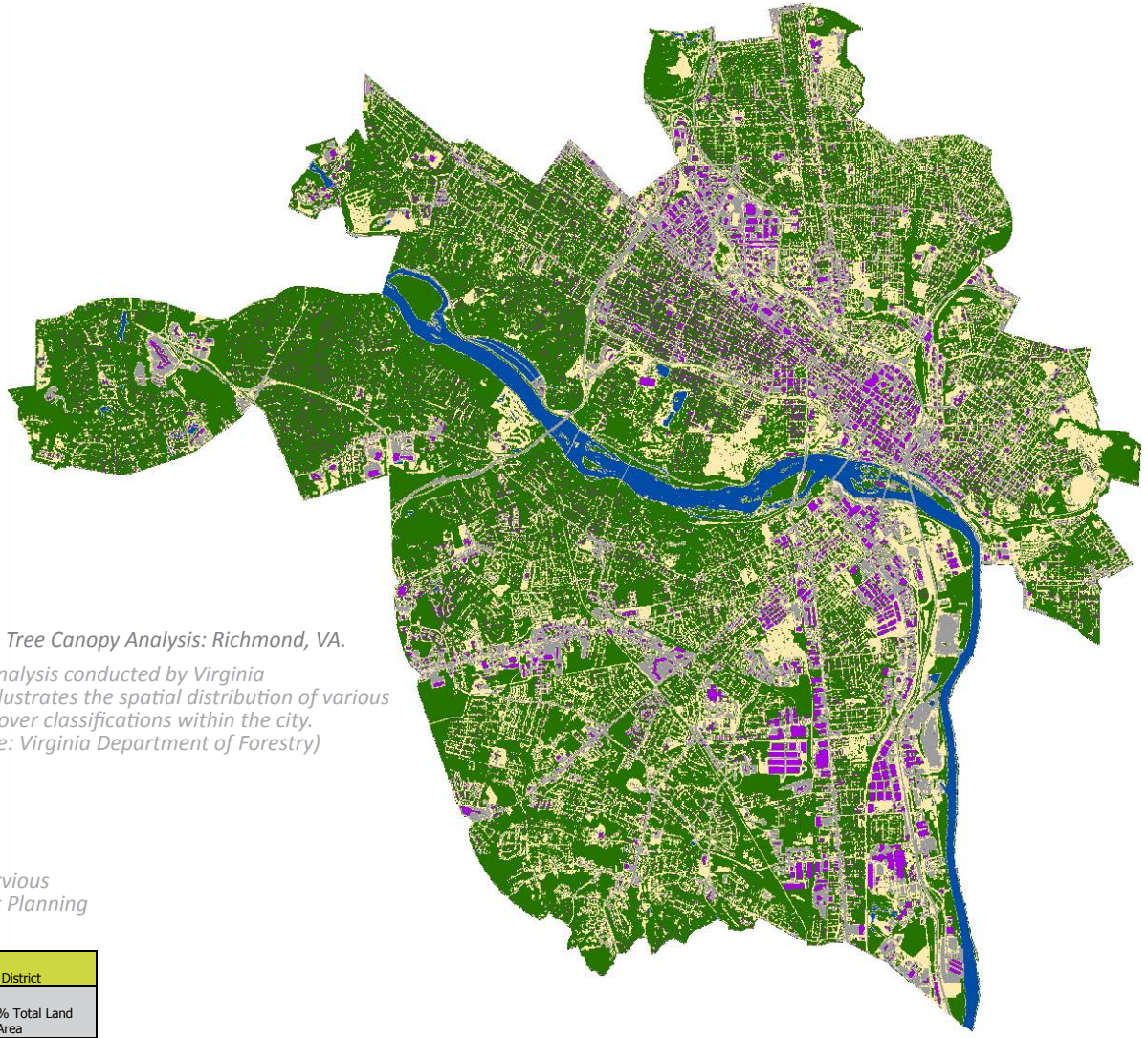
Green Print Base Map



The Richmond Regional Planning District Commission (RRPDC) led Phase I of the Richmond Green Infrastructure Assessment. Part of this phase included identifying the city's existing green assets - the Green Print - as illustrated on the left. This map provides an overview of the city's natural and cultural assets. The RRPDC compiled the results of the Phase I assessment into a report titled "A Green Print Pilot Program for Richmond."

Existing Urban Tree Canopy Analysis

Tree canopy is an important component of the existing green infrastructure network. The figure to the right shows the urban tree canopy analysis conducted by the Virginia Department of Forestry (DOF) for the City of Richmond. The analysis is derived from high resolution aerial imagery (1 meter) from the National Agriculture Imagery Program acquired in the summer of 2008 combined with remote sensing techniques. The analysis determined that approximately 40 percent of the total land area within the city is covered by existing tree canopy. The tree canopy is not evenly distributed throughout the city however, and certain planning districts and neighborhoods have less existing tree canopy than others.



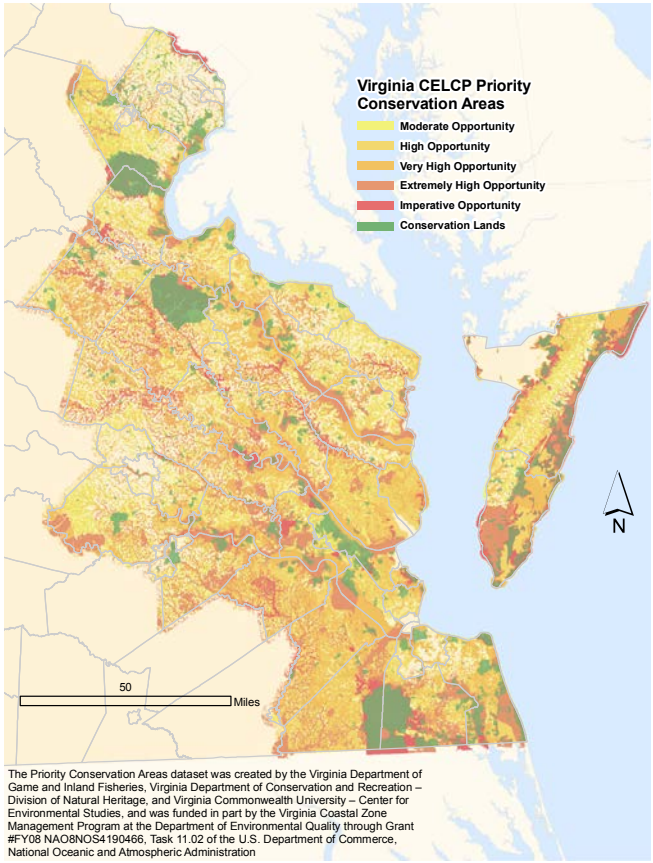
Urban Tree Canopy Analysis: Richmond, VA.

This analysis conducted by Virginia DOF illustrates the spatial distribution of various land cover classifications within the city. (Image: Virginia Department of Forestry)

Table 1. Urban Tree Canopy Coverage in Richmond, VA.

This table shows the percentage of existing urban tree canopy and impervious surface in the city as a whole compared to the Old South and Broad Rock Planning Districts alone.

	City of Richmond		Old South Planning District		Broad Rock Planning District	
	Acres	% Total Land Area	Acres	% Total Land Area	Acres	% Total Land Area
Tree Canopy	16,120.8	40.3	1,625.6	31.3	2,983.8	33.4
Non-Tree Vegetation	8,916.5	22.3	1,358.7	26.2	1,741.7	19.5
Non-Building Impervious	9,331.5	23.3	1,327.9	25.6	1,844.6	20.7
Building Impervious	4,138.7	10.3	586.4	11.3	2,1102.7	23.6
Water	1,501.6	3.8	288.2	5.6	255.6	2.9
Total Area	40,0009.2	100	5,186.8	100	8,928.4	100



The Priority Conservation Areas dataset was created by the Virginia Department of Game and Inland Fisheries, Virginia Department of Conservation and Recreation – Division of Natural Heritage, and Virginia Commonwealth University – Center for Environmental Studies, and was funded in part by the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant #FY08 NAO8NOS4190466, Task 11.02 of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration

Priority Conservation Areas

The Priority Conservation Areas (PCA) assessment was developed jointly by DCR, Virginia Department of Game and Inland Fisheries (DGIF), and Virginia Commonwealth University – Center for Environmental Studies (VCU-CES). Each entity developed a dataset representing "lands and surface waters identified as important for conservation of Virginia's wildlife, plants, and natural communities" (DGIF, 2009). The table below describes each dataset.

These datasets were then combined to create the PCA, or prioritized "areas for preservation, protection or specific management action" (DGIF, 2009). VCU-CES compiled the priorities from all three entities using GIS, such that at any given point on the landscape, the highest of all conservation values assigned to that area by the project partners was assigned to be the prioritization rank for that area. The final PCA is a dataset with cell values from 1-5 representing moderate conservation opportunities (1) up through imperative conservation opportunities (5). PCA data and maps are available for areas within Virginia's coastal zone, including the City of Richmond.

Entity	Dataset	Description
DCR	Conservation Sites and Natural Landscape Network	The Conservation Sites dataset includes known species locations. The Natural Landscape Network dataset includes, from the VaNLA, all highest ranked ecological cores (C1 and C2), all landscape corridors providing linkages between these cores, as well as corridor nodes (i.e. those C3, C4 and C5 cores that intersect landscape corridors).
DGIF	Priority Wildlife Diversity Conservation Areas	Dataset created from existing GIS datasets that were identified from conservation actions in the Wildlife Action Plan. These input datasets were prioritized based on input from DGIF Wildlife Diversity biologists. The final product is a raster GIS dataset where the landscape has been prioritized on a range from 1 to 5, with 5 being the highest conservation priority.
VCU-CES	Aquatic Resource Integrity Layer	Dataset created from stream health scores and watershed integrity scores. The final product has raster cell values from 2 to 5 indicating relative stream health, with 5 representing the healthiest waters.

Richmond Green Infrastructure Assessment

Produced by the Green Infrastructure Center and E² Inc. for the City of Richmond, Virginia
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