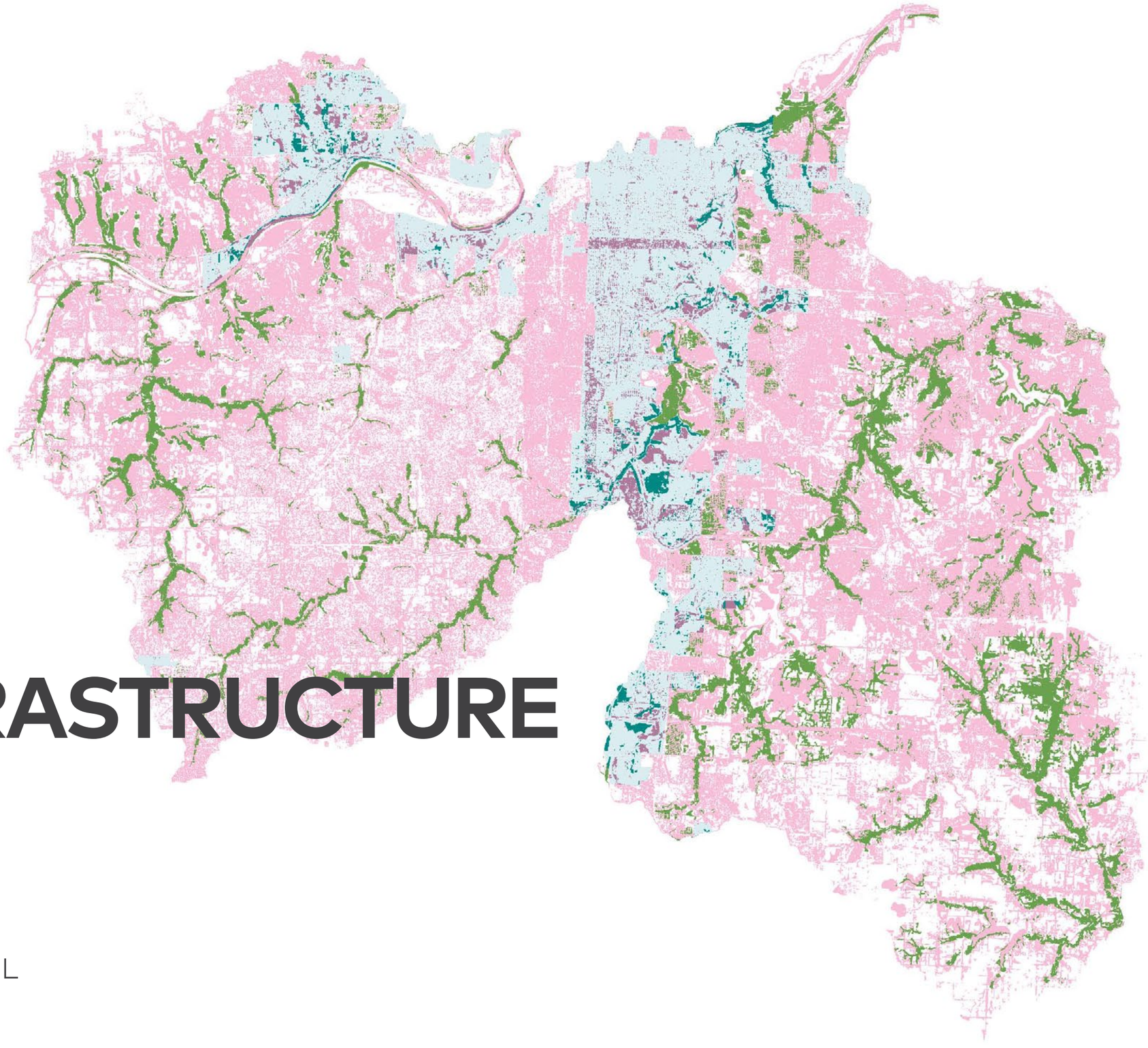

GREEN INFRASTRUCTURE PLAYBOOK

MID-AMERICA REGIONAL COUNCIL
DECEMBER 2017 (REVISED JAN 2018)

ACKNOWLEDGEMENTS

TEAM

MARC
Kym Bledsoe
Tom Jacobs
Alecia Kates
Andrea Repinsky
Kitty Steffens

BNIM
Daniel Eddie
Christina Hoxie
Laura Lesniewski
Aaron Ross
Amanda Santoro
Daniel Siroky
Nicolette Wallis
Xiaoyu Yang

Biohabitats
Claudia Browne
Aiman Duckworth
Chris Rehak

BikeWalkKC
Thomas Morefield

Parson & Associates
Gina Boucher
Alex Miller
Jason Parson

PROJECT APPLICANTS

Jackson County
Josh Boehm

Shawnee Mission School District
Joan Leavens

ADVISORY COMMITTEE

Scott Allen
City of Blue Springs, Missouri

Michael Beezhold
HDR

Jon Birkel
Hunt Midwest

Sarah Crowder
Heartland Tree Alliance

Daniel Erickson
Platte County, Missouri

Matt Garrett
Johnson County, Kansas

Kathy Gates
Kansas City Native Plant Initiative / Westport Garden Club

Jim Harpool
Evergreen Real Estate

Mark McHenry
KC Parks - Kansas City, Missouri

Ginney Moore
The Conservation Fund

Jasmin Moore
Johnson County, Kansas

Mary Nemecek
Burroughs Audubon / Kansas City Native Plant Initiative

Brian Nowotny
Jackson County, Missouri

Gloria Ortiz-Fisher
Equity Network / Westside Housing Organization

Michael Park
Lee's Summit, Missouri

Dennis Randolph
City of Grandview, Missouri

Kristin Riott
Bridging the Gap

Amy Roberts
City of Kansas City, Missouri

Terry Rynard
KC Parks - Kansas City, Missouri

Andy Sauer
Burns and McDonnell

Scott Schulte
Vireo / Heartland Conservation Alliance

Allison Smith
Kansas Department of Transportation

Sarah Smith
Johnson County, Kansas

Tom Stiles
Kansas Department of Health and Environment

Lisa Treese
City of Kansas City, Missouri Water Services

Stephen VanRhein
Missouri Dept. of Conservation

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EXECUTIVE SUMMARY

WHY GREEN INFRASTRUCTURE

Today, the Greater Kansas City region is struggling to address myriad environmental, economic and social challenges that impact human health and well-being. These include exposure to air, water and soil pollution; select access to green space and quality foods; access to jobs; and greater susceptibility to flooding from storm events and climatic shifts. Measured data over the past half century has shown an increase of four inches of average annual rainfall. It is predicted that rainfall will continue to increase through the last half of this century by as much as six inches of average annual rainfall.

Improving the health of our rivers and streams is a significant goal, but so is a desire to connect people equitably to nature and to foster a pride of place in their Heartland communities. Many vulnerable communities tend to feel the negative impacts of extreme weather events, and also lack access to connected green space, pathways and tree canopy, which help to buffer pollution impacts as well as providing opportunity for active living and safe pedestrian and bike pathways. Integrating green infrastructure solutions that benefit social and economic needs as well is critical to wholistic solutions to regional challenges.

The backbone of good regional planning is a framework that reestablishes and integrates ecological processes into the heart of the region's cultural and economic fabric. The work in the Phase 1 Green Infrastructure Framework set the stage for quality of life that is based on regeneration — a process of analysis and engagement with the purpose of integrating living systems with human aspirations. These two Playbooks for the Rock Island Corridor and the Shawnee Mission School District set the stage for demonstrating replicable approaches for implementing green infrastructure that integrates both ecological and socioeconomic needs.

ROCK ISLAND CORRIDOR PLAYBOOK

The Rock Island Corridor spans 17.7 miles through the four watersheds, and the railroad corridor was acquired in May 2016 through a partnership with the KCATA and Jackson County. As part of this effort, Jackson County will benefit from providing critical bike and pedestrian linkages to a number of the region's existing and planned trails, as well as the Sports Complex, downtown Raytown, south Lee's Summit, and the View High corridor. These paths will provide opportunities for physical activity, improved residential property values, connectivity of diverse neighborhoods, and bring residents closer to their natural surroundings.

In addition to stakeholder meetings and ground-truthing site visits, a suitability analysis focused on ecological and socioeconomic factors helped determine hotspots along the corridor for where green infrastructure solutions would be impactful. Stepping down in nested scales, the northern trail connectivity was assessed and how green infrastructure solutions integrate into that to benefits the surrounding communities and ecosystem. The Rock Island Corridor trail has the potential to integrate green infrastructure with multi-benefit solutions along its entire length, and the process demonstrated in its Playbook can and should be used to identify additional sites with project momentum, identifiable champions, access, need, and proximity for maximum replicability.

SHAWNEE MISSION SCHOOL DISTRICT PLAYBOOK

The Shawnee Mission School District embraces the opportunity to lead as it straddles seven watersheds and intends to design sustainable sites using state-of-the-art ecological design principles to increase student achievement, improve environmental quality, and serve the community. Shawnee Mission has already shown its dedication to green infrastructure principles by developing the Center for Academic Achievement (CAA), which includes site stormwater management, native plantings, food production, and community connectivity.

One of the biggest deterrents of green infrastructure is perceived worry and issues of maintaining it after implementation. This playbook explored adaptive management strategies for how to maintain and adapt the CAA's current green infrastructure system, and how these strategies can be implemented district-wide. Additionally, a similar process of stakeholder meetings, site visits, and an ecological, socioeconomic suitability analysis were conducted for the Shawnee Mission School District. This analysis overlapped with school sites identified priority schools for future green infrastructure projects that provide opportunities to link to nearby conservation and restoration initiatives. School facilities offer a unique opportunity to model best practices in green infrastructure for both the future workforce and surrounding communities and help expand the network of green infrastructure strategies at a regional and increasingly impactful scale.

RECOMMENDATIONS & NEXT STEPS

The next phases of work include additional ecological and human systems research, analysis and map refinement, continuing process definition for opportunity area implementation, green infrastructure solution and policy refinement, a communications platform and web-based Framework interface. These playbooks were created as examples and to give a how to on looking at green infrastructure solutions within projects, and how a networked solution can benefit communities in a myriad of ways. Maintaining the momentum of Phase 1 and the Playbooks' engagement and enthusiasm is key to success of the development and use of the Framework. Feedback from communities and organizations that test the Framework will inform its evolution and opportunities for integration. We must continue this important work to help stakeholders of the Greater Kansas City region make strong investments in a resilient future.

WHY GREEN INFRASTRUCTURE?

WHAT IS GREEN INFRASTRUCTURE?

The Environmental Protection Agency (EPA) defines green infrastructure as, "...a cost-effective, resilient approach to managing wet weather impacts that provides many community benefits." The Nature Conservancy defines green infrastructure solutions as, "...planned and managed natural and semi-natural systems which can provide more categories of benefits, when compared to traditional gray infrastructure." Both of these commonly accepted definitions focus on benefits to the environment and to people.

The systems that the Nature Conservancy definition refers to are often soil or vegetation-based and include planning approaches (e.g., tree preservation, stream buffer zone protection and impervious surface reduction) as well as physical strategies (e.g., tree planting, prairie restoration, stream bank stabilization, and permeable pavement). Green infrastructure treats rain as a key ingredient to solutions rather than a waste and thereby allows community development goals to align with water, land and air quality goals. The purpose of this document is to show the potential of an expanded approach to green infrastructure that connects our region's natural resources to people in ways that create networks of environmental, economic and social benefits in all communities.

WHY - GREEN VS. GRAY

Just as significant as the goals for improving the health of our rivers and streams, is a desire to connect people equitably to nature and to foster a pride of place in their Heartland communities. Too often our most vulnerable populations are the most susceptible to the negative impacts of a degraded environment and extreme weather events. Some communities suffer increased pollution and related health issues based on proximity to major roadways. Many have aging streets and sewers that flood in all rain events and more severely in the increasing number of flash floods.

When trying to alleviate wet weather impacts, the instinct is to turn solely to human-engineered infrastructure such as pipes and drains that collect and push the water downstream. However, grey infrastructure is challenged more and more with urbanization and high volumes of impervious surfaces, which leads to undersized, piped systems that are difficult and costly to replace. In addition, grey infrastructure typically only assists with managing stormwater without being able to layer in other benefits to its surrounding communities and ecosystems.

Green infrastructure solutions are solutions that simultaneously help to alleviate the pressures of wet-weather events as well as provide important amenities to our communities. In addition to providing the ecosystem services of cleaning the air and slowing and cleaning water, green infrastructure systems also improve the economic value of our built environment and connect people to nature and to one another. Pathways for water are also pathways for pedestrians and cyclists, and provide healthy lifestyle and mobility opportunities that are needed for the health and resilience of our community systems.

WHAT IS A GREEN INFRASTRUCTURE PLAYBOOK?

A playbook is a framework that demonstrates replicable approaches for implementing green infrastructure for ecological and socioeconomic benefits using nested scales of analysis. It looks beyond analyzing ecological value areas and ecosystem benefits, but also looks at the human outcomes and social benefits that a green infrastructure solution can provide. A playbook project may fall within an area prioritized regionally because it depicts high ecological and socioeconomic factors that a green infrastructure solution could benefit. However in addition to these factors that show need, three other non-geospatial criteria for near-term implementation serve as catalysts. These include momentum, accessibility, and proximity (as described below). These criteria add additional weight to projects to help understand the impact and timing of green infrastructure solutions implemented.

The following introduction and chapters explain the context and processes of a playbook as well a flush out two playbook examples. These two playbooks show in depth two very different projects, processes for integrated ways to incorporate green infrastructure solutions, and how to adaptively manage green infrastructure solutions once implemented.

MOMENTUM

- **Projects Already Started**
- **Partners in Place**

ACCESSIBILITY

- **Translatable to Wide Audience**
- **Projects' Lessons Learned**
- **Exemplify Replication and Education**

PROXIMITY

- **Connect The Dots / Ripple Effect**
- **Through Trails, Schools, or Recreation Links**

NEED

- **Natural Resource and Human Health Need**
- **Nexus of Food, Active Living, Jobs, Water, Energy, Transportation**

CONTEXT
GREEN INFRASTRUCTURE PLAYBOOK

BACKGROUND

This Playbook is the next step in the process of examining green infrastructure opportunities within the Kansas City region and builds upon these earlier phases:

- *Phase 1 Green Infrastructure Framework - Connecting People with Nature*: This document addresses the question of "Why green infrastructure?" and provides the background qualitative and quantitative analysis used to establish a methodology and process for next steps. The Atlas maps created during this process highlight ecological and social needs in the region, and outline integrated strategies for specific areas in the region that are ripe for action based on criteria of need, momentum, accessibility and proximity to other high value projects.
- *Phase 2 Green Infrastructure Framework - Suitability Analysis Report*: Stakeholders within the region submitted their projects to MARC for technical support and/or to be highlighted as success stories in the Atlas. Two projects were prioritized for technical support based on their alignment with criteria established in the Phase 1 Framework, and are included in this Playbook:
  - *Rock Island Corridor*, selected because of its clear connection to regional transportation priorities, and because of its current funding and committed partners (momentum) as well as its accessibility to a wide audience for advocacy and education on the benefits of green infrastructure to people and nature.
  - *Shawnee Mission School District (represented by the CAA)*, selected because of its significant momentum, accessibility for lessons learned and proximity to many other school sites for replication.

Additional data analysis and input from stakeholders have guided the contents of this Playbook. Both projects are specific to their place within the Kansas City metro, while serving as examples for implementation of similar strategies throughout the region. Further, these are but two examples upon which to base other entries into the Playbook, the goal of which is to add many more projects from the region that are prime for green infrastructure and all the benefits associated with it.

CONTRIBUTORS

The following projects were submitted as applications for inclusion in the green infrastructure Atlas and Playbook. These success stories remain critical contributions to the good work occurring within the region. The team has deep gratitude for all applicants that took the time to respond to the call for entries in both categories.

Atlas

- 151st Street and Lindenwood Drive Floodwater Project
- 20th Street Streetscape
- 56 Commerce Center of Johnson County
- Blue River Trailhead
- Chestnut Detention Real-Time Control
- Green Infrastructure Demonstration Project
- Hiawassee Park
- Kansas City Municipal Farm Habitat Restoration
- Kansas City Parks with Purpose
- Lexington Lake Park
- Middle Blue River Green Infrastructure Pilot
- Northeast Industrial District Green Infrastructure
- Olathe Environmental Laboratory
- Olathe West High School BMPs
- Peetwood Park
- Pollinator Plot at Heritage Park
- Swope Campus Parking Lot Supplemental Environmental Project
- Target Green East (Phases 2, 3)
- Target Green West (Phases 1, 3)
- Willow Lake
- Wornall Road and 75th Street Green Infrastructure

Playbook

- Blue Valley Oxbow Habitat Enhancement
- Charlotte Sawyers Nature Area Restoration
- East High School Green Infrastructure Project (collaboration between KC Public Schools and city of Kansas City, Missouri)
- Golf Hill Development
- Rock Island Corridor
- Schools as Hubs Lead Communities to Thrive with Nature
- Shawnee Mission School District Sustainable Sites
- The Giving Grove

PURPOSE

The purpose of the MARC Green Infrastructure Playbook is to help communities see how integrated green infrastructure planning can benefit high value community needs as well as natural resources. It is also to demonstrate a replicable method for:

1. Using watershed-based mapping to identify multi-benefit opportunity areas embedded within a network of planned or ongoing projects;
2. Identifying potential partners within an opportunity area where green infrastructure conversations serve as a catalyst to build community connections, and;
3. Designing green infrastructure strategies that support, restore, and enhance natural landscape functions while providing social benefits.

Nonprofits, neighborhood organizations, and government agencies are encouraged to use the approaches described here to find partners to address common issues and work with MARC to build community connections that leverage momentum, funding, and development and implementation of creative solutions.

OVERVIEW
GREEN INFRASTRUCTURE PLAYBOOK

PROCESS

The steps of preliminary study for integrated green infrastructure strategies include both qualitative and quantitative evaluation. An outline of the steps follows:

1. Define a study area boundary or buffer zone around your focal project area, including community connections.

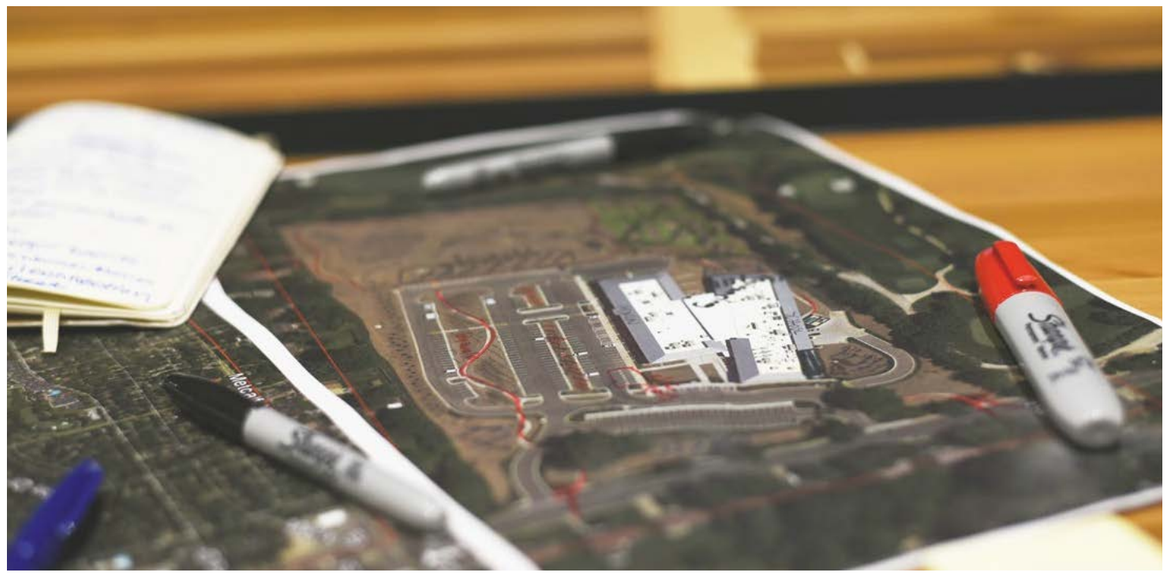
2. Identify priority ecological and human assets and needs in the area using regional mapping resources (e.g., MARC's Atlas and models).

3. Engage with stakeholders to set goals and identify upcoming challenges and opportunities within the study area.

4. Identify and evaluate the places with the strongest intersections of opportunities and needs for the application of green infrastructure strategies.

5. Assign responsibilities and implement strategies.

This Playbook is designed for use by municipal and county staff, environmental conservation organizations, transportation organizations, neighborhood leadership, school administrators, and facility managers of campuses and public land holdings. As shown in the Playbook examples, there are many ways to start applying this process, depending on the momentum of other ongoing projects.



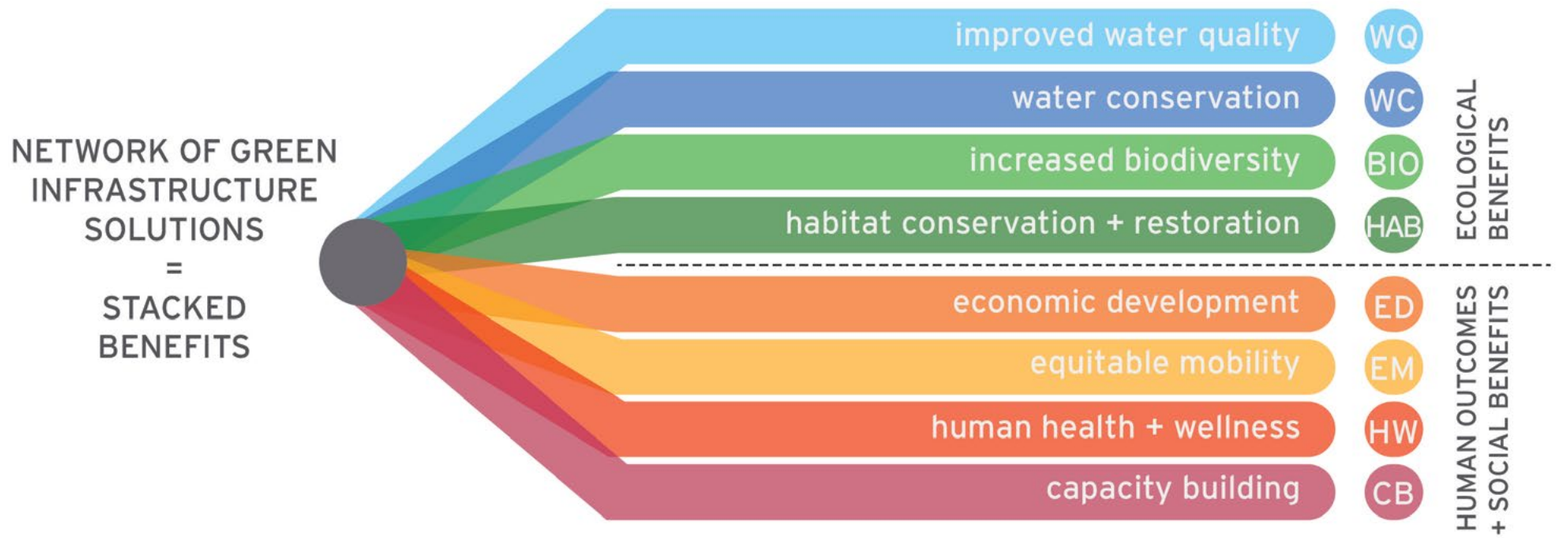
GREEN INFRASTRUCTURE BENEFITS

This Playbook provides on-the-ground examples in the Greater Kansas City region of the mutual benefit and beauty of considering green infrastructure solutions as a network. This model looks to a healthy state of nature for solutions on how to support resilient and connected communities of people. When implemented together these nature-based solutions not only assist stormwater infrastructure, but also benefit:

- Water quality.
- Water conservation.
- Biodiversity.
- Habitat conservation and restoration.
- Economic development.
- Equitable mobility.
- Human health and wellness.
- Capacity building of communities (to create the places each community wants to live in, through education and partnership).

The outcomes sought are straightforward, and the solutions are proven, but achieving a network of solutions that provide much greater benefit through being implemented together is what requires a new way of thinking and acting. As you will see in the following examples of Rock Island Corridor and Shawnee Mission School District, the planning and implementation of each requires coordinated involvement from multiple perspectives and responsible parties. The factors of influence include public and private landholders, conservation/restoration projects underway, neighborhood cohesion, regional attractions, educational opportunities, employment opportunities, pollution sources, city codes and regulations, funding sources, and many others depending on the unique conditions of each area. By implementing green infrastructure solutions as a network, you can achieve both ecological and social benefits to a project, beyond just assisting with stormwater infrastructure. A network of green infrastructure solutions can create a stack of benefits for a project.

The diagram below depicts eight broad categories of potential benefits green infrastructure can create. It can be broken down into more specifics and is not exclusive, but a green infrastructure project done well can stack many of these benefits and be impactful. Benefits listed here are linked to strategies discussed in the Rock Island and Shawnee Mission playbooks that follow.



SCALES OF STUDY

GREEN INFRASTRUCTURE PLAYBOOK

GLOSSARY OF TERMS

The Green Infrastructure Framework begins at the regional scale with a series of maps called the Atlas that serve to highlight priority areas based on value and need (see Phase 1 for these maps). As previously explained, a playbook is a project framework that demonstrates replicable approaches for implementing green infrastructure for ecological and socioeconomic benefits using nested scales of analysis.

Based on a watershed-scale analysis, Priority Areas are locations selected for further study based on the established criteria of momentum, need, access and proximity set forth in Phase 1 of the Green Infrastructure Framework. The foundation of a playbook is the watershed scale because it groups priority areas and partners based on ecological and hydrological relationships that go beyond municipal/political boundaries. A watershed-scale area is natural drainage area boundaries developed by the U.S. Geological Survey. Within each Priority Area of a watershed, there are often multiple clusters of opportunities that merit further analysis to identify a starting point that will have the greatest potential for immediate impact, which is called an Opportunity Area. For the Rock Island playbook, this translates to the scale of a transit corridor. For the Shawnee Mission School District, this translates to the school district boundaries. Within an Opportunity Area, a Focus Area is the neighborhood or community-scale area that is used to establish connections between projects and to develop recommendations for implementable, site-specific green infrastructure strategies. Both the Rock Island and Shawnee Mission School District playbooks illustrate this scale through the context of adjacent neighborhoods. Another term used is Network Connectors, which is a list of green infrastructure solutions that work within an area to address multiple challenges and link smaller project sites together to strengthen the network of watershed-scale benefits.

These playbooks vary in the scale selection and naming based on the unique features of each project (see diagram on following page). When reading each playbook, these scale names will be used to describe geographically the scale of the study and the level of detail for that current analysis. For the Rock Island playbook, the Corridor scale is the largest scale within multiple watersheds that identifies a common focus for infrastructure improvements along a common transit zone. Zooming further in on scale, a Sub-Corridor scale is a more manageable area to comprehend the benefits of integrated green infrastructure within the context of specific neighborhoods and partnerships with local stakeholders. Within a Sub-Corridor scale, a Neighborhood scale is critical to green infrastructure implementation because of the engagement required of local landowners and stakeholder organizations to steward the work and champion the benefits for people and nature. Lastly, within a Focus Area or Neighborhood, the Site scale is where on-the-ground implementation occurs for fundable projects that address site-specific needs, while contributing to the integrated green infrastructure approach that is envisioned for all other scales.

For the Shawnee Mission School District playbook, the School District scale allows the school administration to understand the breadth of green infrastructure implementation across their property holdings and the municipalities within which they operate. Like the other playbook, it steps down in scale from the school district to the Neighborhood scale. This Neighborhood scale looks at the engagement required of local landowners and stakeholder organizations to steward the work and champion the benefits for people and nature to implement green infrastructure. Lastly again, the site scale is where on-the-ground implementation occurs for fundable projects that address site-specific needs while contributing to the integrated green infrastructure approach that is envisioned for all other scales.

The following page depicts this study of scales in a diagram showing how the team stepped from the regional scale analysis of the Atlas down to a site scale for each playbook.

GREEN INFRASTRUCTURE: Three Stages

For each project in the Playbook, there are three main stages of the work: Ideation and Planning, Design, and Maintenance. A sidebar is included to briefly describe the critical nature of each stage, which is necessarily customized for each project.

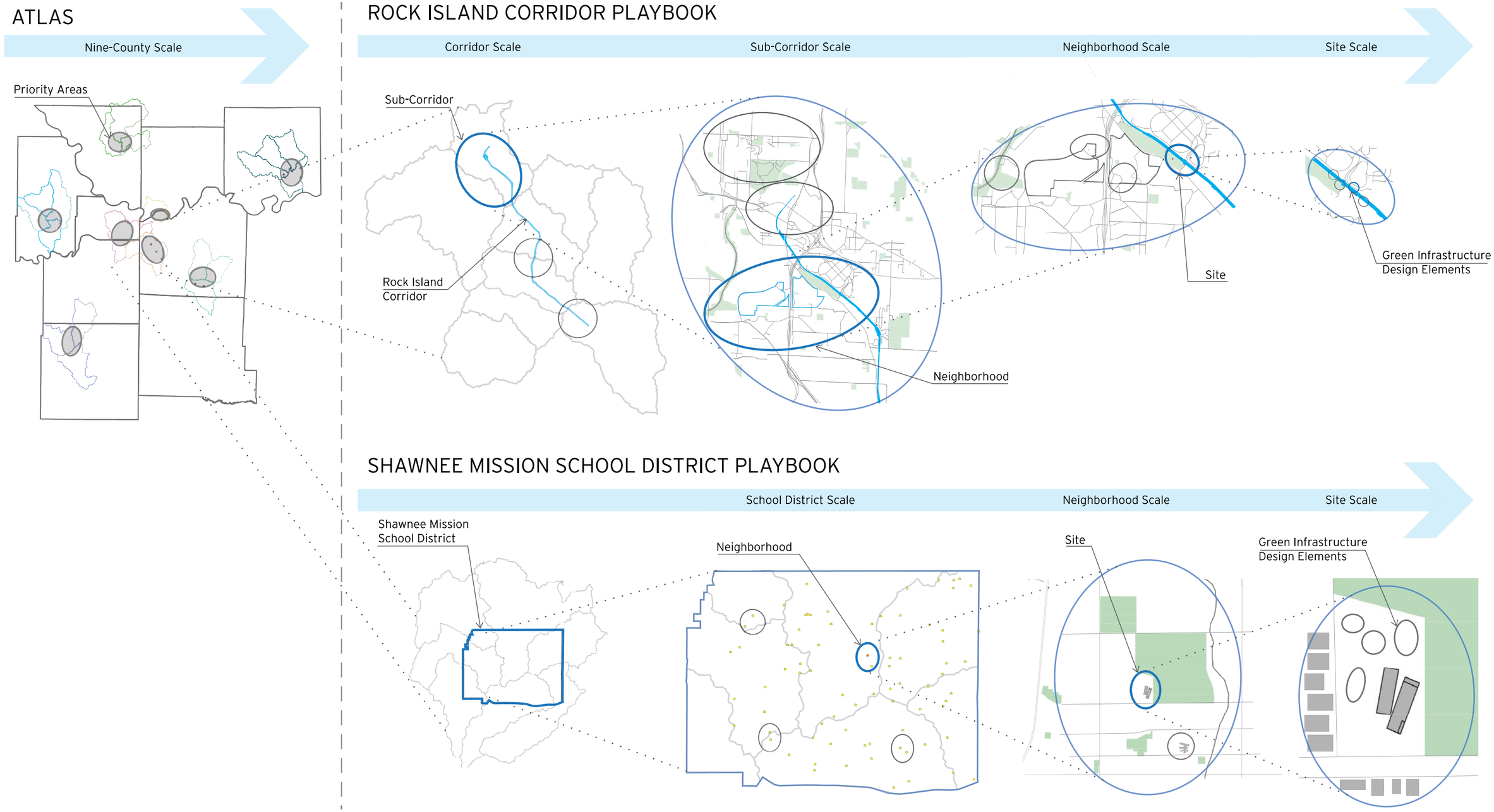
Ideation and Planning: The emphasis in this stage lies on engagement with key stakeholders that can facilitate an integrated green infrastructure framework. At times, momentum already exists with a project that is underway and that can be bolstered by green infrastructure to expand both ecological and human benefits.

Design: Crucial in this stage is the identification of clear points of influence, focusing on human and ecological values and needs. Design is the vehicle for integrating solutions that provide greater connectivity for existing conditions and future projects anticipated in the area.

Maintenance: After implementation of green infrastructure, focus turns toward increasing their benefits over time. These are living systems that require stewardship with an adaptive management approach that learns over time. Ongoing engagement with key partners is often critical to success at this stage; successful projects then become models for future integrated green infrastructure projects.

SCALE DIAGRAMS

These diagrams depict the progression of scales for the Rock Island Corridor and Shawnee Mission School District playbooks. These two Playbook examples vary in the scale selection and naming, based on the unique features of each project and the process the team went through to filter priorities and create an integrated network of green infrastructure strategies. The language from the glossary on the previous page further describes the scales of focus.



ROCK ISLAND CORRIDOR

GREEN INFRASTRUCTURE PLAYBOOK

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WHY TRAIL PROJECTS FOR GREEN INFRASTRUCTURE IMPLEMENTATION?

Trail projects are unique in their ability to cross ecological and social boundaries. They have the potential to transcend these boundaries and connect people and systems at a local and regional scale. Because of this, they are ideal frameworks for the implementation of green infrastructure (GI).

The Rock Island Corridor in particular was selected because it of its clear connection to regional transportation priorities, and because of its current funding and committed partners (momentum) as well as its accessibility to a wide audience for advocacy and education on the benefits of GI to people and nature. Implementing green infrastructure along a 17+ mile trail corridor has the potential to connect and positively impact many cities and neighborhoods, watersheds, underserved areas, and a wide range of ecosystems.

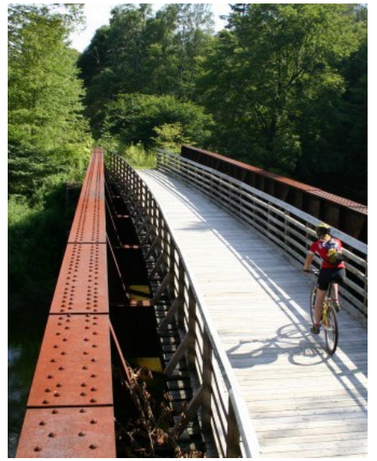
HOW TO USE THIS PLAYBOOK

The Rock Island Playbook is the next step in the process of examining green infrastructure opportunities within the Kansas City region and builds upon the Phase 1 Green Infrastructure Plan and the Phase 2 Suitability Analysis, which identified the Rock Island Corridor as a priority, and demonstrates how to strategically move from a regional scale to smaller scales for GI implementation.

The Rock Island Playbook shows the methodology the team used to identify and prioritize GI opportunities along the corridor. The team began at the Corridor Scale shown in the Suitability Analysis, and in studying the intersection of ecological and social needs along the corridor, began to zoom in, first at a Sub-Corridor Scale, then a Neighborhood Scale, and finally a Site Scale. At each of these scales, the Playbook provides examples of GI implementation, with each subsequent scale demonstrating more specific and detailed strategies.

This Playbook entry was created in collaboration with the Rock Island team specifically for the Rock Island corridor and its unique conditions, but the methodology and strategies outlined in the following pages provide a model that should be highly applicable to other trail corridor projects, especially those looking for ways to move from regional planning to “on-the-ground” site implementation.

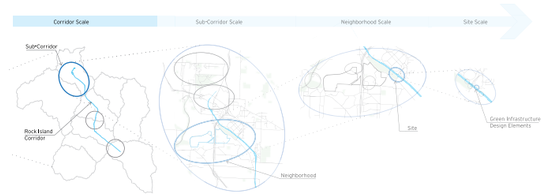

The MARC GI and Rock Island team exploring the current state of the Rock Island rail corridor.


Reuse of rail trestle at West Fork in West Virginia


Completed “rails to trails” project in British Columbia

INTRODUCTION
ROCK ISLAND CORRIDOR

CORRIDOR SCALE



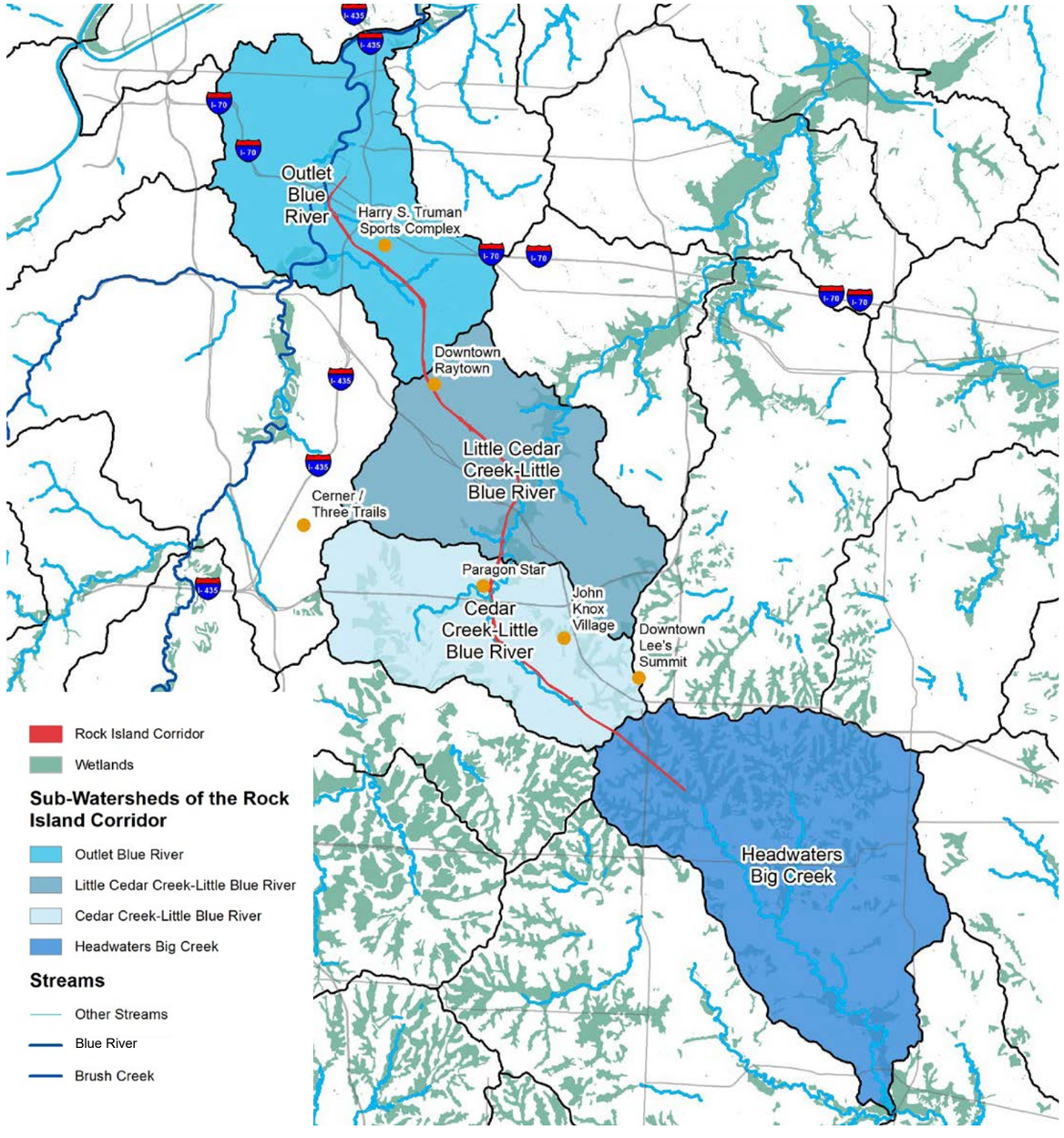
The Rock Island Corridor spans 17.7 miles through the four watersheds shown on the adjacent map. Through over a decade of community capacity building and outreach, the corridor was identified as the Kansas City region's ideal connection to the Katy Trail. Additionally, through transportation planning efforts spearheaded and supported by Jackson County, the corridor was sought as a future commuter rail connection to the Harry S. Truman Sports Complex, city of Raytown, and city of Lee's Summit. The railroad corridor was acquired in May 2016 through a partnership with the Kansas City Area Transportation Authority (KCATA) and Jackson County. As part of this effort, Jackson County will benefit from providing critical bike and pedestrian linkages to a number of the region's existing and planned trails, as well as the Sports Complex, downtown Raytown, south Lee's Summit, and the View High corridor. These paths will provide opportunities for physical activity, improved residential property values, connectivity of diverse neighborhoods, and bring residents closer to their natural surroundings.

KEY CONSIDERATIONS AND ISSUES

- *Transportation:* Access to multi-modal transportation, including public transit, walkability and bikeability are not in neighborhoods adjacent to the corridor.
- *Economy:* Indicators of equity show conditions are below average for income and education in portions of the corridor.

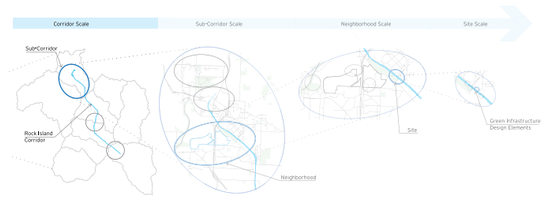
BENEFITS AND METRICS

- *Transportation equity:* Increased number of people/communities with improved access to bike/walk routes, especially supporting access to jobs. Metrics include tracking pedestrian and biking traffic counts over time as infrastructure and access points are constructed.
- *Water resources:* Protected water resources through green infrastructure strategies linked to ecological zones. Metrics include monitoring of water quality and runoff quantities at green infrastructure sites and on sensitive sites downstream in watershed.
- *Connected and restored habitat:* Opportunities to conserve and restore native habitat and increase species diversity. Metrics include population and habitat surveys of indicator plant and animal species in habitat zones over time, and animal tracking studies.
- *Human health and wellness:* Increased healthy food access, education, and outreach programs for healthy lifestyles. Metrics include surveys to determine effectiveness of outreach, data from wearable tracking devices, and opportunities to engage in wellness programs (in person or via mobile devices).
- *Economy:* Community hubs that attract businesses and investments that increase opportunities for lower-income communities. Metrics include monitoring local job opportunities and household incomes.



INTRODUCTION
ROCK ISLAND CORRIDOR

CORRIDOR SCALE



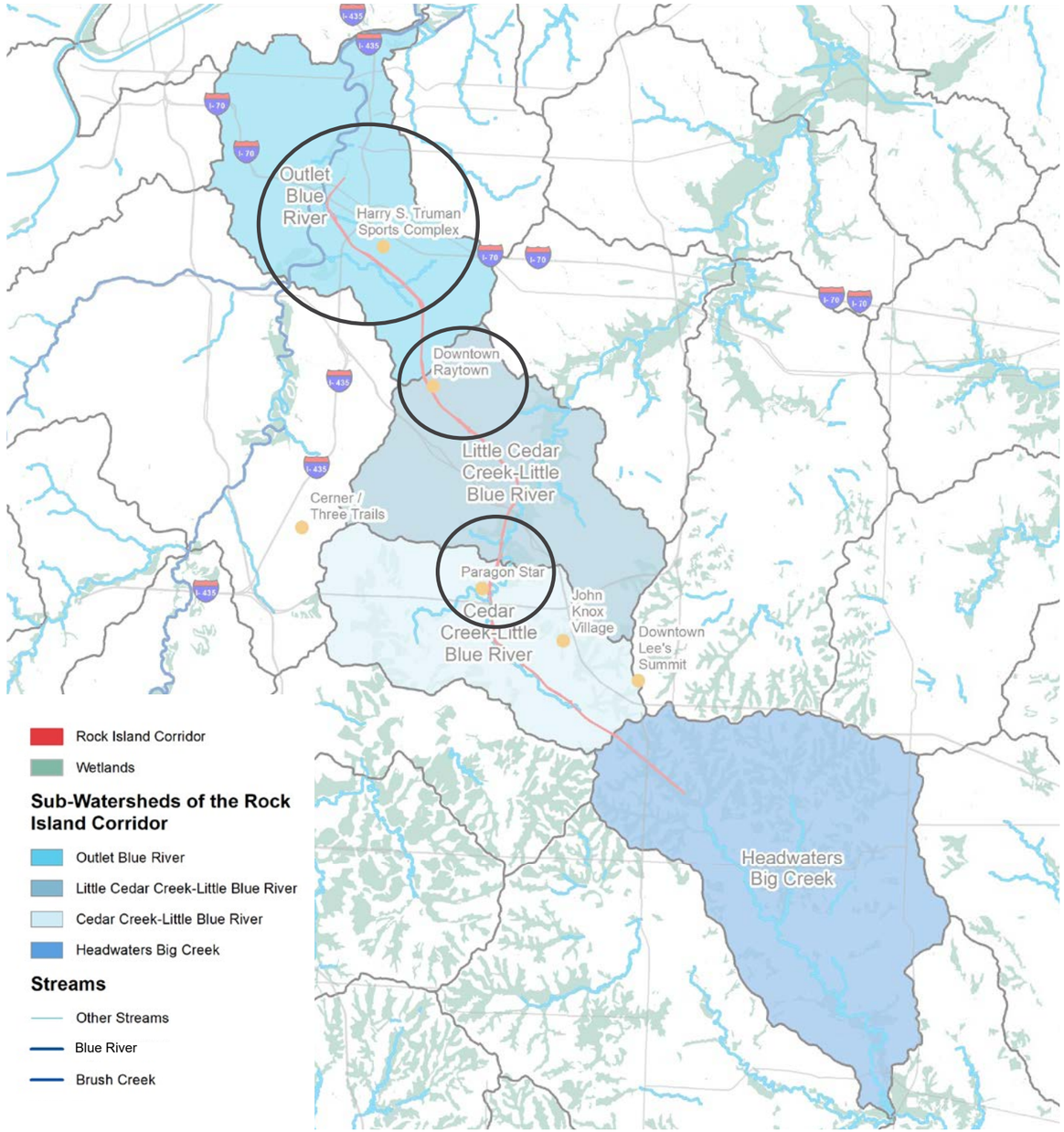
MAPPING AND SCREENING PROCESS

Ecological and social mapping from the Phase 1 Atlas were refined and intersected to show areas where high quality natural resources and potential community connections exist along the trail corridor. Four of these maps are presented and described on the following pages with additional mapping provided in the Appendix.

Interviews with the Rock Island Corridor project coordinator provided additional mapping of challenges and connectivity considerations along the regional trail. Site visits were conducted to observe the trail first-hand (i.e., ground-truth) and identify possible opportunity areas. Initially based on this screening process, multiple opportunity areas were identified. The three areas identified on this map focused around the northern trail segment near the Harry S. Truman Sports Complex, the trail segment near Raytown, and the trail segment at Paragon Star — a mixed-use project underway at View High Drive and Interstate 470 in Lee's Summit to be anchored by a youth sports complex.

Based on the mapping, site visits, and additional stakeholder/partner interviews, the northern trail segment and its connection to the Blue River Corridor were selected to explore further in the Playbook. The selection criteria included:

- Proximity to land owned by Jackson County.
- Connection to multiple organizations interested in green infrastructure such as those listed below.
- Opportunity to connect to Blue River, Round Grove Creek, additional trails, and nearby East High School.
- Opportunity where diversity of challenges meets an existing capacity to act.



GREEN INFRASTRUCTURE: 1 - Ideation and Planning Stage

The earlier that all involved parties come together, the more interconnection of design and implementation can occur. However, it is more likely that one or two projects have already started and created some momentum, as in the case of our two project examples. In this case, the process begins with getting up to speed on current projects and setting goals that define the opportunities that weave into the current projects in order to expand their benefits. The next set of projects grow from the goals and process established.

GEOGRAPHIC ANALYSIS CONTEXT

ROCK ISLAND SUB-CORRIDOR

SUB-CORRIDOR SCALE

GEOGRAPHIC ANALYSIS

To move from suitability analysis of the Rock Island Corridor to the development of networked strategies, a closer look at indicators of health and livability related to green infrastructure was taken on the northern opportunity area. Some of the factors used to evaluate types of beneficial strategies and locations for the strategies that can positively impact ecological and social connectivity are:

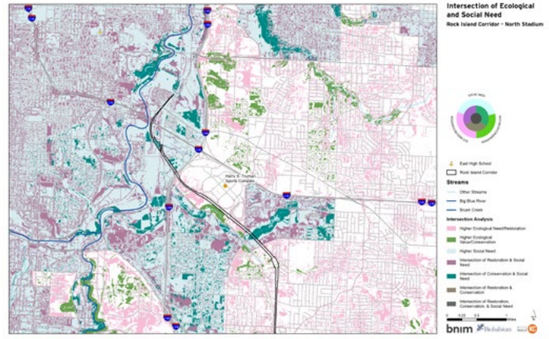
- Ecological-hydrologic zones, such as uplands, lowlands, rocky slopes and floodplains.
- Existence of community hubs and service providers, such as parks, hospitals, clinics, social service providers, schools, grocery stores, corner stores, community gardens, libraries, police stations and other meeting places.
- Areas to develop green infrastructure components to manage stormwater, such as the intersection of large land holders (five acres or more, public or private) with conservation and restoration need.
- Communities with vulnerability such as those with high percentage of households without a vehicle, at or below poverty level, with high minority population, and with low educational attainment.

Maps showing this geographic information may be seen in the Appendix. While this is not a comprehensive process of analysis, these outcomes, paired with local stakeholder interviews, result in the design of strategies that are well-suited to the place and people and have support from local organizations to carry them out, such as:

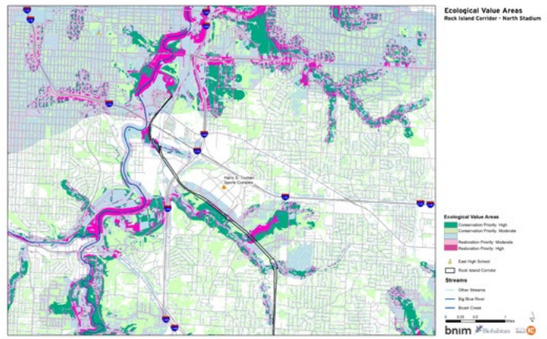
- Complete and green streets for safe multi-modal connectivity and reduced air and water pollution.
- Continuous trails linking activity centers and neighborhoods.
- Stream bank stabilization to increase water quality and stabilize water quantity for healthy habitat.
- Advocacy, education, and training on green infrastructure benefits, landscape maintenance, and job opportunities for all ages.
- Development of green infrastructure components for stormwater management that increase land use potential and density without increasing the strain on the environment and infrastructure.
- Access to safe outdoor active recreation options.

As the regional green infrastructure framework continues to benefit from success stories of other projects and data from their metrics, the process of analysis can be informed by accurate data on health and wellness of people and nature.

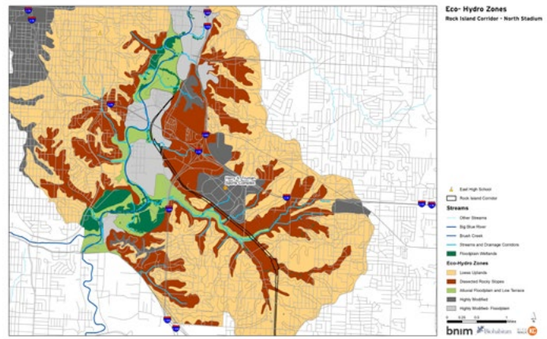
Intersection of Ecological and Social Needs



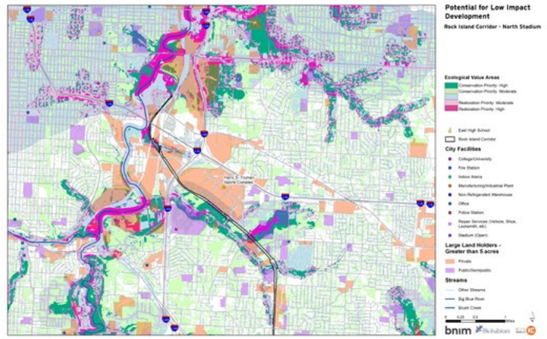
Ecological Value



Eco-Hydro Zones



Potential for low impact Development



GEOGRAPHIC ANALYSIS CONTEXT

ROCK ISLAND SUB-CORRIDOR

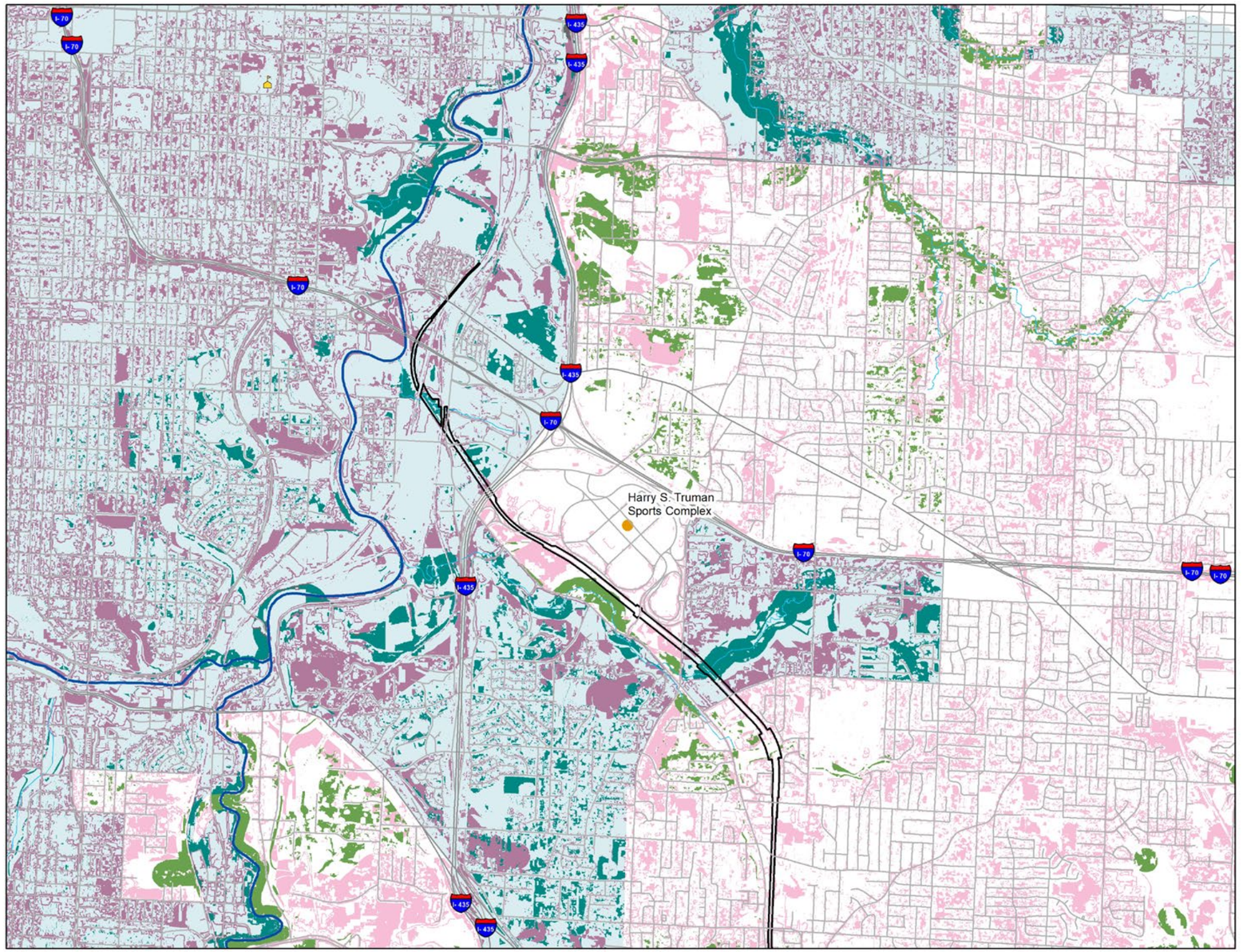
SUB-CORRIDOR SCALE

INTERSECTION OF ECOLOGICAL AND SOCIAL NEED

The value of green infrastructure exists in the potential it has to enhance the health and well-being of our communities. Locations where ecological needs intersect with social needs become ideal places to focus attention and investment. In these places, the connection between the ecological functions of the land and the communities who live there are most direct.

Social needs can be varied and wide-ranging and depend greatly on the context and history of a place. In general, measures of community health, mobility, economic opportunity, and equity can provide a measure of social need. The social need areas on this map represent a composite of the following factors: high percentage of households without a car, in poverty, with high minority population, low educational attainment, food deserts, CDC health indicators, population loss, and hazardous waste indicators.

This is not an exhaustive mapping of social needs, nor an exact template for other areas of study, but provides a starting point for identifying locations of opportunity for green infrastructure.



Intersection of Ecological and Social Need

Rock Island Corridor - North Stadium

East High School

Rock Island Corridor

Streams

Other Streams

Blue River

Brush Creek

Intersection Analysis

Higher Ecological Need/Restoration

Higher Ecological Value/Conservation

Higher Social Need

Intersection of Restoration & Social Need

Intersection of Conservation & Social Need

Intersection of Restoration & Conservation

Intersection of Restoration, Conservation, & Social Need

0 0.25 0.5 1 Miles

N

bnim Biohabitats BIKE WALK KC

GEOGRAPHIC ANALYSIS CONTEXT

ROCK ISLAND SUB-CORRIDOR

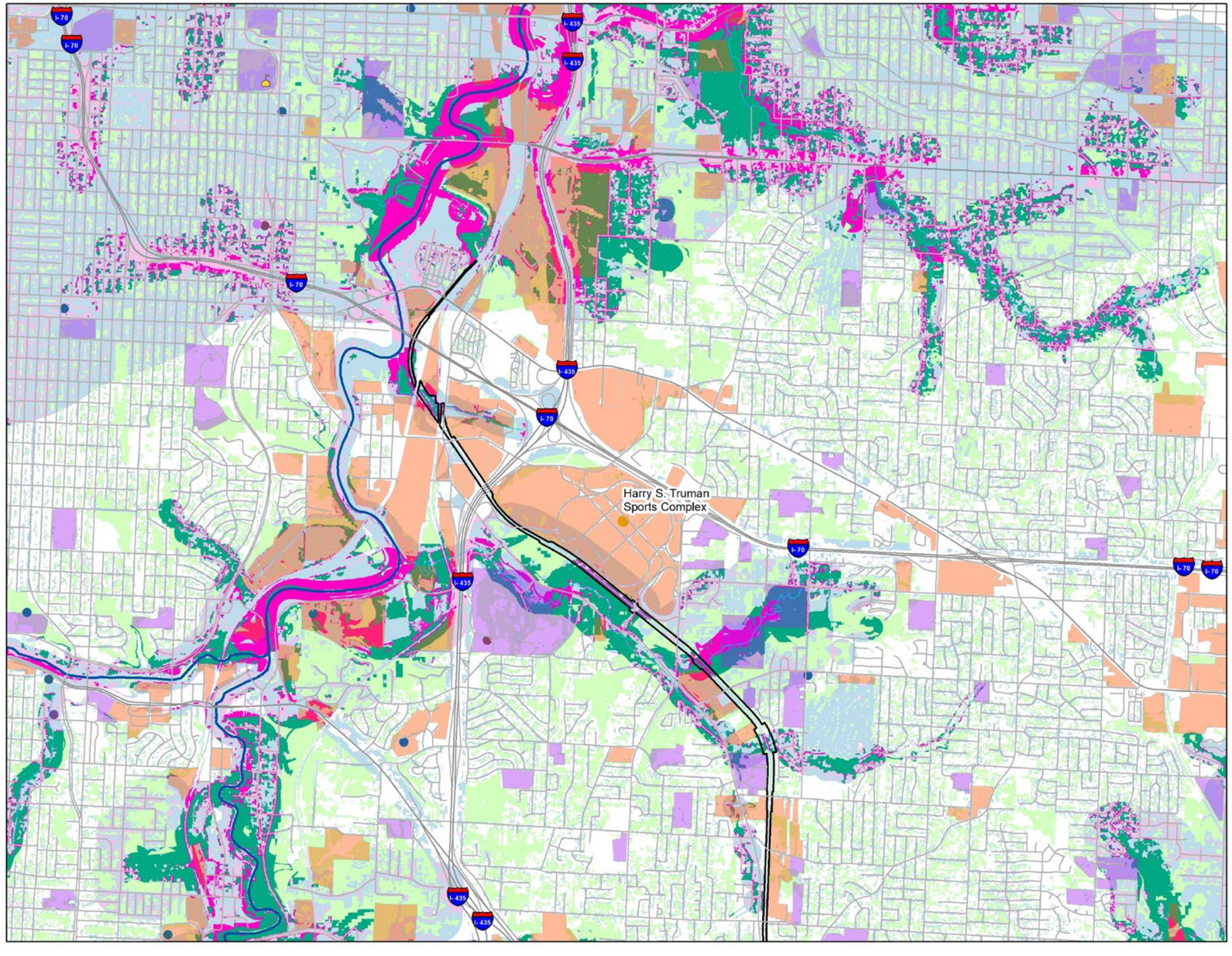
SUB-CORRIDOR SCALE

ECOLOGICAL VALUE AREAS & THE POTENTIAL FOR LOW-IMPACT DEVELOPMENT

Every part of the landscape plays a role in a watershed. The areas of highest ecological value are defined by the presence of streams, lakes, wetlands, floodplains, glades, caves and karst, and forest, along with weighted combinations of ecosystem service benefits for clean water and wildlife. The factors of ecological impact or need are impervious surfaces, major roads, and highest forest restoration priority.

The map indicates priority conservation areas where development impacts should be avoided. Large parcels, such as the area directly south of the Sports Complex, indicate locations to avoid and minimize impacts when aligning alternative trail routes. Dark pink areas identify potential locations for reforestation or grassland restoration, primarily along the drainageways. Examples of priority restoration patches include larger areas where parcel ownership can facilitate a project and areas where restoration can reconnect fragmented parcels.

By mapping restoration areas, we can identify locations where development and green infrastructure can be coordinated to improve ecological functions while creating new communities that are healthy, accessible and livable.



Potential for Low Impact Development

Rock Island Corridor - North Stadium

Ecological Value Areas

- Conservation Priority: High
- Conservation Priority: Moderate
- Restoration Priority: Moderate
- Restoration Priority: High

- East High School
- Rock Island Corridor

City Facilities

- College/University
- Fire Station
- Indoor Arena
- Manufacturing/Industrial Plant
- Non-Refrigerated Warehouse
- Office
- Police Station
- Repair Services (Vehicle, Shoe, Locksmith, etc)
- Stadium (Open)

Large Land Holders - Greater than 5 acres

- Private
- Public/Semipublic

Streams

- Other Streams
- Blue River
- Brush Creek

0 0.25 0.5 1 Miles

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bnim Biohabitats BIKE WALK KC

GEOGRAPHIC ANALYSIS CONTEXT

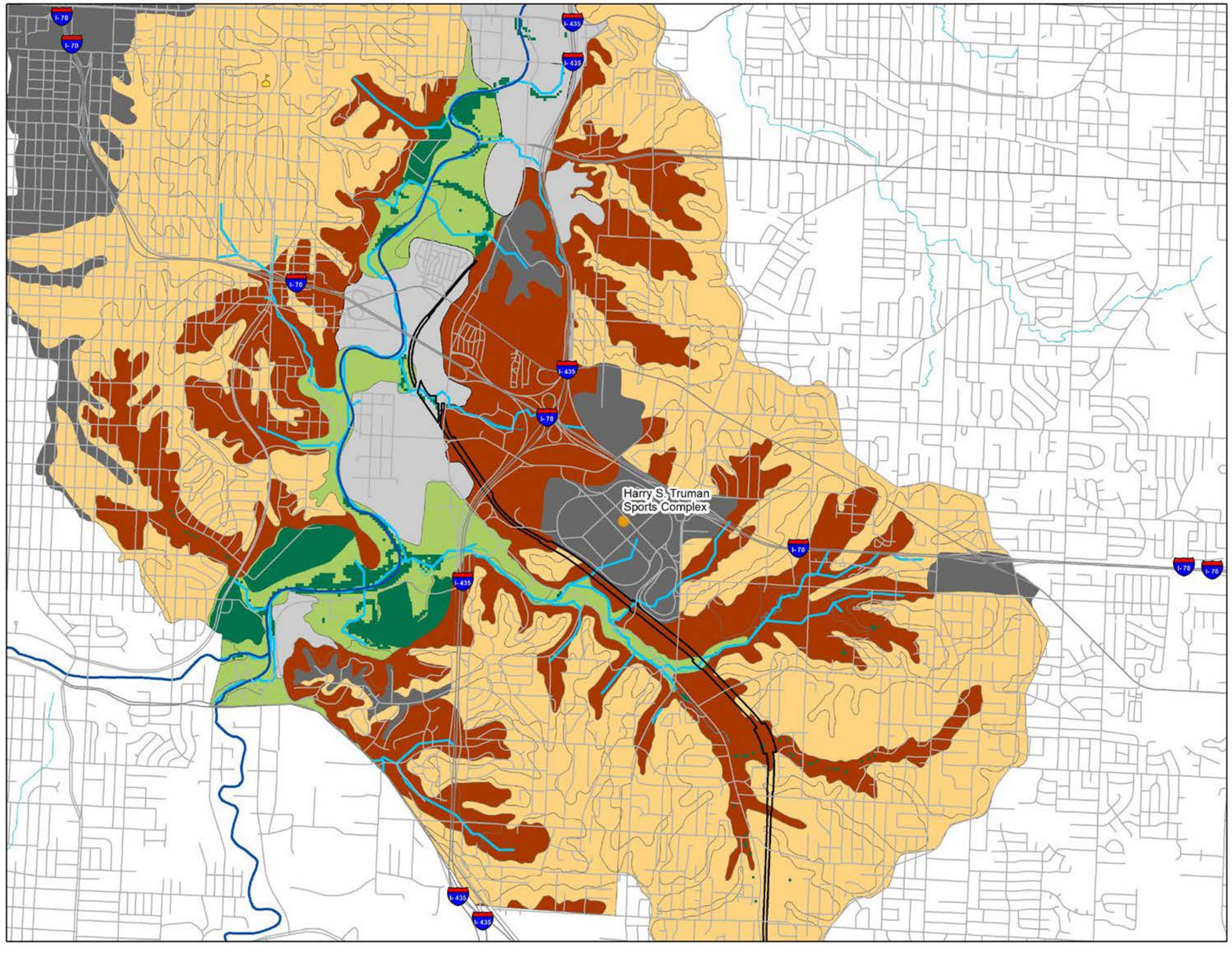
ROCK ISLAND SUB-CORRIDOR

SUB-CORRIDOR SCALE

ECO-HYDRO ZONES

Green infrastructure strategies can be most effective when they are based on an understanding of landscape patterns and how water moves through a site. The Rock Island Corridor project provides an opportunity to demonstrate how geology, soils, topography, and hydrologic processes can be used to classify ecologic-hydrological zones (eco-hydro zones). This analysis was carried out at the sub-watershed scale to best understand how the corridor and associated sites fit within the greater landscape following existing watershed boundaries. Study of specific properties such as topographic position, dominant slope range, hydrologic soil grouping, soil available water capacity, and off-trail soil erodibility, led to the identification of five zones.

The classification of these zones suggests constraints and opportunities for green infrastructure and guides recommended treatments and approaches associated with the Rock Island Corridor and connections. For example, higher elevation areas tend to be best suited for methods that infiltrate flows; dissected rocky slopes are potential locations to slow flows; and lowland floodplains have good potential for restoration. Taking into account eco-hydrologic zones helps water flow paths support a soil's potential for: plant productivity, erosion control, subsurface water storage, and stormwater collection for microbial ecosystems.



Eco- Hydro Zones

Rock Island Corridor - North Stadium

OPPORTUNITY AREA NORTHERN TRAIL SEGMENT

ROCK ISLAND SUB-CORRIDOR

SUB-CORRIDOR SCALE

DESCRIPTION

The northern segment of the Rock Island Corridor presents a unique opportunity to realize a wide range of green infrastructure strategies in ways that connect diverse types of natural areas and typologies. Three areas were examined.

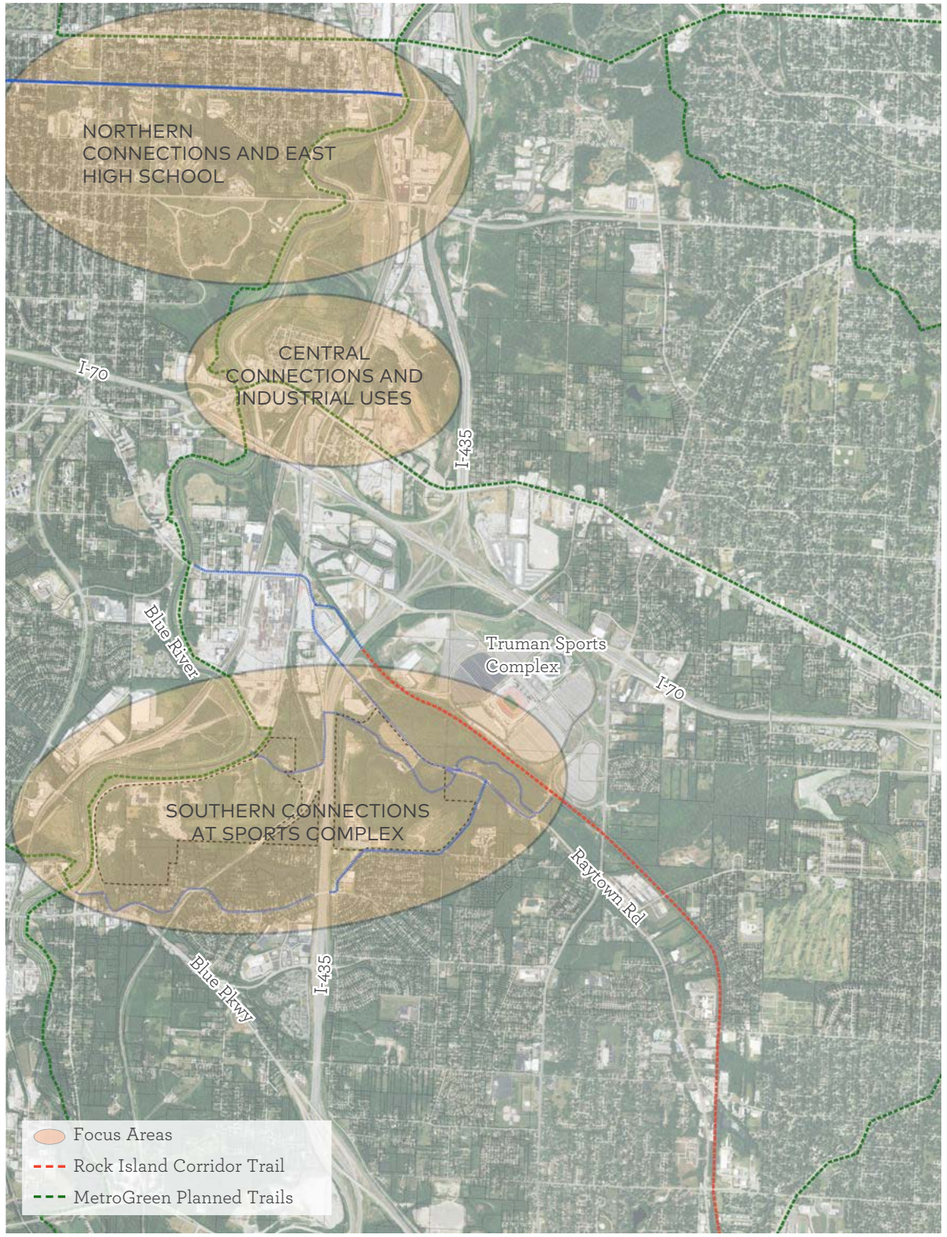
- *Northern Connections and East High School:* This area explores the stacked benefits of extending the Rock Island Trail from the Brush Creek and Blue River confluence to 17th Street, and from the 17th Street Corridor to East High School (and potentially beyond to 18th and Vine). This extension would provide opportunities to implement green infrastructure strategies ranging from streambank stabilization on the Blue River to complete streets improvements on 17th Street, as well as incorporating educational and community engagement programming related to these strategies.
- *Central Connections and Industrial Uses:* The industrial and floodplain areas immediately east of the Blue River provide key opportunities to model brownfield remediation, identify green infrastructure development practices for 21st century industries, and conserve or restore land in the floodplain to its highest and best ecosystem service potential.
- *Southern Connections at Sports Complex:* The Rock Island team has identified areas between the Sports Complex and the confluence of Brush Creek and the Blue River as the most likely route to connect north, rather than the obstacle-laden extension of the Rock Island corridor north of the Sports Complex. This east-west connection has the potential to create green infrastructure implementation projects both within the Municipal Farms area and within the neighborhoods to the south.

At the time of this study, the southern neighborhood area and the green infrastructure opportunities surrounding alternate trail routes connecting the Blue River had the most momentum, accessibility, need and proximity to other high value projects.

LOCAL STAKEHOLDERS

These organizations in this sub-corridor area have the potential to support green infrastructure strategies and benefit from them:

- A.B. May
- City of Kansas City, Missouri (Municipal Farms)
- CultivateKC
- East High School (KCMO School District)
- Eastwood Hills Community Organization
- Eastwood Hills Elementary School (KCMO School District)
- Eastwood Hills Farmers Market
- Hardesty Renaissance
- Heartland Conservation Alliance
- Jackson County
- KC Community Gardens
- KC Native Plant Initiative
- MetroGreen
- Monarchs on the Move
- Paragon Star
- The Giving Grove
- U.S. Army Corps of Engineers

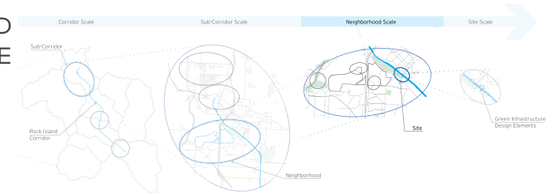


FOCUS AREA

SOUTHERN CONNECTIONS AT SPORTS COMPLEX

NORTHERN TRAIL SEGMENT

NEIGHBORHOOD SCALE



The multi-modal trailhead at the Harry S. Truman Sports Complex is an extremely important piece of the Rock Island Corridor trail. It has the potential to connect the trail to a large number of users at the Sports Complex itself, as well as provide a logical location to extend trail connections to Independence, Missouri to the northeast. It is also unique in that it represents the point at which, due to a number of difficult infrastructure barriers and land use challenges, it becomes increasingly difficult to extend the Rock Island Corridor trail north along the existing rail right-of-way to reach the desired trailhead destination at the intersection of Truman Road and the Blue River. Therefore, an alternative connection to the Blue River trail is needed.

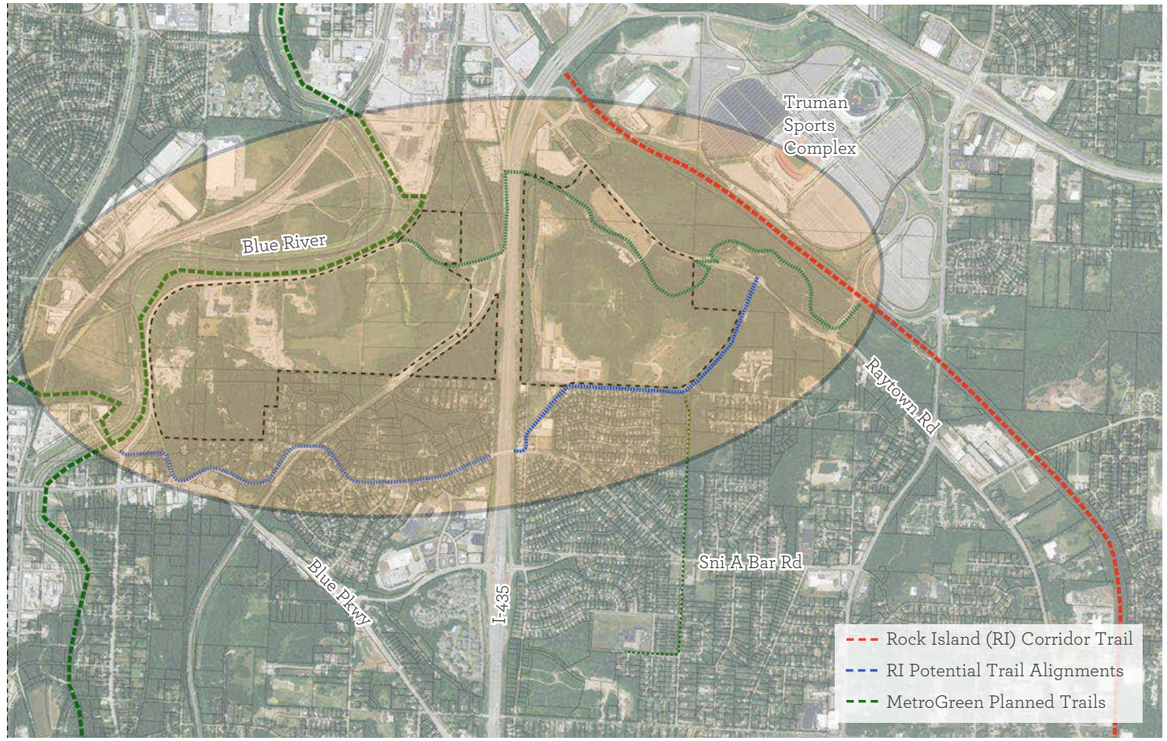
The neighborhood illustrated in the adjacent map provides unique opportunities to solve these connectivity challenges. This can be achieved by creating alternative trail routes that connect underserved neighborhoods and underutilized city-owned land at Municipal Farms to existing and planned trail infrastructure on the Blue River that extend to the desired Truman Road location. These potential routes travel through areas of the city that are highly conducive to green infrastructure strategies, further enhanced by the social and ecological benefits that they can bring. The potential trail and street connections in this area can be envisioned as a series of projects that meet these four green infrastructure objectives:

- Zones for Ecological Conservation and Restoration.
- Secondary Multi-Modal Connections and Access to Natural Systems.
- Education and Outreach Opportunities.
- Zones for Economic Development and Conservation.

NETWORK CONNECTORS

Network Connectors are green infrastructure solutions that address multiple challenges in the highlighted neighborhood and link the areas together to strengthen the watershed-scale system of benefits. In this Rock Island sub-corridor area, the following opportunities are present:

1 Implement education and demonstration hubs of green infrastructure solutions (i.e., parks, schools, community centers, campuses).
2 Remove weed and landscape ordinance barriers to native plantings.
3 Coordinate parks and trail planning that prioritizes habitat connection opportunities.
4 Commit to the management and restoration of stream and river setbacks and habitats in buffer zones.
5 Coordinate with Missouri Department of Transportation and transportation authorities to address and implement landscaping and buffer zones along highways and major roads.
6 Continue long-term investment in transit infrastructure such as bus rapid transit and light rail.
7 Implement green and complete streets, including pedestrian and bicycle infrastructure.
8 Create replicable guidelines to address the connection between industrial uses and the river, with restoration of habitat and public trail connections.
9 Adopt form-based zoning codes and transit-oriented development to enhance and preserve the walkability of commercial centers, mixed-use areas and neighborhoods.
10 Create partnerships and programs for all-ages wellness programs that streamline access to healthcare and spark a culture of health.



11 Employ educational programs targeted towards developers and property managers regarding best practices for construction and development.
12 Create opportunities for increased access to the Middle Blue River that supports community ownership and stewardship.

GREEN INFRASTRUCTURE: 2 - Design Stage

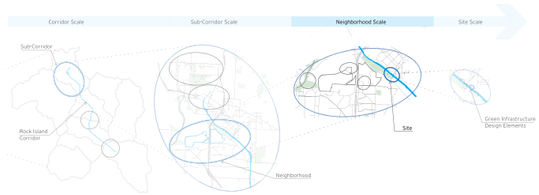
When projects are in a design phase, it is crucial to define the key points of influence within the project. This utilizes the same process as previously described, and focuses on where the most important human and ecological values and needs are in the defined project area first. This helps inform specific design solutions that can be incorporated to adapt the design to greater health, and for greater connectivity to other solutions in the future. This relies on an open and flexible mindset of current and new design team members as well as familiarity with the solutions recommended and their impact on cost, schedule and maintenance.

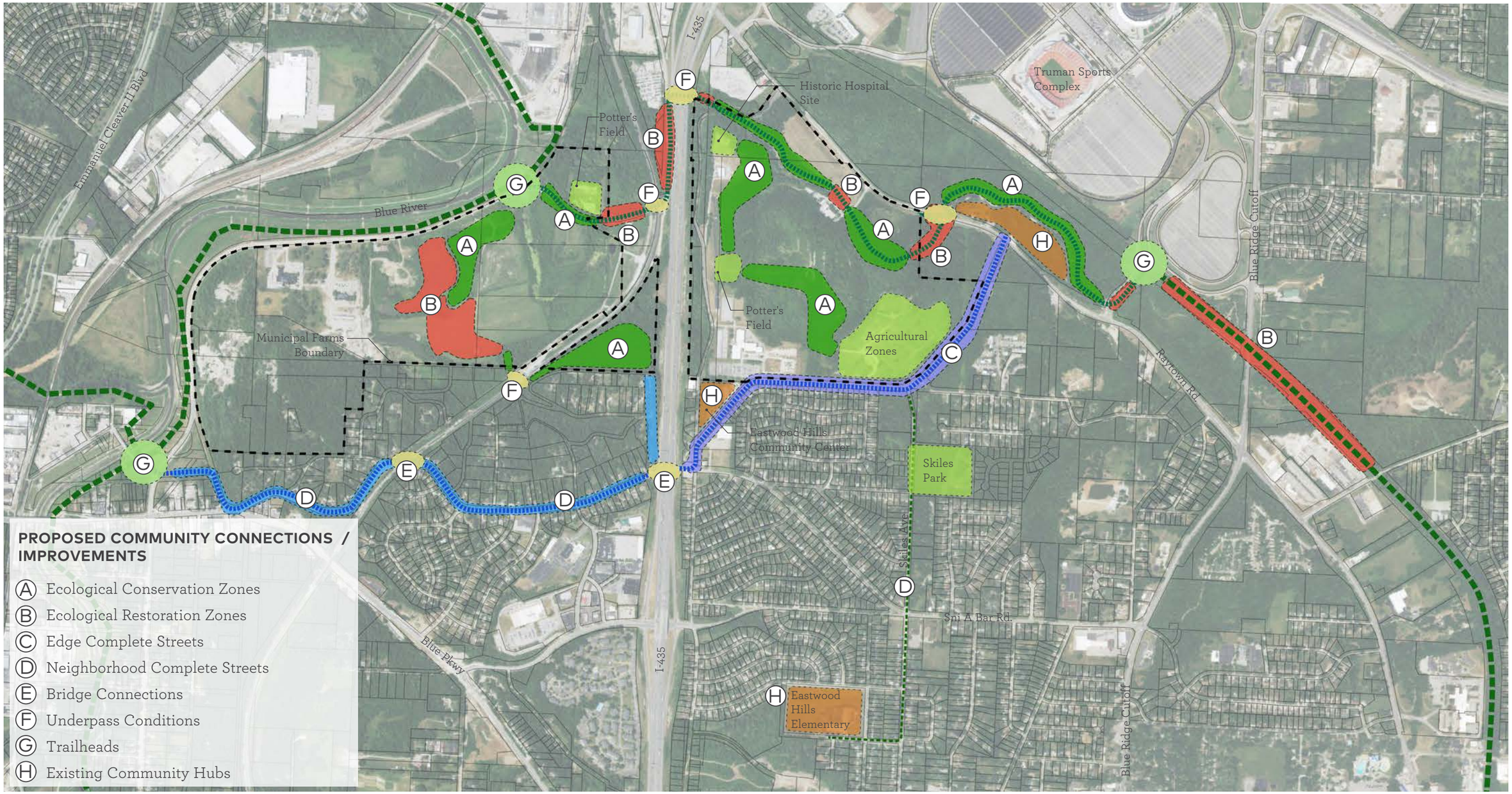
FOCUS AREA

SOUTHERN CONNECTIONS AT SPORTS COMPLEX

NORTHERN TRAIL SEGMENT

NEIGHBORHOOD SCALE





NEIGHBORHOOD COMMUNITY CONNECTIONS

SOUTHERN CONNECTIONS AT SPORTS COMPLEX

Ⓐ ECOLOGICAL CONSERVATION ZONES CONNECTING ROCK ISLAND CORRIDOR AND MUNICIPAL FARM TRAILS

Create multi-modal trails using green infrastructure components to manage stormwater adjoining relatively healthy ecological zones that limit the impact and footprint on ecosystems and habitats. Green infrastructure opportunities include:

- Creation of green trail standards that provide access to rarely experienced natural settings, resources, habitats and historical features while limiting potential damage of these environments.
- Engagement in management and restoration practices, including removal of invasive species, erosion control measures, habitat protection and appropriate green infrastructure strategies for water and ecological management.
- Provision of educational and wayfinding signage that illustrate green infrastructure strategies, historical and ecological features, watershed information, and other significant information.

Refer to detailed Stadium Trailhead study (page 25) for more information on identification of zones and strategies.

PARTNERS

- City of Kansas City, Missouri (Municipal Farm)
- Heartland Conservation Alliance
- Jackson County
- Missouri Department of Conservation
- Missouri Department of Natural Resources

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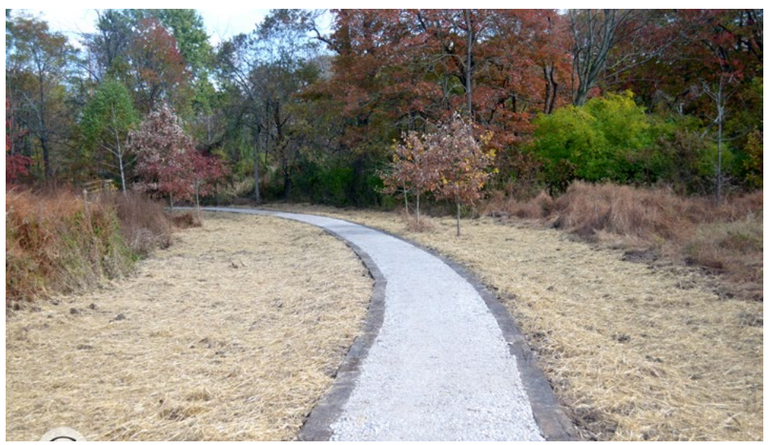

Ⓑ ECOLOGICAL RESTORATION ZONES ON ROCK ISLAND CORRIDOR AND MUNICIPAL FARM TRAILS

Use multi-modal trail design and construction through highly damaged zones as an opportunity to implement restoration strategies and educate the public on the use and effectiveness of these strategies. Green infrastructure opportunities include:

- Erosion control measures, revegetation and reforestation of damaged sites, reconstruction of water channels and re-establishment of critical habitats.
- Provision of educational and wayfinding signage that illustrate green infrastructure strategies and its role in restoration of damaged sites, historical and ecological features, watershed information, and other significant information.

Refer to detailed Stadium Trailhead study for more information on identification of zones and strategies.

PARTNERS

- City of Kansas City, Missouri (Municipal Farm)
- Heartland Conservation Alliance
- KC Native Plant Initiative
- Monarchs on the Move
- Jackson County
- Missouri Department of Conservation
- Missouri Department of Natural Resources

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NEIGHBORHOOD COMMUNITY CONNECTIONS

SOUTHERN CONNECTIONS AT SPORTS COMPLEX

© EDGE COMPLETE STREET PROJECT ON OZARK ROAD

Complete street project to connect Eastwood Community Center with the county parcel at Ozark and Raytown Road intersection. Opportunities include:

- Multi-modal connections to key neighborhood amenities and development zones, and creating connectivity between Eastwood Hills neighborhood and Municipal Farms property with access to community gardens.
- Implementation of green infrastructure streetscape components to capture street runoff, with the potential to utilize larger, city-owned areas outside of street right-of-ways for additional treatment of stormwater (e.g., bioretention and biofiltration).
- Educational opportunities, including signage, visible complete streets green infrastructure strategies that include stormwater treatment, neighborhood training and participation related to street amenities and community gardens.

PARTNERS

- City of Kansas City, Missouri (Public Works)
- Eastwood Hills Community Organization
- KC Community Gardens
- KC Native Plant Initiative

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Ⓓ NEIGHBORHOOD COMPLETE STREET ON SNI-A-BAR ROAD

Complete street project connecting Eastwood Hills Community Center to Blue River Trailhead adjacent to Coal Mine Road. Opportunities include:

- Multi-modal connections to key neighborhood amenities, development zones, and creating stronger connections to neighborhoods to the west and to the MetroGreen trail system along the Blue River.
- Implementation of green infrastructure strategies in a neighborhood setting with limited right-of-way, including curb inlets into bioretention zones.
- Educational opportunities, including signage, visible complete streets green infrastructure strategies, neighborhood training and participation related to street amenities.

PARTNERS

- City of Kansas City, Missouri (Public Works)
- Eastwood Hills Community Organization
- KC Community Gardens
- KC Native Plant Initiative

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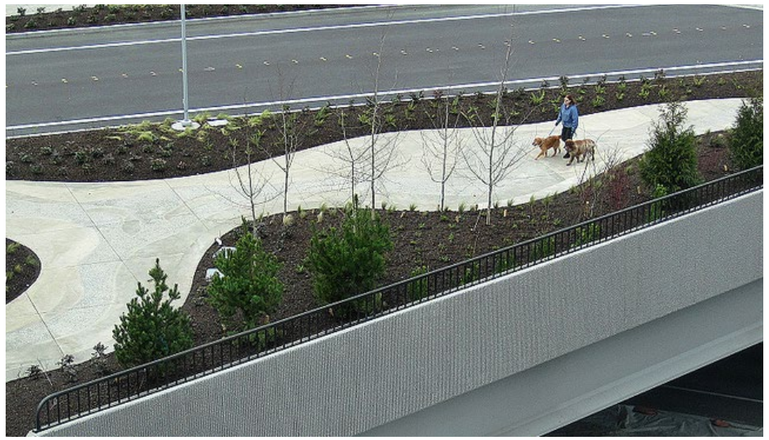
NEIGHBORHOOD COMMUNITY CONNECTIONS

SOUTHERN CONNECTIONS AT SPORTS COMPLEX



Ⓔ BRIDGE CONNECTION OVER INTERSTATE 435

Creation of multi-modal connection over I-435 to connect east and west areas of Eastwood Hills neighborhood. Green infrastructure opportunities include:

- Connectivity on existing vehicular infrastructure.
- Creative stormwater management on existing structures to mitigate infrastructure impact.

PARTNERS

- Missouri Department of Transportation (MoDOT)
- Eastwood Hills Community Organization

WQ WC HAB ED EM HW

Ⓕ UNDERPASS CONDITIONS UNDER I-435 AND RAILROAD BRIDGES

Creation of multi-modal connectivity between the east and west portions of Municipal Farm. Green infrastructure opportunities include:

- Safe connector under I-435, overcoming the connectivity challenges presented by the interstate system. This project can become a model for how to creatively connect areas of the city that have been separated by regional infrastructure.
- Connections under Kansas City Southern bridges.

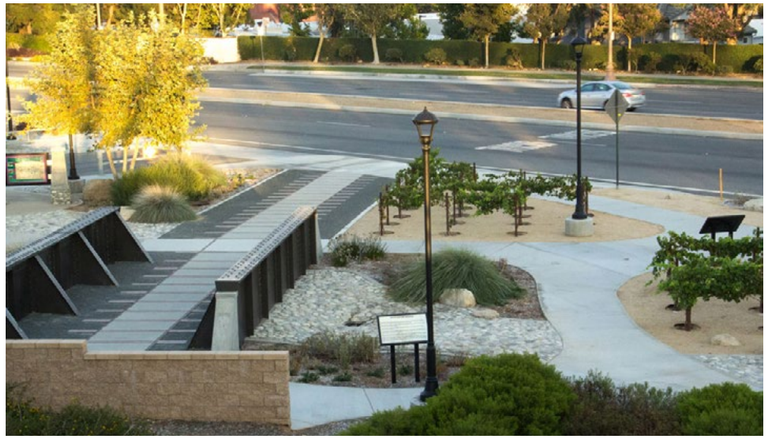
PARTNERS

- Missouri Department of Transportation (MoDOT)
- Kansas City Southern Railroad
- Kansas City Native Plant Initiative

WQ BIO HAB EM HW

NEIGHBORHOOD COMMUNITY CONNECTIONS

SOUTHERN CONNECTIONS AT SPORTS COMPLEX



TRAILHEADS

Designed trailheads as locations for multi-modal access, regional wayfinding, and education about healthy Kansas City watersheds. Green infrastructure strategies include:

- Trailheads as major activity zones with high traffic to maximize public exposure to green infrastructure strategies and benefits.
- Trailheads as a design showcase for green infrastructure strategies, to link concepts with on-the-ground implementation in a highly visible and understandable way.
- Trailheads as a forum for green infrastructure strategies and public health information.
- Trailheads as outdoor education centers for watershed health, native habitat, regional ecosystem connections, active lifestyles and greater Kansas City pride.

PARTNERS

- The Giving Grove
- Jackson County
- Jackson County Sports Complex Authority
- Kansas City, Missouri Health Department

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COMMUNITY HUBS

Community hubs — including Eastwood Hills Community Center, the Jackson County parcel at the intersection of Ozark and Raytown Road, and the Community Garden in Municipal Farms — are critical locations to implement green infrastructure strategies and promote education and community engagement. Green infrastructure strategies include:

- Connections between neighborhoods and food (both food and food education), including Municipal Farms and potential farmers markets in the Eastwood Hills neighborhood and/or at the Sports Complex.

PARTNERS

- KC Community Gardens
- CultivateKC
- The Giving Grove
- Eastwood Hills Elementary School, KCMO School District

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PROJECT SITE ROCK ISLAND STADIUM TRAILHEAD

SOUTHERN CONNECTIONS AT SPORTS COMPLEX

NEIGHBORHOOD SCALE

EXAMPLE PROJECT SITE

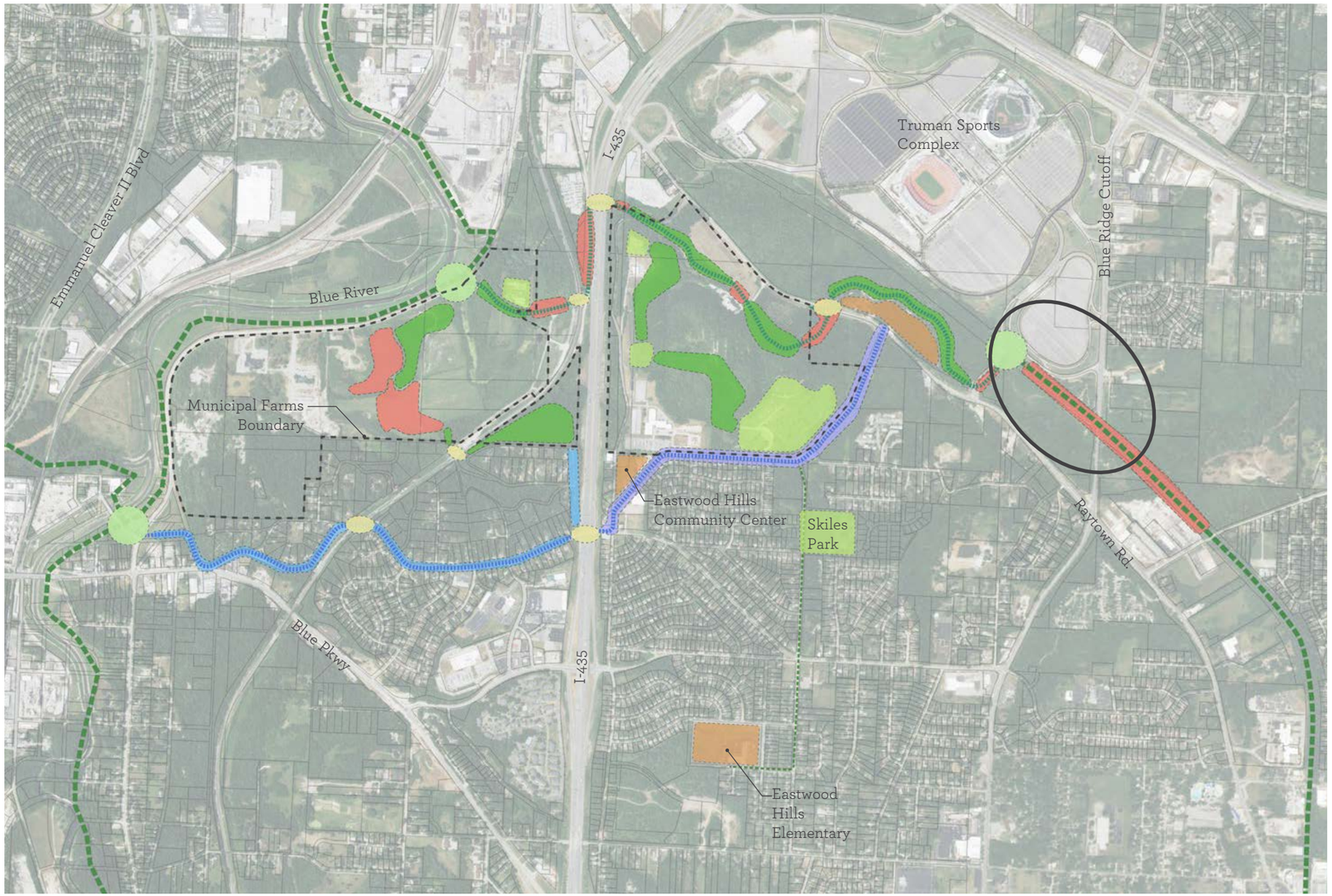
This focus area contains a network of potential Project Sites that can incorporate a series of green infrastructure design elements. For this study, the team explored one such Project Site focused around a potential trailhead near the Sports Complex as indicated on the adjacent map.

The following pages depict types of green infrastructure design elements applied to the Sports Complex trailhead area to help meet overarching goals of protecting and enhancing ecological resources and community experiences.

RESOURCES FOR SUSTAINABLE TRAIL AND GREEN INFRASTRUCTURE

There are a number of excellent existing resources for planning, design and implementation of green infrastructure practices, and sustainable trail design elements including those listed here:

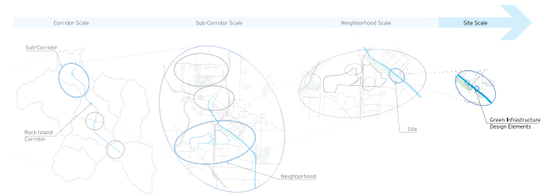
- *Green Infrastructure in Parks Guide*, December 2017 (National Recreation and Parks Association (NRPA)): *http://www.nrpa.org/parks-recreation-magazine/2017/december/nrpas-new-conservation-resource-guide-now-available/*. Note NRPA resources on social equity, facilitation, and funding projects.
- *Guide to Green Infrastructure in Parks*, June 2017 (EPA): *https://www.epa.gov/sites/production/files/2017-05/documents/gi_parksplaybook_2017-05-01_508.pdf*.
- Round Grove Demonstration Project described in *http://jacksongov.org/DocumentCenter/Home/View/679*.
- *Stormwater Management Plan, 2010* (Jackson County), including the Round Grove Demonstration Project: *http://jacksongov.org/DocumentCenter/Home/View/679*.
- *Sustainable Trail Management Resource Guides*, including Objectives and Standards, 2016 (USFS): *https://www.fs.fed.us/recreation/programs/trail-management/strategy/index.shtml*.
- *Sustainable Transportation* (American Society of Landscape Architects (ASLA)): *https://www.asla.org/sustainabletransportation.aspx*.



GREEN INFRASTRUCTURE DESIGN ELEMENTS

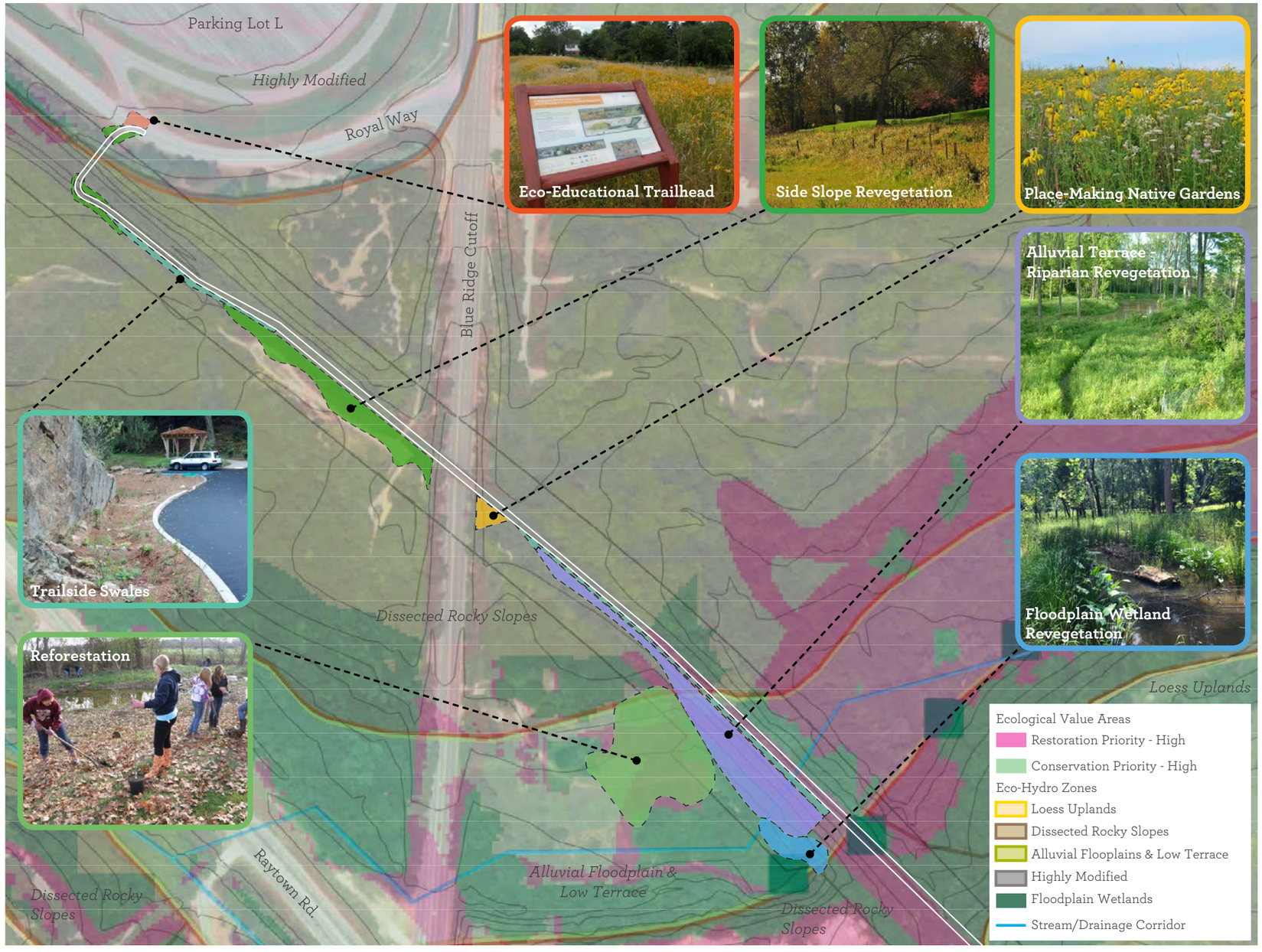
ROCK ISLAND STADIUM TRAILHEAD

SITE SCALE



This conceptual diagram shows how a group of strategies work together to create a network of improvements that can:

- Enhance natural water flow paths for water quality and stormwater management benefits.
- Use native vegetation to improve habitat for pollinators.
- Reforest areas to mitigate project impacts.
- Encourage infiltration at vegetated areas and meadow.
- Enhance protective vegetation (riparian buffer) for habitat and erosion/flood protection benefits.
- Protect existing natural resources.
- Educate about watersheds and health.



GREEN INFRASTRUCTURE:
3 - Maintenance Stage

After the implementation of green infrastructure projects, there are many touchpoints to increase their benefits over time. These living systems require regular stewardship and maintenance that is very different from a more conventional approach to landscape maintenance. An adaptive landscape management plan for the constructed design elements proposed here, in addition to a thoughtful assessment of existing Best Management Practices (BMPs) in the area, can provide annually increasing benefit to the health and biodiversity of the land and waterways, as well as the connectivity and health of adjacent neighborhoods. Successful stewardship and maintenance of these green infrastructure projects also provide a how-to model for even more projects to be initiated and developed throughout the Rock Island Corridor.

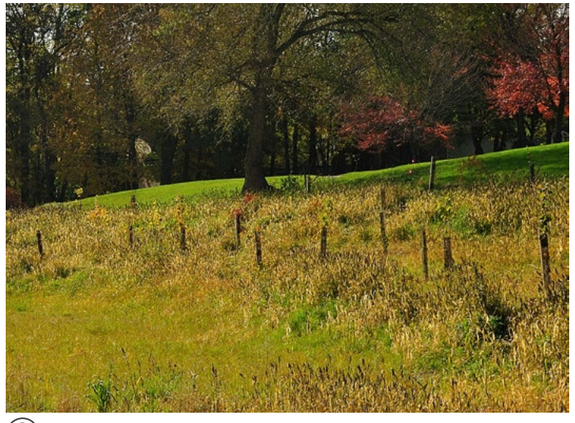
GREEN INFRASTRUCTURE DESIGN ELEMENTS

ROCK ISLAND STADIUM TRAILHEAD

NOTE: There are numerous guides available to assist with development and implementation of design elements, a small sampling of which are included here.

① ECO-EDUCATIONAL TRAILHEAD

See "Ride the Shed": describes watersheds, human influences, watershed zones, and the need for stewardship. Watershed education resources: *http://www.marc.org/Environment/Water-Resources/Reports-and-Publications/Educational-Brochures*.



② SIDE SLOPE REVEGETATION

See Kansas Native Plant Society resources: *http://www.kansasnativeplantsociety.org/resources.php*.

③ TRAILSIDE SWALES

Minimize concentrated runoff with vegetated filter strip and temporary dams in select locations. See also Kansas Native Plant Society resources.

④ NATURALLY-FORMED TERRACE - PROTECTIVE REVEGETATION

Create and maintain stream buffer protection.

⑤ REFORESTATION

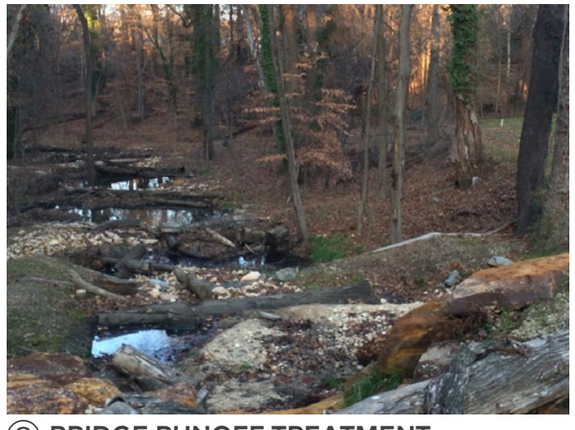
Collaborate with school programs to engage volunteers. See also Kansas Forest Service's Conservation Tree Planting Program: *http://www.kansasforests.org/conservation_trees/*.

⑥ PLACE-MAKING NATIVE GARDENS

Focus on prairie pollinator habitat. Refer to: *https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/plantsanimals/pollinate/?cid=nrcseprd402207*.

⑦ FLOODPLAIN WETLAND REVEGETATION

Regrade to expand floodplain width with native revegetation. See: *https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/water/manage/restoration/?cid=stelprdb1247762*.

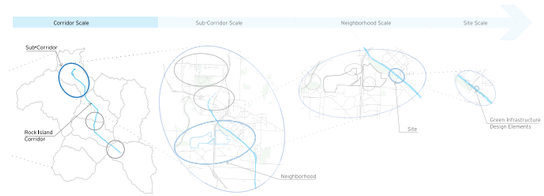


⑧ BRIDGE RUNOFF TREATMENT

Encourage regenerative stormwater management.

SUMMARY
ROCK ISLAND CORRIDOR

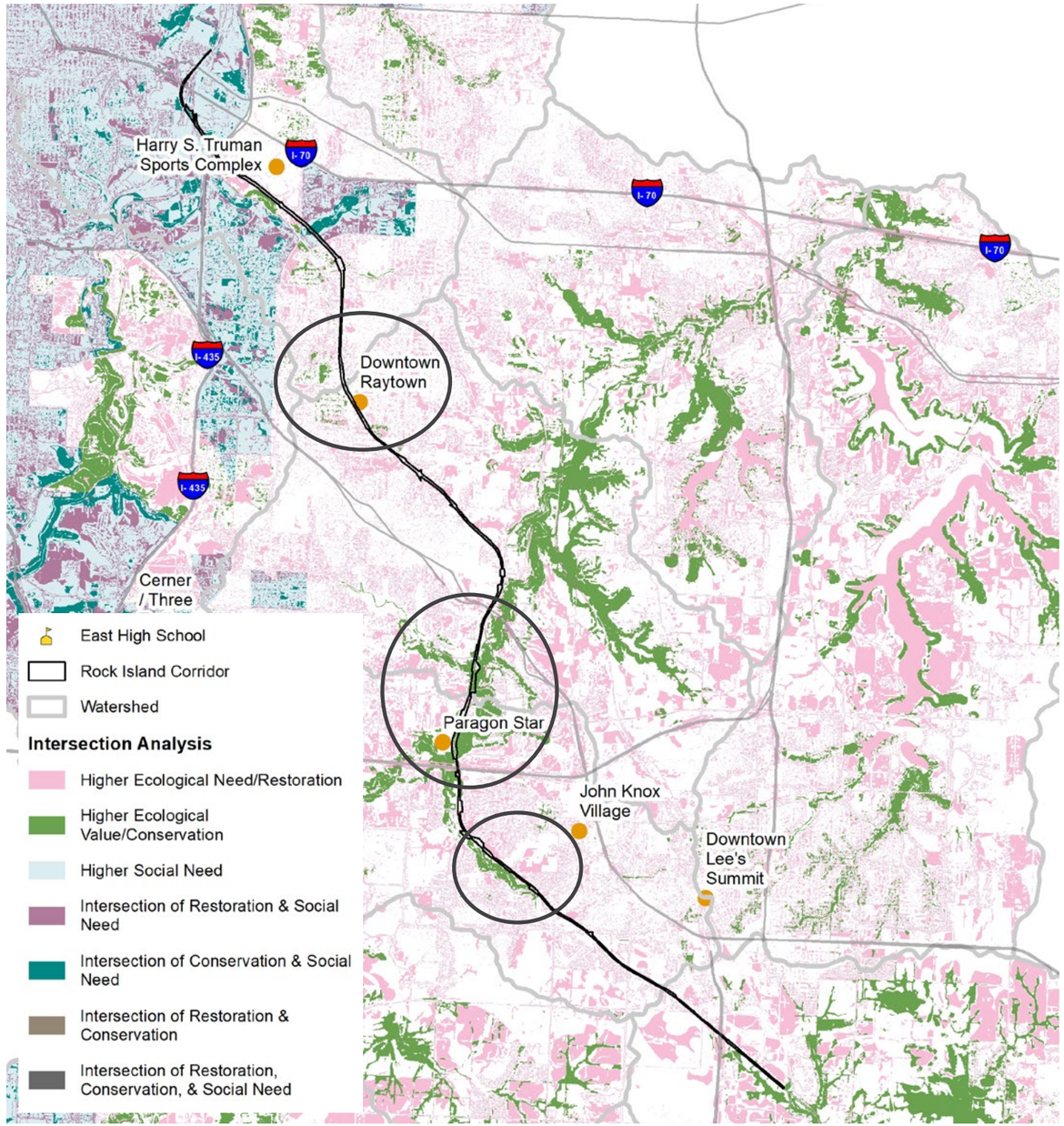
CORRIDOR SCALE



This Playbook followed a process based on watershed-based mapping and stakeholder engagement to identify multi-benefit opportunity areas along different segments of the Rock Island Corridor trail. In tandem, green infrastructure strategies and potential partners were identified. The preceding pages focused on the northern segment of the trail. However, throughout the entire corridor there are multiple hotspots identified through mapping that also have high potential for green infrastructure. The intersection analysis map (shown on the right) depicts areas where ecological value/need intersect with social need. This can be used as a tool to identify additional areas to study for green infrastructure implementation. The following are a few of the other hotspots that could be explored using the replicable process described in the Playbook.

- The zone between the Sports Complex and Raytown, Missouri has a number of access points as well as areas of environmental concern near wetlands. This is a prime area for considering ecological remediation strategies and educational signage, though it is not an area of high social need.
- As the corridor turns south at South Noland Road, it curves around the quarry site. It is not known how soon the quarry site will become dormant and transition to County development opportunities. There are major contamination sites on the trail, on either side of the quarry. This is also an intersection area with high ecological value and need in parallel to the Rock Island Corridor and Little Blue River. Therefore, this is an important zone of the trail to consider for networked strategies of restoration, green infrastructure components, and education as the trail meets the Paragon Star development site and trailhead at I-470.
- The trail continues south and east through Lee's Summit and presents opportunities to access the trail at several at-grade crossings as well as a major trailhead. While this is not in an area of high social need, much of this section of the trail has high ecological value, and the potential to connect older adults to the trail and through future County residential developments (Winterset subdivision and John Knox Village retirement community, for example).

Green infrastructure solutions are those that simultaneously help to alleviate the pressures of wet-weather events as well as provide important amenities to local communities. In addition to providing the ecosystem services of cleaning the air and slowing/cleaning water, living systems also improve the economic value of our built environment and connect people to nature and to one another. Pathways for water are also pathways for pedestrians and cyclists, and provide healthy lifestyle and mobility opportunities that are needed for the health and resiliency of our community systems. The Rock Island Corridor trail has the potential to integrate green infrastructure with multi-benefit solutions along its entire length, and the process demonstrated in this Playbook can and should be used to identify additional sites with project momentum, identifiable champions, access, need and proximity for maximum replicability.



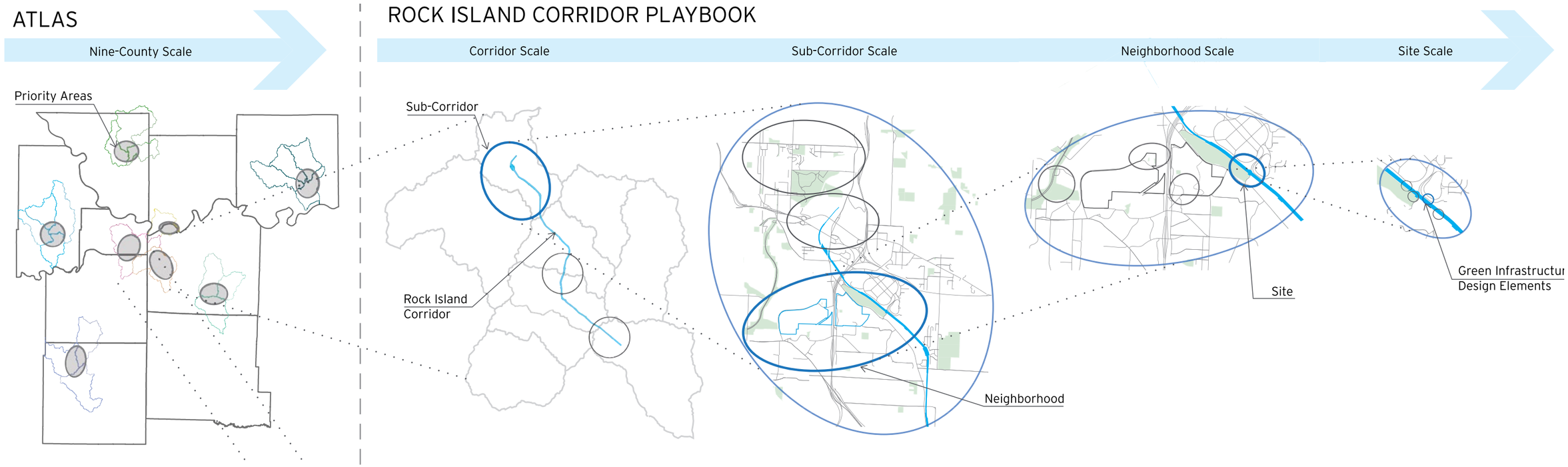
APPENDIX

STUDY OF SCALES

GREEN INFRASTRUCTURE PLAYBOOK

SCALE DIAGRAM

Below is the scale diagram for the Rock Island Corridor, and on the following page is a glossary describing the scales and terms used throughout the Playbook.



GLOSSARY OF TERMS (ordered by scale)

Atlas: A set of maps that help identify priority areas for integrated green infrastructure strategies at a regional scale.

Playbook: A framework that demonstrates replicable approaches for implementing green infrastructure for ecological and socioeconomic benefits using nested scales of analysis.

Priority Area: Based on a watershed-scale analysis, these locations are selected for further study based on the established criteria of momentum, need, access and proximity set forth in Phase 1 of the Green Infrastructure Framework.

Watershed: Natural drainage area boundaries developed by the U.S. Geological Survey are the foundation of the Playbook because they group priority areas and partners based on ecological and hydrological relationships that go beyond municipal/political boundaries. In the first map of each playbook, multiple watershed boundaries are illustrated.

Corridor Scale: For the Rock Island playbook, this is the largest scale within multiple watersheds that identifies a common focus for infrastructure improvements along a common transit zone.

Opportunity Area: Within each priority area of a watershed, there are often multiple clusters of opportunities that merit further analysis to identify a starting point that will have the greatest potential for immediate impact. For the Rock Island playbook, this translates to the scale of a transit corridor. For the Shawnee Mission School District, this translates to the school district boundaries.

Sub-Corridor Scale: This scale is a more manageable area to comprehend the benefits of integrated green infrastructure within the context of specific neighborhoods and partnerships with local stakeholders.

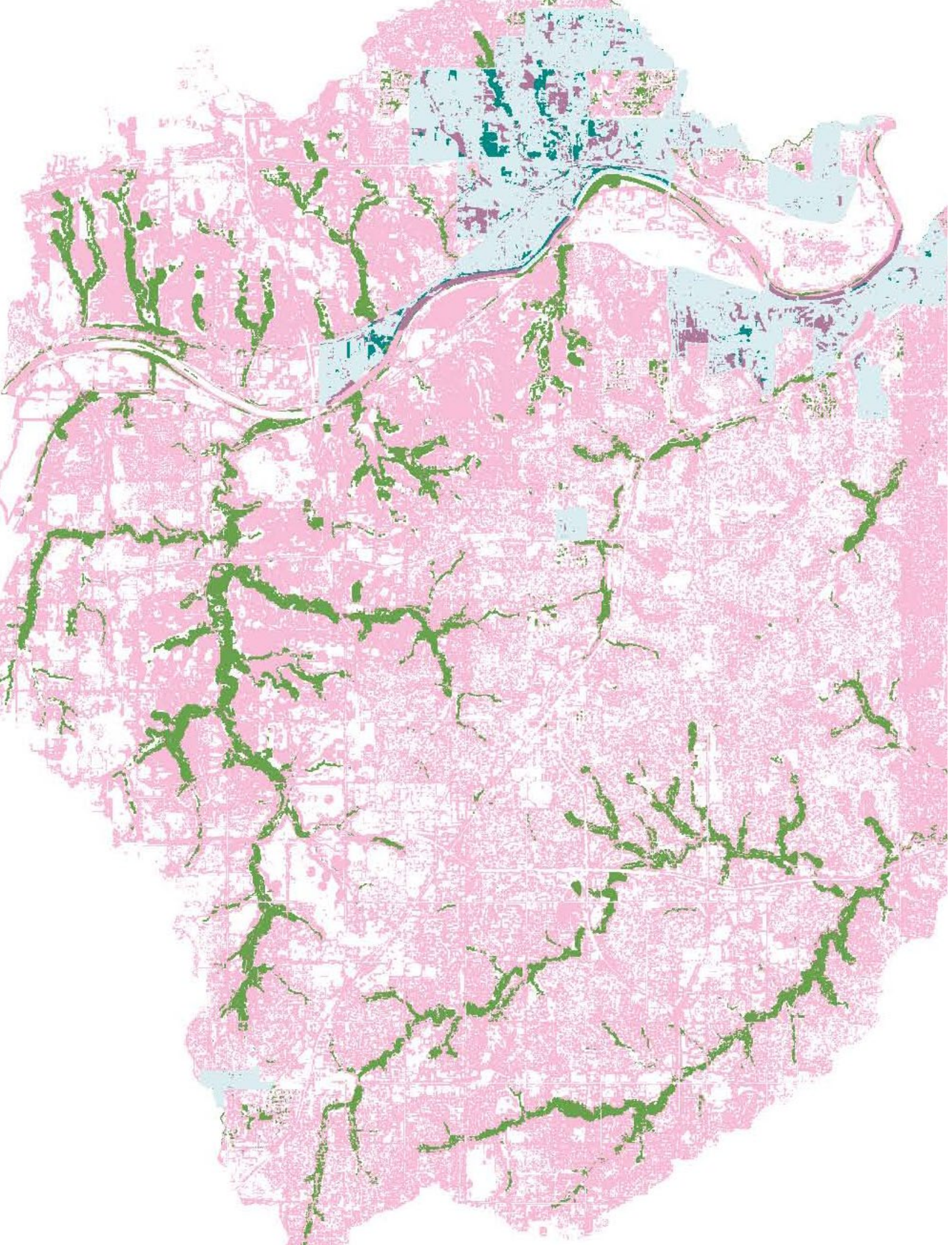
School District Scale: For the Shawnee Mission playbook, this scale allows the school administration to understand the breadth of green infrastructure implementation across their property holdings and the municipalities within which they operate.

Focus Area: Within an opportunity area, this is the neighborhood or community-scale area that is used to establish connections between projects and to develop recommendations for implementable site-specific green infrastructure strategies. Both the Rock Island and Shawnee Mission School District playbooks illustrate this scale through the context of adjacent neighborhoods.

Network Connectors: These are a list of green infrastructure solutions that work together within an area to address multiple challenges and link smaller project sites together to strengthen the network of watershed-scale benefits.

Neighborhood Scale: The neighborhood scale is critical to green infrastructure implementation because of the engagement required of local landowners and stakeholder organizations to steward the work and champion the benefits for people and nature.

Site Scale: Within a focus area or neighborhood, this scale is where on-the-ground implementation occurs for fundable projects that address site-specific needs while contributing to the integrated green infrastructure approach that is envisioned for all other scales.



GEOGRAPHIC DATA

INTRODUCTION

This Appendix contains maps with geographic information for the Rock Island Corridor project. This data was used, in conjunction with stakeholder interviews and site visits, to produce the Playbook guidance for this project. While this data is not an empirically comprehensive process of analysis, these inputs result in the design of integrated strategies that are well-suited to the place and people, and have support from local organizations for implementation.

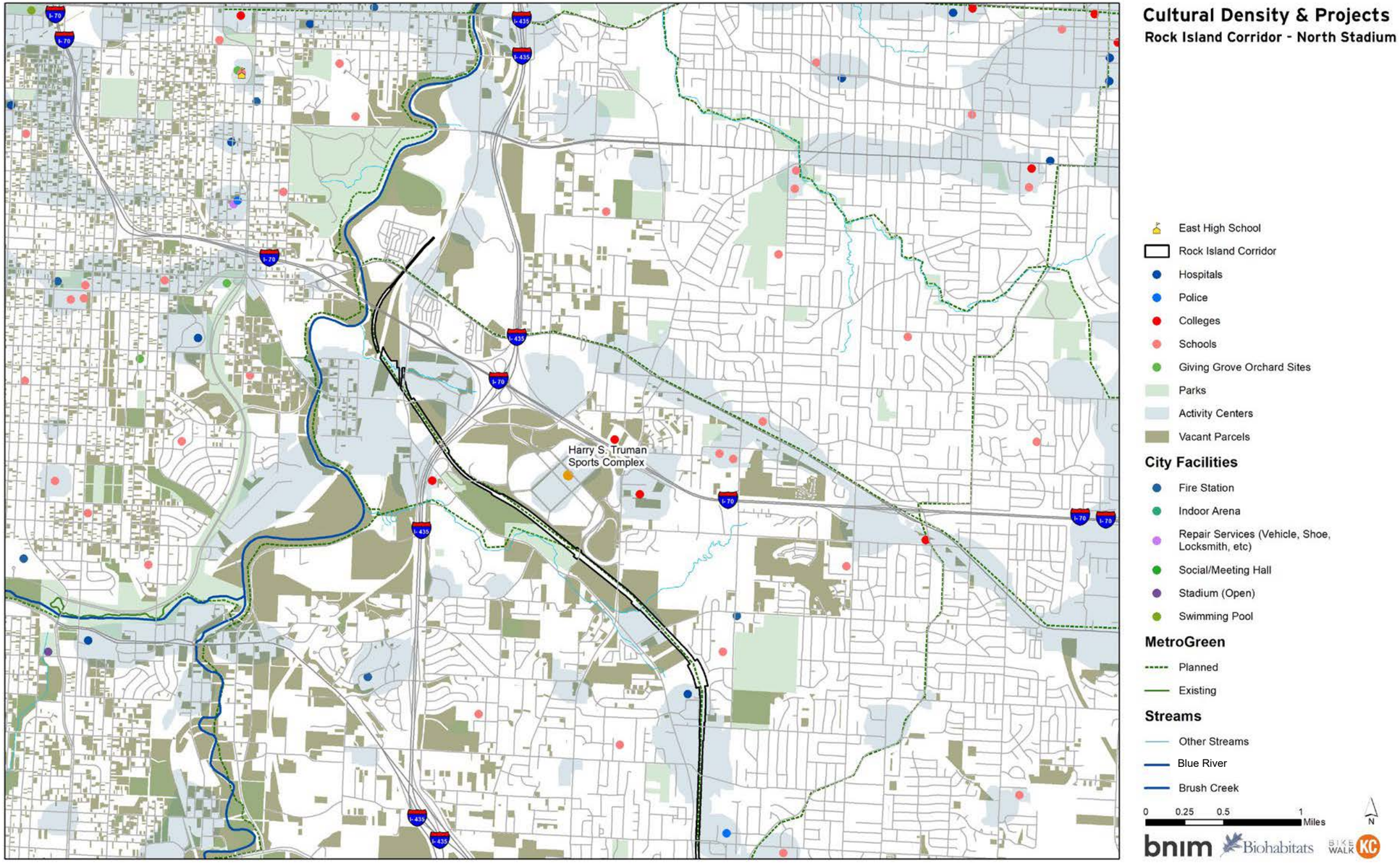
CULTURAL DENSITY AND PROJECTS

ROCK ISLAND SUB-CORRIDOR

SUB-CORRIDOR SCALE

Within communities, civic and cultural sites are public places where people convene and where services are provided. The public access, service functions and cultural relevance of these sites provide opportunities for communities to engage, understand and benefit from green infrastructure.

While public sites (schools and hospitals, for example) serve community needs that are also relevant for green infrastructure (education and health, for example), it is not necessarily the case that interventions on these civic sites will be most impactful. Reviewing green infrastructure needs and opportunities in the broader context of ecological and social needs is critical for each area of intervention.



Data Sources: *MARC, KCMO Parcel Viewer*

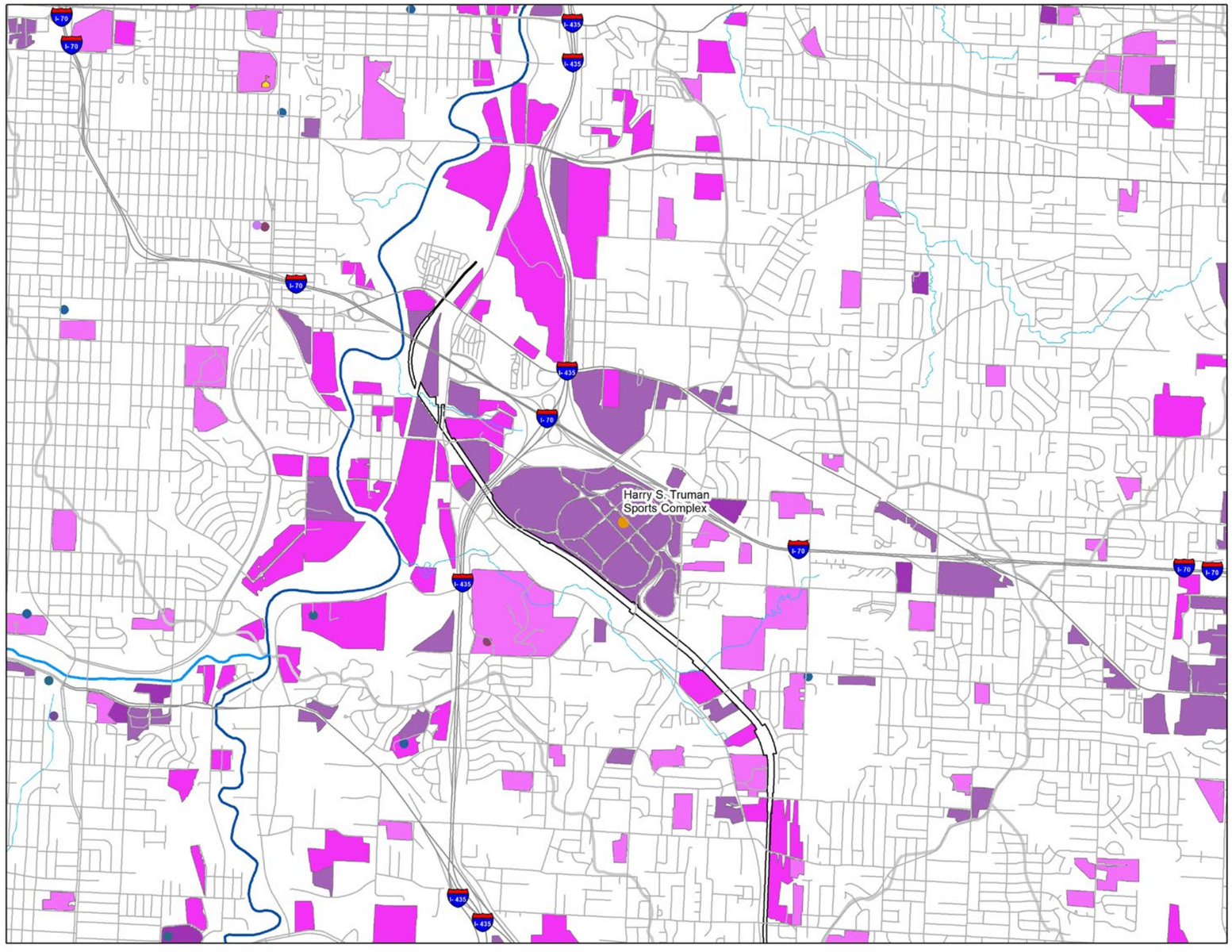
LARGE LAND HOLDERS

ROCK ISLAND SUB-CORRIDOR

SUB-CORRIDOR SCALE

Sites with larger acreage are critical to review as they have the potential for green infrastructure strategies that can have a larger impact on the overall watershed system. Knowing the different land use types can also influence what type of green infrastructure strategies should be implemented.

This data is based on land use information and requires verification when sites are identified.



Large Land Holders

Rock Island Corridor - North Stadium

East High School
Rock Island Corridor
Watershed

City Facilities

College/University
Fire Station
Indoor Arena
Manufacturing/Industrial Plant
Non-Refrigerated Warehouse
Office
Police Station
Repair Services (Vehicle, Shoe, Locksmith, etc)
Stadium (Open)

Large Land Holders - Greater than 5 acres

Commercial
Indust./Bus. Park
Mixed Use
Office
Public/Semipublic

Streams

Other Streams
Blue River
Brush Creek

0 0.25 0.5 1 Miles

N

bnim Biohabitats BIKE WALK KC

Data Sources: *MARC, KCMO Parcel Viewer*

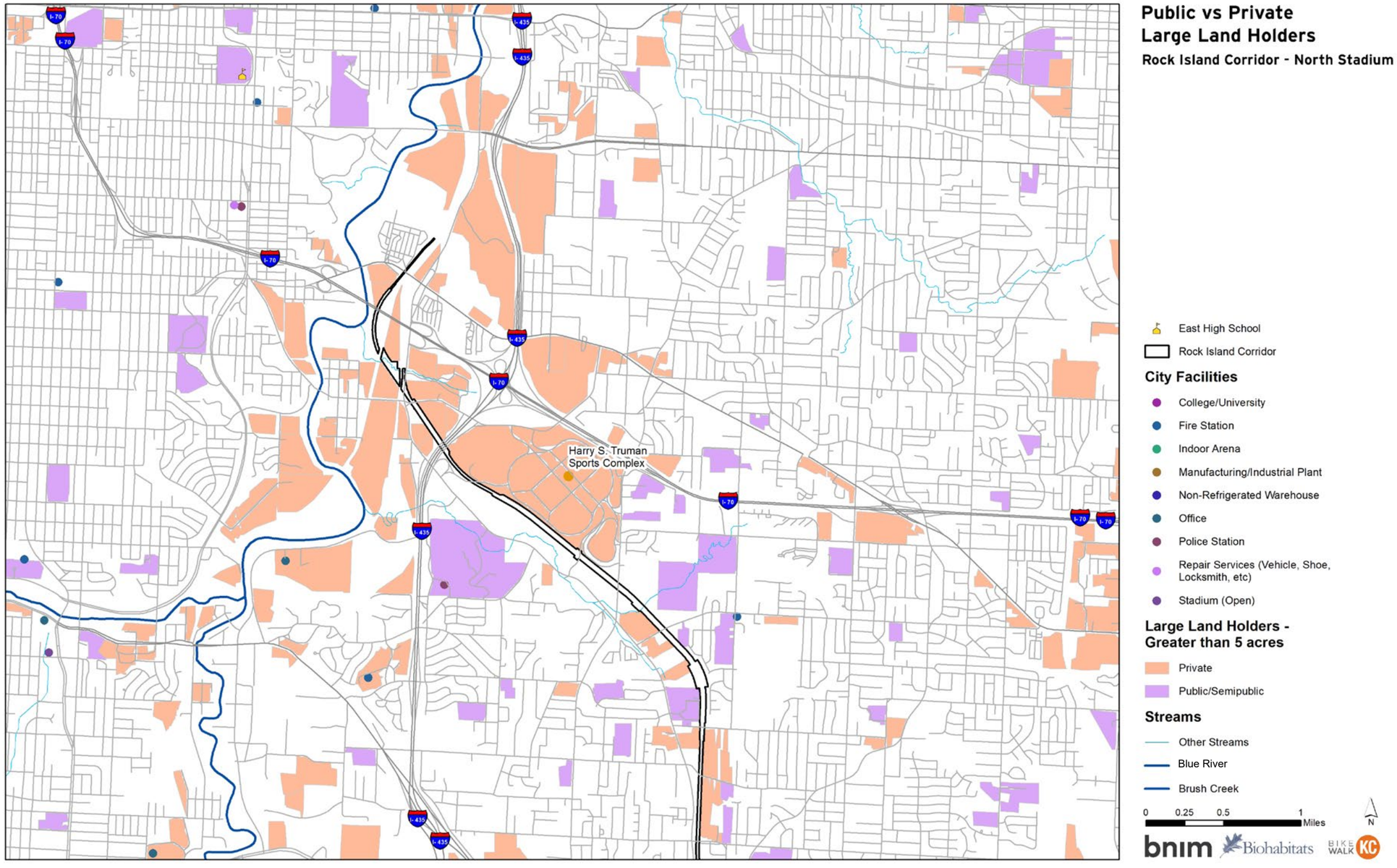
LARGE LAND HOLDERS - PUBLIC / PRIVATE

ROCK ISLAND SUB-CORRIDOR

SUB-CORRIDOR SCALE

When looking at sites for green infrastructure opportunities, it is important to look back on the criteria of momentum, need, proximity and access. Understanding ownership and status of publicly- or privately-owned property can help to identify sites that may have more momentum or may be more implementable in the coming years compared to others. Large acreage can create potential for large impacts to the watershed.

This data is based on land use information, so ownership requires verification when sites are identified.



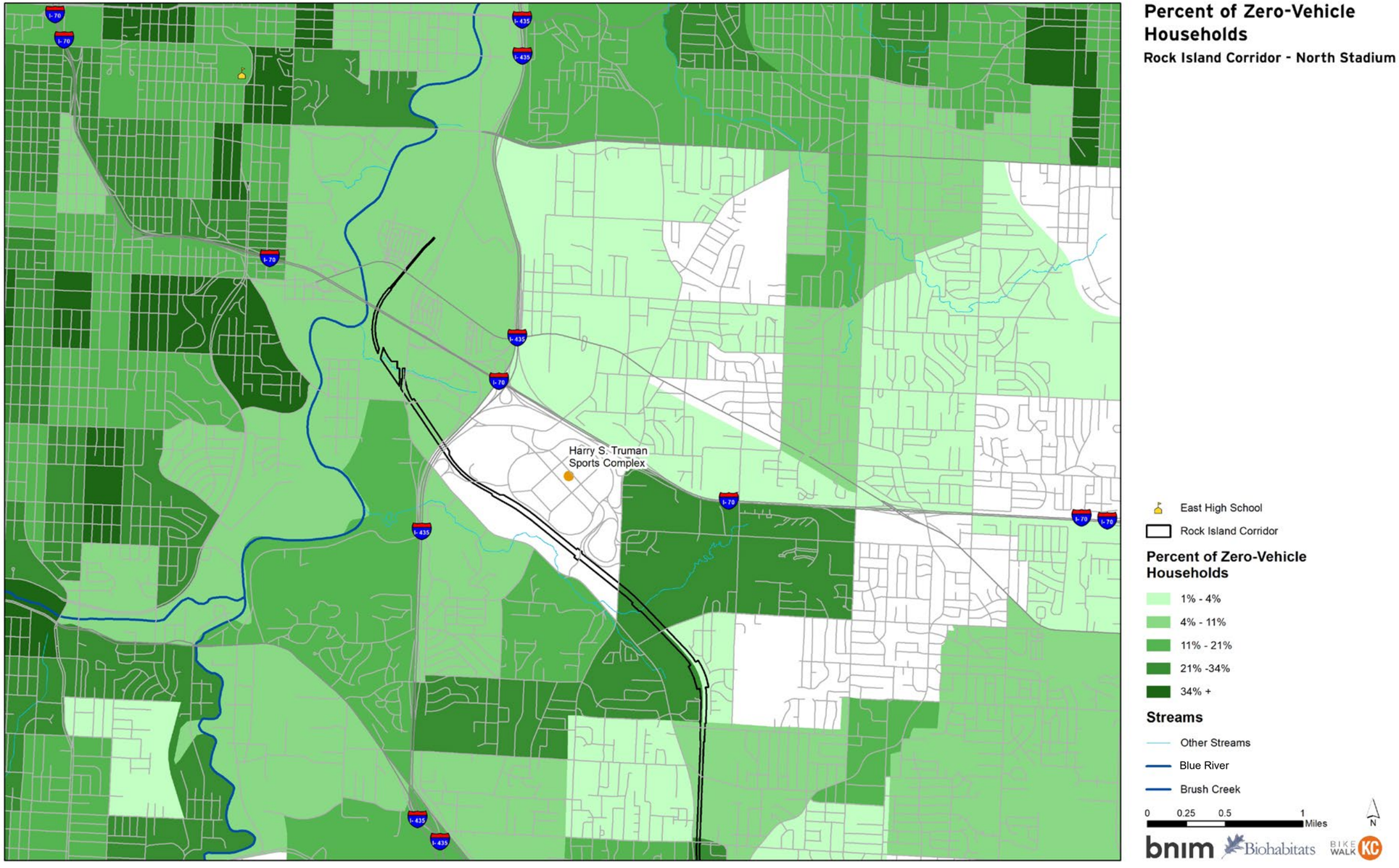
Data Sources: *MARC, KCMO Parcel Viewer*

ZERO-VEHICLE HOUSEHOLDS

ROCK ISLAND SUB-CORRIDOR

SUB-CORRIDOR SCALE

Zero-vehicle households were mapped as one component of social need. Trail projects of all types, and the Rock Island Corridor in particular, are important components of green infrastructure for a variety of reasons, and in large part because they provide transportation alternatives to the automobile, with all of the environmental impacts that automobile use entails. Zero-vehicle households are those who use alternative transportation modes by necessity rather than by choice, and so represent an important consideration when identifying trail and green infrastructure opportunities.



Data Sources: *ACS 2015 5-year Block Group, MARC, KCMO Parcel Viewer*

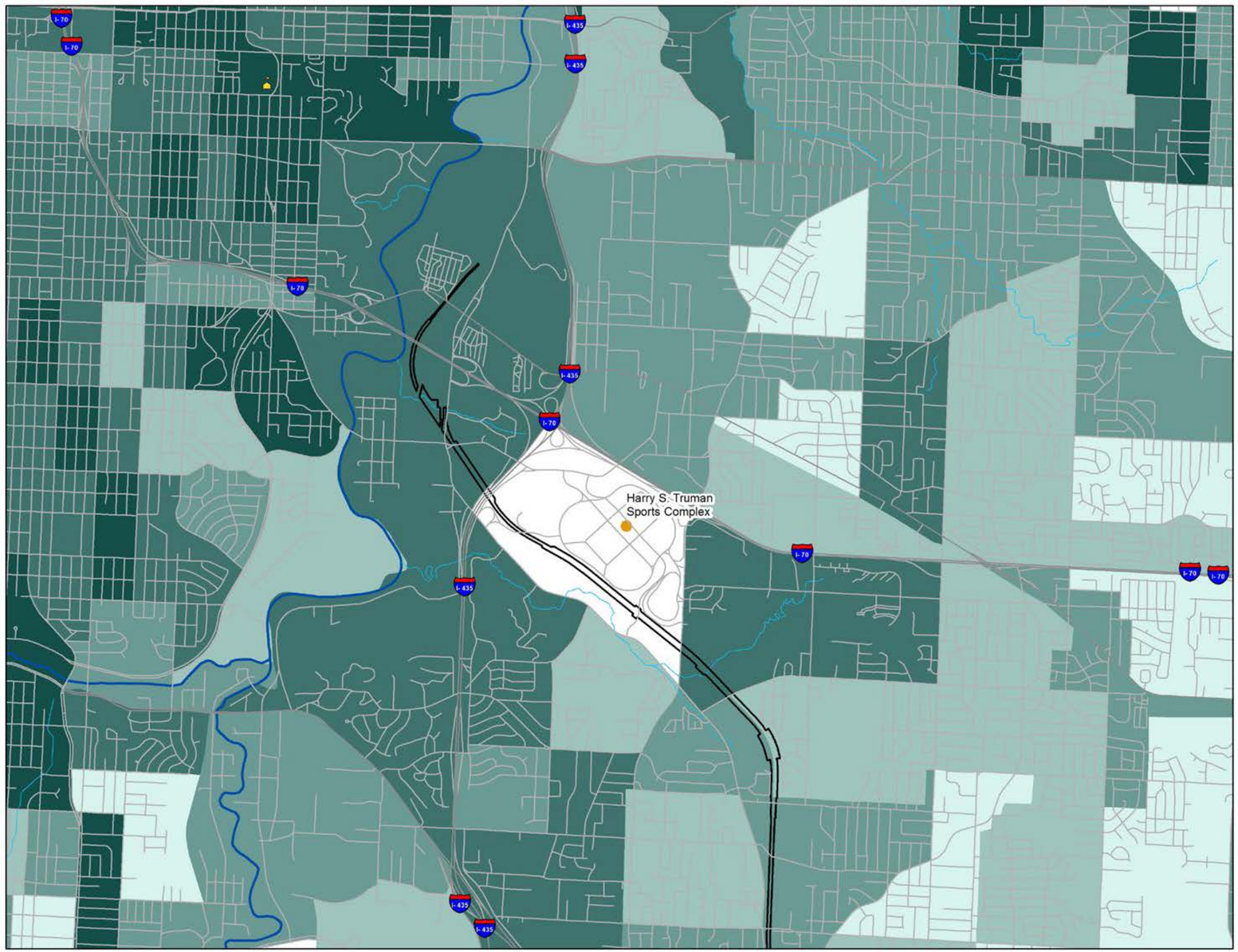
PERCENT OF POPULATION WITH INCOME BELOW POVERTY

ROCK ISLAND SUB-CORRIDOR

SUB-CORRIDOR SCALE

Poverty was mapped as one component of social need. Areas of poverty are places of particular vulnerability, where health, education, access to opportunity and equity needs are pronounced.

The white area around the Truman Sports Complex has no population contributing to this data.



Percent of Population with Income Below Poverty
Rock Island Corridor - North Stadium

East High School
Rock Island Corridor

Percent of Population with Income Below Poverty
1% - 6%
6% - 15%
15% - 27%
27% - 42%
42% +

Streams
Other Streams
Blue River
Brush Creek

0 0.25 0.5 1 Miles

N

bnim Biohabitats BIKE WALK KC

Data Sources: *ACS 2015 5-year Block Group, MARC, KCMO Parcel Viewer*

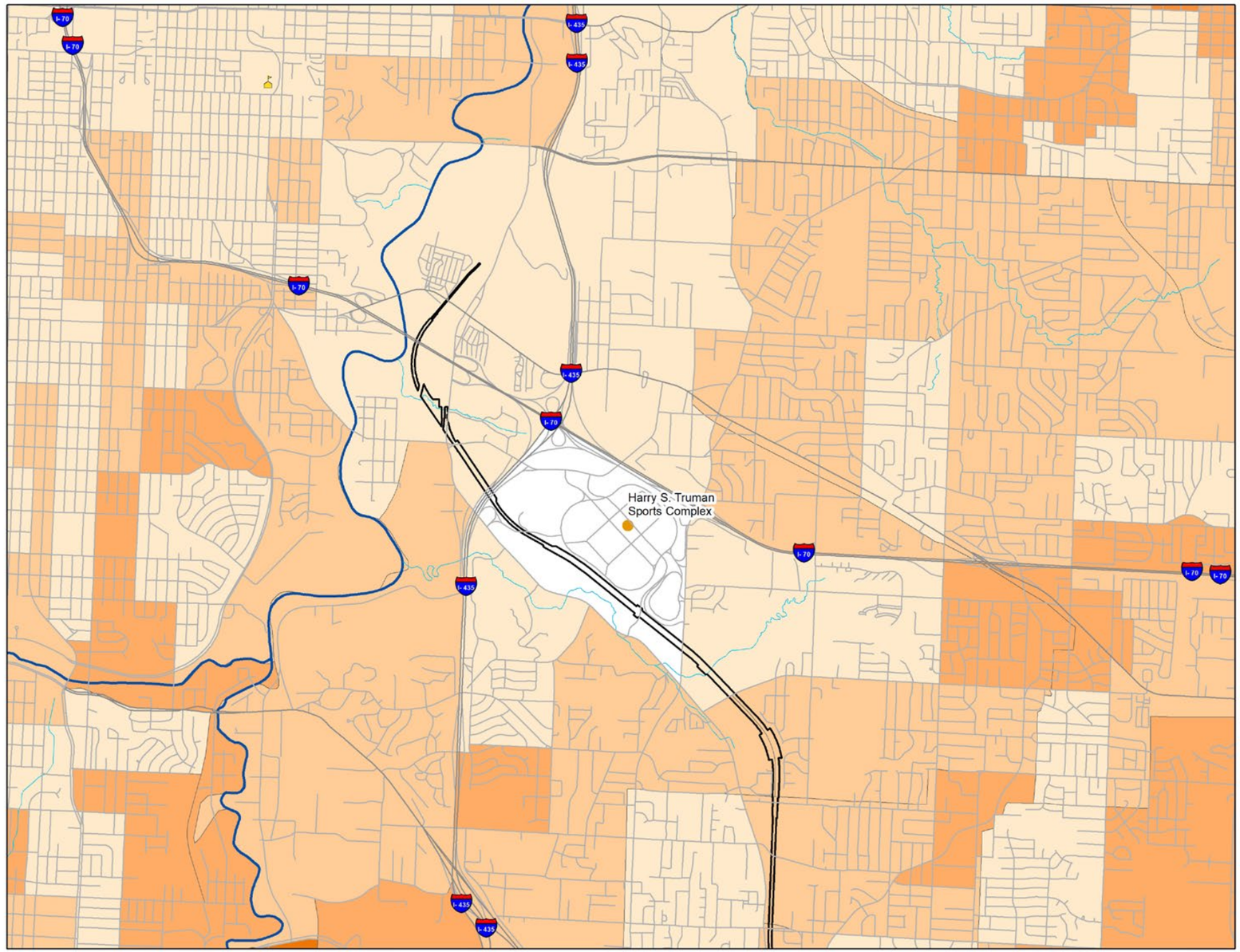
EDUCATIONAL ATTAINMENT

ROCK ISLAND SUB-CORRIDOR

SUB-CORRIDOR SCALE

Educational attainment was mapped as one component of social need. Areas of low educational attainment are places of particular vulnerability, where health, education, access to opportunity and equity needs are pronounced.

The white area around the Truman Sports Complex has no population contributing to this data.



Percent with Associate Degree of Higher

Rock Island Corridor - North Stadium

Data Sources: *ACS 2015 5-year Block Group, MARC, KCMO Parcel Viewer*

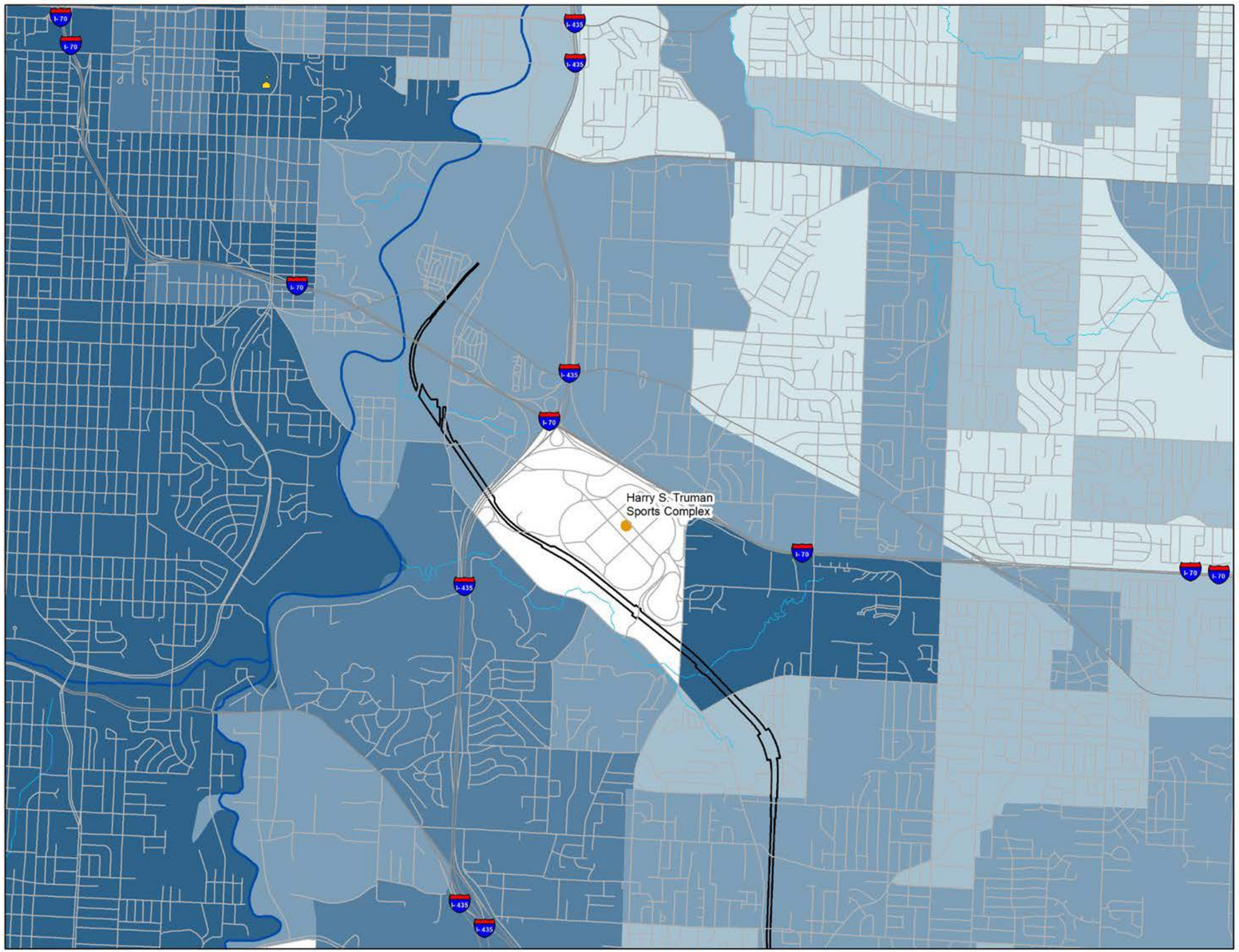
MINORITY POPULATION

ROCK ISLAND SUB-CORRIDOR

SUB-CORRIDOR SCALE

Minority populations were mapped as one component of social need. Historically, minority communities are places of particular vulnerability, where health, education, access to opportunity and equity needs are pronounced.

The white area around the Truman Sports Complex has no population contributing to this data.



Percent Minority Population

Rock Island Corridor - North Stadium

East High School

Rock Island Corridor

Percent of Minority Population

1% - 12%

12% - 27%

27% - 50%

50% - 76%

76% +

Streams

Other Streams

Blue River

Brush Creek

0 0.25 0.5 1 Miles

N

bnim Biohabitats BIKE WALK KC

Data Sources: *ACS 2015 5-year Block Group, MARC, KCMO Parcel Viewer*

SOCIAL-NEED INTERSECTION ANALYSIS

ROCK ISLAND SUB-CORRIDOR

SUB-CORRIDOR SCALE

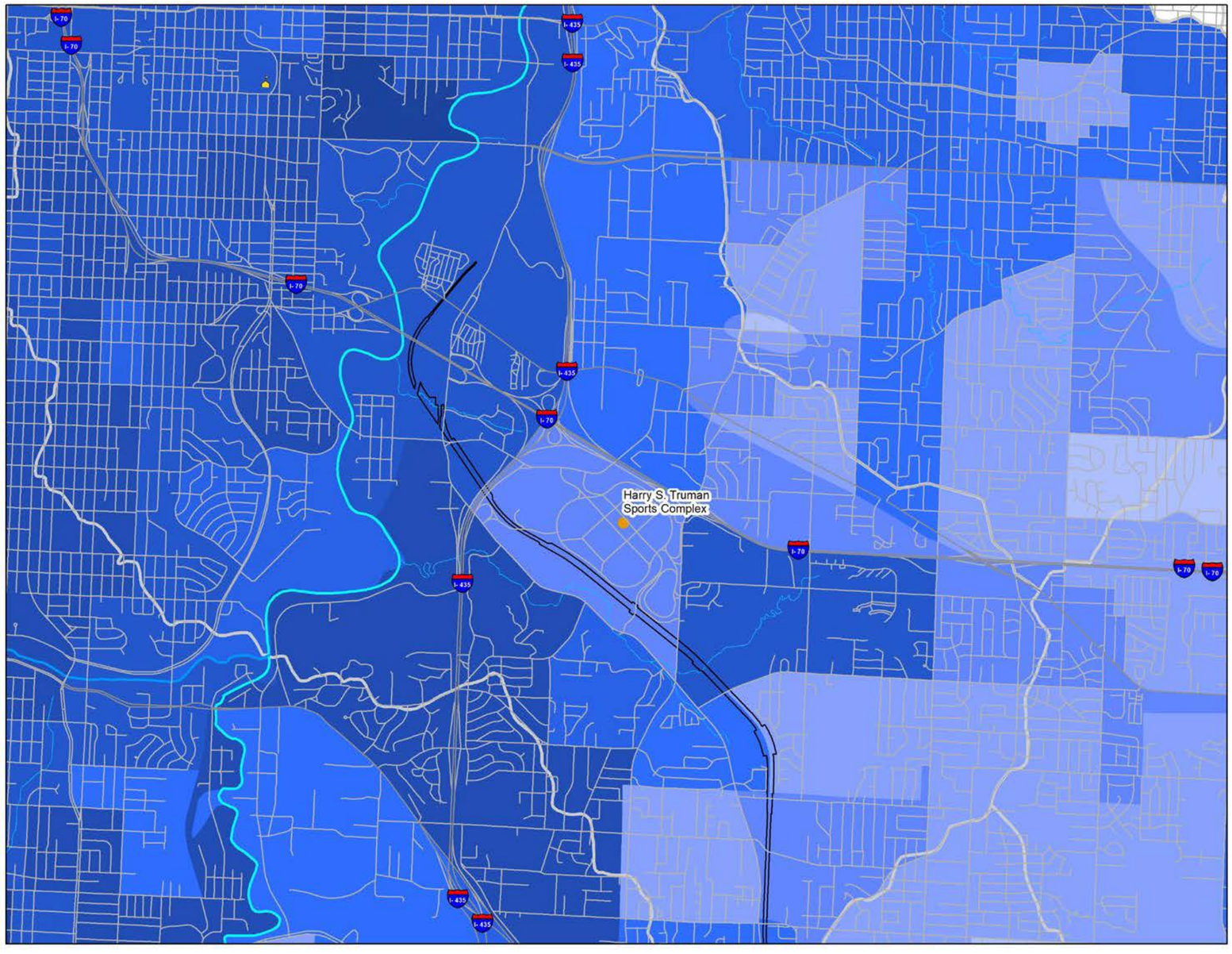
Social need was modeled along with data for the watersheds and analyzed the following social factors:

- Poverty.
- Hazardous Waste.
- Population Loss.
- Health Indicators.
- Food Deserts.
- Educational Attainment.
- Zero-vehicle Households.
- Minority Populations.

On this map, the darker the blue the higher number of intersection/ overlap of these social factors.

The data sets of Health Indicators and Food Deserts were selected as proxies for access to healthcare and healthy environments. Hazardous waste was selected as a proxy for the nexus between land use, environmental conditions, and human health. Population loss, poverty and patterns that imply minority segregation were selected as proxies for economic disinvestment and vulnerability. Educational Attainment was selected as a proxy for access to education. Zero-vehicle households was selected as a proxy for general access to opportunity and services. Areas identified with high levels of intersection are identified as high social need and therefore a priority for using green infrastructure to address social needs.

Data Sources: *ACS 2015 5-year Block Group, MARC, KCMO Parcel Viewer*



Intersection of Social Needs

Rock Island Corridor - North Stadium

0 1 2 3 4 5 6 7 8

Social Need Score

East High School

Rock Island Corridor

Watershed

Streams

Other Streams

Blue River

Brush Creek

0 0.25 0.5 1 Miles

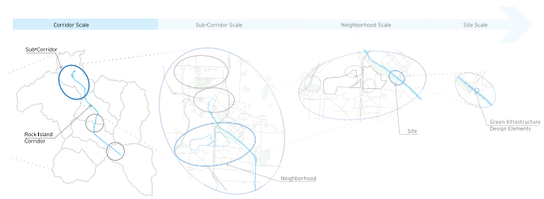
N

bnim Biohabitats BIKE WALK KC

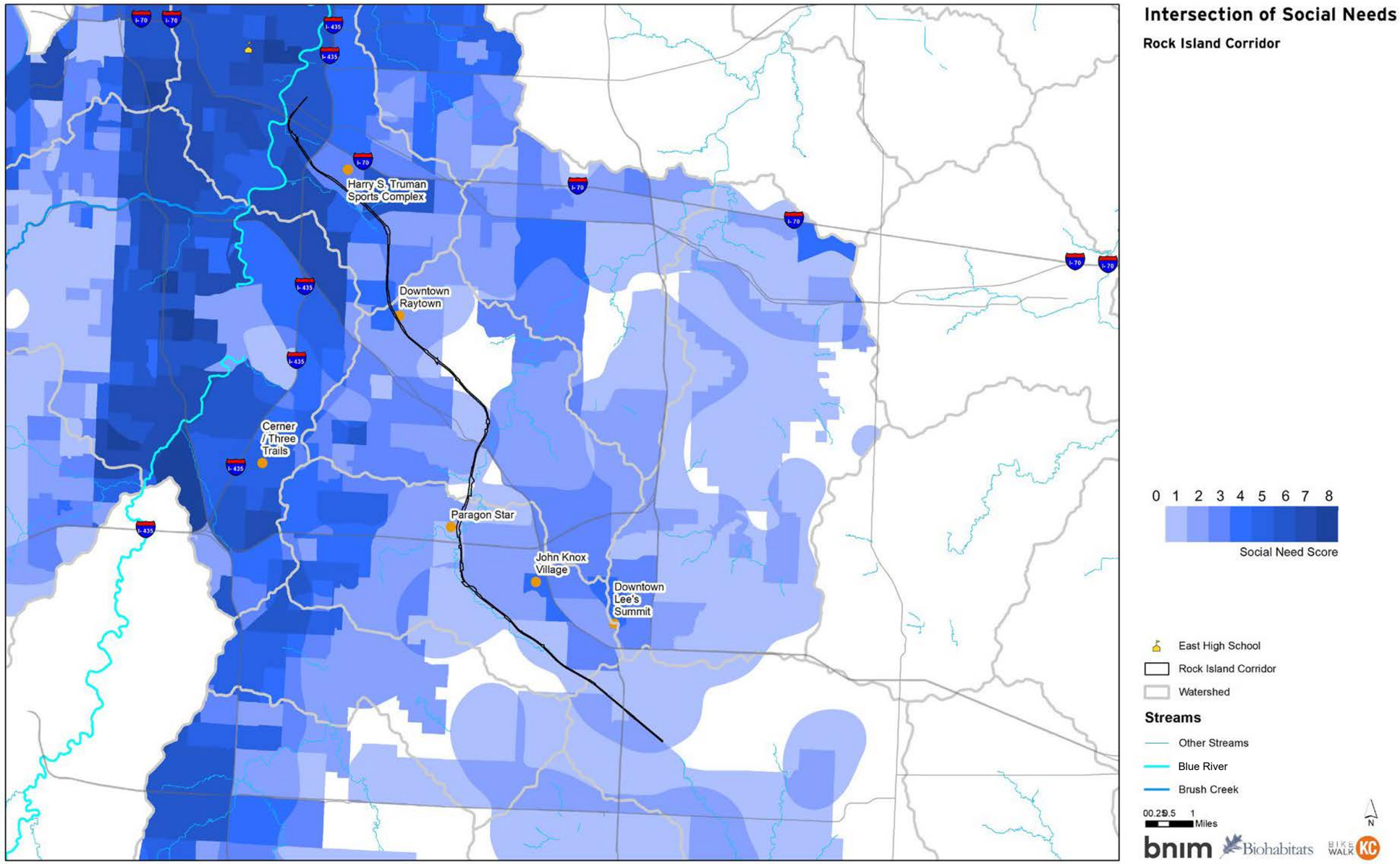
SOCIAL-NEED INTERSECTION ANALYSIS

ROCK ISLAND CORRIDOR

CORRIDOR SCALE



This is the same social-need intersection analysis as described on the previous page, looking at the larger, corridor-wide scale. See previous map for explanation of map content.



Intersection of Social Needs

Rock Island Corridor

0 1 2 3 4 5 6 7 8

Social Need Score

East High School

Rock Island Corridor

Watershed

Streams

Other Streams

Blue River

Brush Creek

0 0.25 0.5 1 Miles

N

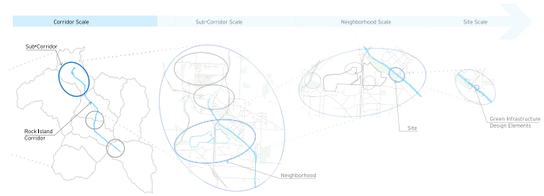
bnim Biohabitats BIKE WALK KC

Data Sources: *ACS 2015 5-year Block Group, MARC, KCMO Parcel Viewer*

ECOLOGICAL VALUE AREAS

ROCK ISLAND CORRIDOR

CORRIDOR SCALE



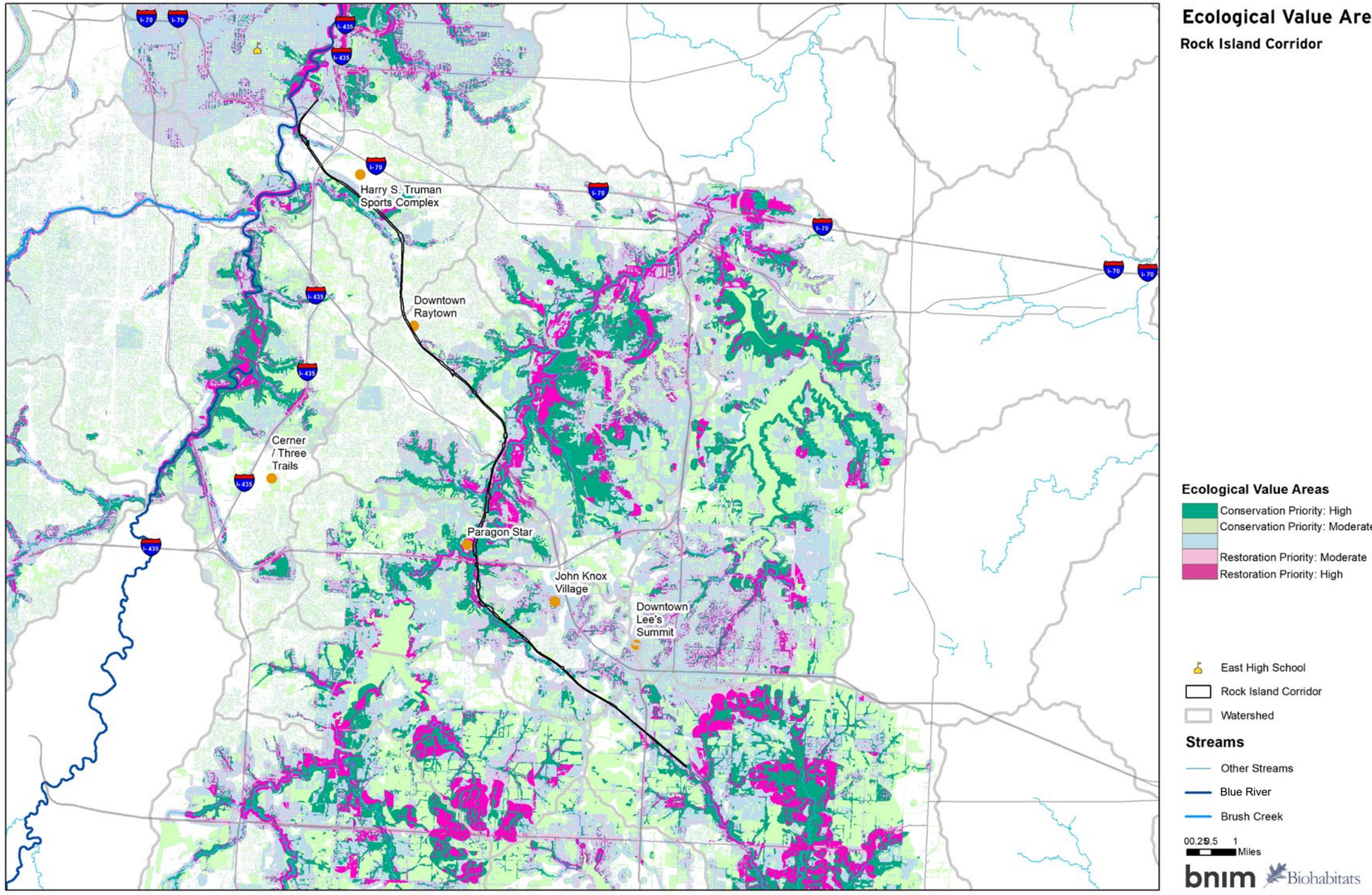
This map was created to show the intersections between the values and needs. Areas with moderate- and high-ecological value and no impacts or needs are considered a conservation priority (light and dark green). Areas with moderate- and high-ecological value that do have impacts or needs are considered a restoration priority (pink and magenta).

The factors of high ecological value include:

- Streams.
- Lakes.
- Wetlands.
- Floodplains.
- Existing Forest.
- Large Herbaceous Patches.
- Caves and Karst.
- Glades.
- Clean Water Benefits.
- Wildlife Benefits.

The factors of ecological impact or need are:

- Impervious Surface.
- Major Roads.
- Highest Forest Restoration Priority.



Ecological Value Areas

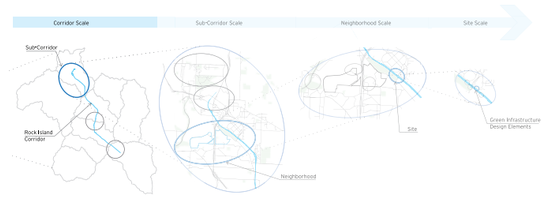
Rock Island Corridor

Data Sources: *MARC, KCMO Parcel Viewer, The Conservation Fund*

INTERSECTION OF ECOLOGICAL AND SOCIAL NEEDS

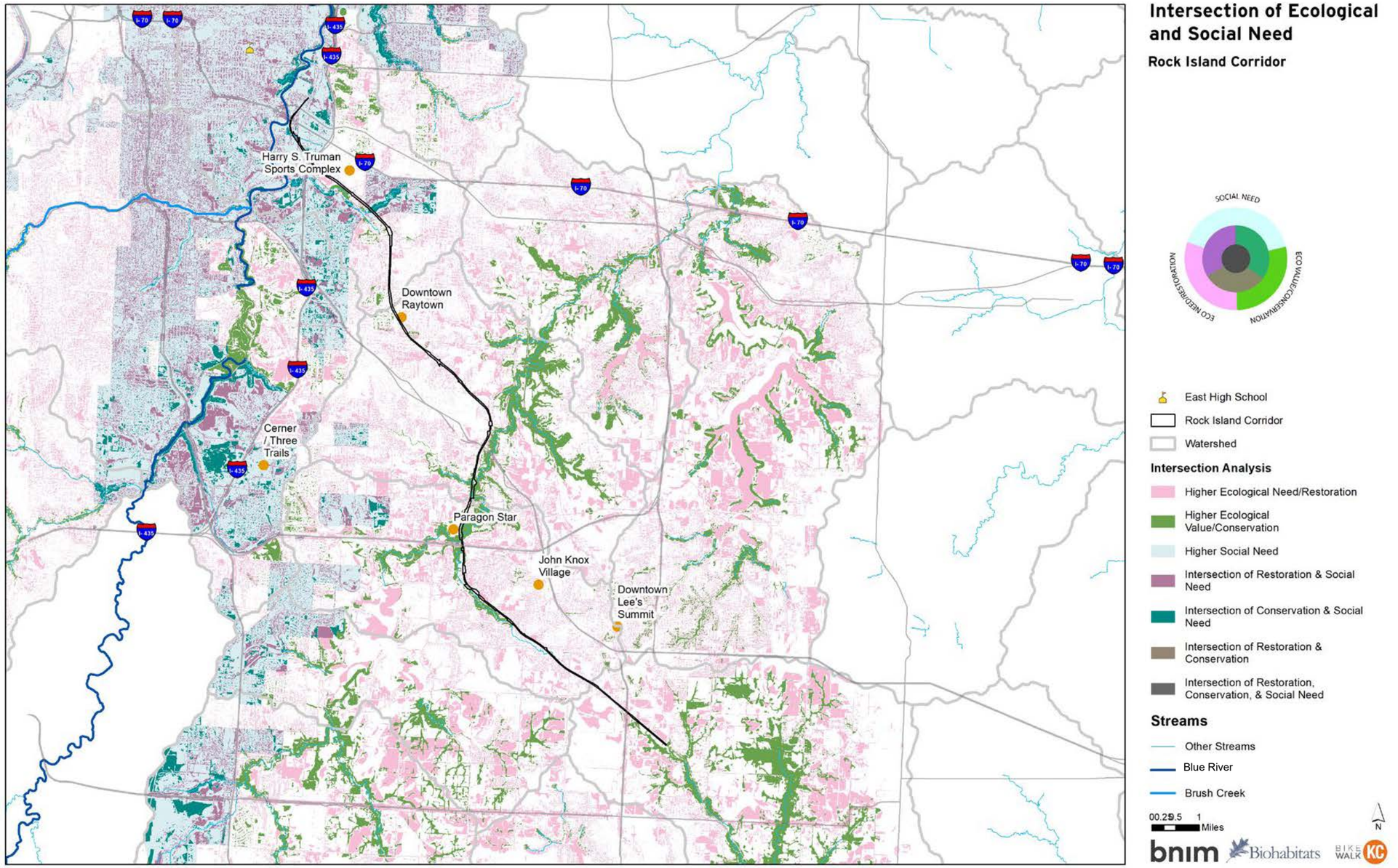
ROCK ISLAND CORRIDOR

CORRIDOR SCALE



The primary purpose of this analysis is to find areas of the greatest intersection of ecological and social need, so the areas of black, dark teal, and dark purple indicate areas of high interest in this study.

The quantitative analysis used was an intersection analysis to view ecological value and need and social need jointly and holistically. This is a trivariate map, where each unique color represents a different combination of intersection. Light pink indicates the presence of high-value ecological resources and conservation needs, but no other need intersection. Green and blue indicate ecological need for restoration and social need, respectively. Darker shades are used to represent greater intersection: dark teal for areas of social and restoration intersection, and dark purple for social and conservation intersection. Black indicates an intersection of all three needs, which does not occur as restoration and conservation values do not typically overlap.



Intersection of Ecological and Social Need

Rock Island Corridor

Data Sources: *ACS 2015 5-year Block Group, MARC, KCMO Parcel Viewer, The Conservation Fund*

SHAWNEE MISSION SCHOOL DISTRICT
GREEN INFRASTRUCTURE PLAYBOOK

ACKNOWLEDGEMENTS

TEAM

MARC
Kym Bledsoe
Tom Jacobs
Alecia Kates
Andrea Repinsky
Kitty Steffens

BNIM
Daniel Eddie
Christina Hoxie
Laura Lesniewski
Aaron Ross
Amanda Santoro
Daniel Siroky
Nicolette Wallis
Xiaoyu Yang

Biohabitats
Claudia Browne
Aiman Duckworth
Chris Rehak

BikeWalkKC
Thomas Morefield

Parson & Associates
Gina Boucher
Alex Miller
Jason Parson

PROJECT APPLICANTS

Jackson County
Josh Boehm

Shawnee Mission School District
Joan Leavens

ADVISORY COMMITTEE

Scott Allen
City of Blue Springs, Missouri

Michael Beezhold
HDR

Jon Birkel
Hunt Midwest

Sarah Crowder
Heartland Tree Alliance

Daniel Erickson
Platte County, Missouri

Matt Garrett
Johnson County, Kansas

Kathy Gates
Kansas City Native Plant Initiative / Westport Garden Club

Jim Harpool
Evergreen Real Estate

Mark McHenry
KC Parks - Kansas City, Missouri

Ginney Moore
The Conservation Fund

Jasmin Moore
Johnson County, Kansas

Mary Nemecek
Burroughs Audubon / Kansas City Native Plant Initiative

Brian Nowotny
Jackson County, Missouri

Gloria Ortiz-Fisher
Equity Network / Westside Housing Organization

Michael Park
Lee's Summit, Missouri

Dennis Randolph
City of Grandview, Missouri

Kristin Riott
Bridging the Gap

Amy Roberts
City of Kansas City, Missouri

Terry Rynard
KC Parks - Kansas City, Missouri

Andy Sauer
Burns and McDonnell

Scott Schulte
Vireo / Heartland Conservation Alliance

Allison Smith
Kansas Department of Transportation

Sarah Smith
Johnson County, Kansas

Tom Stiles
Kansas Department of Health and Environment

Lisa Treese
City of Kansas City, Missouri Water Services

Stephen VanRhein
Missouri Dept. of Conservation

TABLE OF CONTENTS

INTRODUCTION
SHAWNEE MISSION SCHOOL DISTRICT

WHY GREEN INFRASTRUCTURE AT SCHOOLS?

Implementing Green Infrastructure on school district properties provides a number of transformative benefits from an ecological and social standpoint. School facilities offer a unique opportunity to model best practices in green infrastructure for both the future workforce and surrounding communities, and help expand the network of green infrastructure strategies at a regional and increasingly impactful scale. The opportunity to demonstrate GI first hand to students and visitors is a vital educational opportunity. School districts are typically large land-holders, with a variety of facilities spread over a geographic area, which means successful GI projects can be piloted on individual sites, and then exported across the district to create exponential benefits.

The Shawnee Mission School District in particular was chosen for this Playbook entry because the district has embraced the opportunity to design sustainable sites to increase student achievement, improve environmental quality and serve the community, beginning with the development of the Center for Academic Achievement (CAA).

Shawnee Mission School District Center for Academic Achievement

HOW TO USE THIS PLAYBOOK

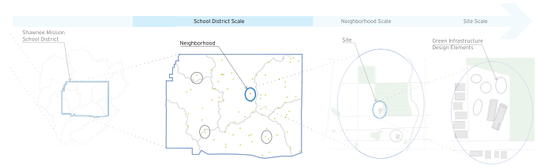
Shawnee Mission began investing in GI by developing the Center for Academic Achievement as a pilot project for the Shawnee Mission School District. This playbook explores adaptive management strategies for how to maintain and adapt the CAA's current green infrastructure system to continue to improve performance over time, and how these strategies can be implemented district-wide, both on school sites, and on sites adjacent to school properties that can connect these facilities to surrounding communities. Similar to the analysis conducted for the Rock Island Corridor, the team created a methodology to prioritize school sites for future green infrastructure projects, where these strategies can be implemented for maximum benefit. Similar to the Rock Island playbook, these strategies are specific to the CAA and the Shawnee Mission School District but have broad applicability for other school districts seeking a roadmap for implementing GI strategies at a site and district scale.

Bioswale feature at the CAA

School Garden Example in New Jersey

INTRODUCTION
SHAWNEE MISSION SCHOOL DISTRICT

SCHOOL DISTRICT SCALE

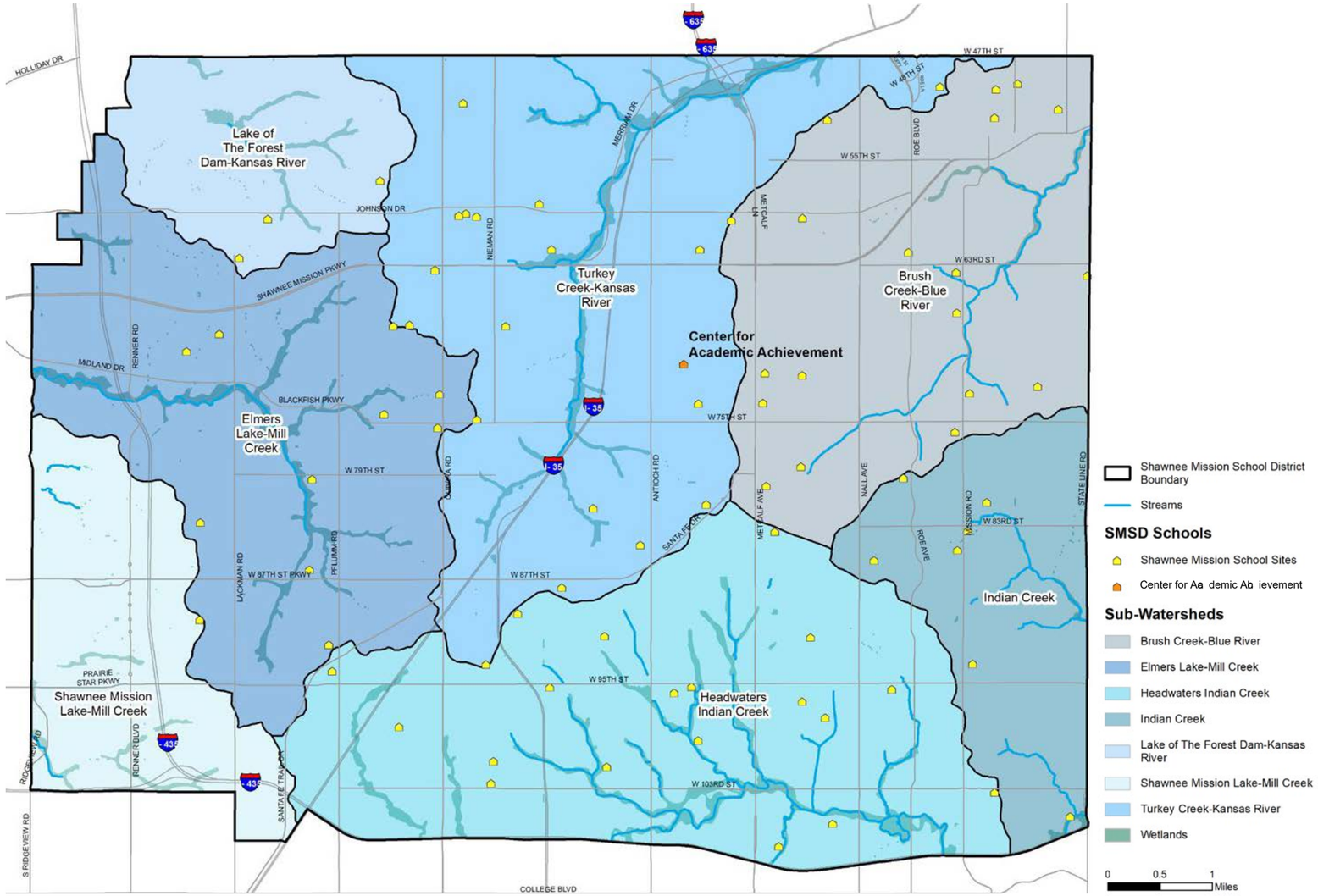


CONTEXT

The Shawnee Mission School District intends to design sustainable sites using state-of-the-art ecological design principles to increase student achievement, improve environmental quality and serve the community. Further, the Shawnee Mission School District aims to contribute to promoting sustainable landscapes throughout the greater Kansas City region. As a centrally located metropolitan school district, straddling seven watersheds (shown at right) and sharing its eastern border with Missouri, the district embraces this opportunity to lead.

Shawnee Mission has already shown its dedication to green infrastructure principles by developing the Center for Academic Achievement (CAA), which includes site stormwater management, native plantings, food production and community connectivity. The CAA is an important first step for Shawnee Mission and gives the school district the advantage of having a living green infrastructure laboratory where design applications and management strategies can be explored and then exported to different sites throughout the district and community.

This playbook is described in two parts. The first part defines CAA's existing green infrastructure and connections to the community, while focusing on opportunities for adaptive landscape management. The second part discusses how these green infrastructure design and adaptive management strategies can be implemented district-wide, and illustrates an approach for identifying future green infrastructure projects on school sites near high value ecological areas elsewhere in the school district.



GREEN INFRASTRUCTURE: 1 - Ideation and Planning Stage

The earlier that all involved parties come together, the more interconnection of design and implementation can occur. It is often the case that one or two projects have already started and created some momentum, as in the case of this Shawnee Mission School District example. In this situation, the process begins with getting up to speed on the work that has already been completed (a green infrastructure landscape) and setting goals that define next opportunities. The next set of projects then grows from the goals and process established.

INTRODUCTION
SHAWNEE MISSION SCHOOL DISTRICT

KEY CONSIDERATIONS AND ISSUES

- *Multi-modal interactions:* Access to safe routes and zones where vehicular, bicylcle and pedestrian interactions are needed near schools and throughout the community.
- *Vehicular impact on sites:* Conventional development and transportation projects add impermeable surfaces and divert natural water flows, often carrying road runoff with sediment, oil and grease into streams.
- *Management strategy:* Conventional guidance and communication tools have had limited effectiveness in managing green infrastructure installations.
- *Education / curriculum:* Integration of green infrastructure strategies and curriculum for students and professionals needs further development.
- *Metrics and values of green infrastructure:* Difficulties remain in conveying the true benefits of green infrastructure compared to conventional design and construction.
- *Human health and wellness:* Access to native and productive landscapes that promote active lifestyles and healthy eating are lacking in the region.

BENEFITS AND METRICS

- *Multi-modal interactions:* Providing strategies for safe vehicular, bike, and pedestrian interactions at activity nodes, and supporting *Safe Routes to School* efforts in the region. Metrics include tracking pedestrian and biking traffic counts over time as infrastructure and access points are constructed.
- *Vehicular impact on sites:* Enhancing design and maintenance plans for bioremediation zones on-site, and creating multiple methods of capturing and mitigating impacts of vehicular runoff on-site. Metrics include monitoring of water quality and runoff quantities at green infrastructure sites and on sensitive sites downstream in watershed.
- *Management strategy:* Developing an adaptive management strategy that is accessible to diverse audiences and distributed through multiple media. Metrics include measuring implemented projects over time throughout the school district, engagement of facilities staff and faculty, and cultural shift in green infrastructure adoption of adaptive management strategies.
- *Education/curriculum:* Refining school-related curriculum and professional education programs that support a robust and adaptive site management strategy and that teach the benefits of green infrastructure. Metrics include engagement of students including career path tracking, integration of curriculum tied to site and district-wide learning, and perceived ownership of the land by students and neighbors.
- *Metrics and values of green infrastructure:* Developing tools that monitor and capture data, and then convey the broad beneficial impacts of implementing green infrastructure strategies. Metrics include improvement to water quality, stormwater flows, increased habitat, and increased community engagement and well-being.
- *Human health and wellness:* Demonstrating new opportunities in the community to engage in active lifestyles, both physically and socially. Metrics include surveys to determine effectiveness of outreach, incentivized use of tracking devices and wearables, and opportunities to engage in wellness programs (in person or via mobile devices).

PARTNERS, PROJECTS, PROGRAMS AND NEIGHBORHOOD AMENITIES

The projects and organizations listed here have the potential to support these green infrastructure strategies and benefit from them.

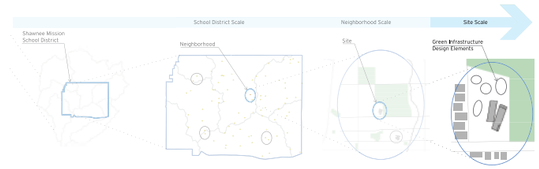
- Antioch Acres Park
- Antioch Park
- CAA Curriculum: Engineering, Health Sciences, Biotechnology, Culinary Arts, Animation and Interactive Media, Project Blue Eagle Firefighting / EMT
- CAA Services: Shawnee Mission School District Fitness and Wellness Centers
- City of Overland Park, Kansas
- East Antioch Elementary School
- Johnson County Health & Environment LiveWell Programs
- Johnson County Parks & Recreation
- Johnson County Stormwater Management
- Johnson County Sustainability Programs
- K-State Horticulture Research & Extension Center
- Kansas Department of Transportation
- Kansas State University
- Marty Park/Pool
- Milburn Golf & Country Club
- Neighborhood Associations
- Overland Park Public Works Department
- Safe Routes to School Program
- Shawnee Mission School District administrators, faculty, students and school communities
- Shawnee Mission School District staff (including grounds crews, building custodians, etc.)

PROJECT SITE

CENTER FOR ACADEMIC ACHIEVEMENT

SHAWNEE MISSION SCHOOL DISTRICT

SITE SCALE



SCHOOLS AND SCHOOL DISTRICTS

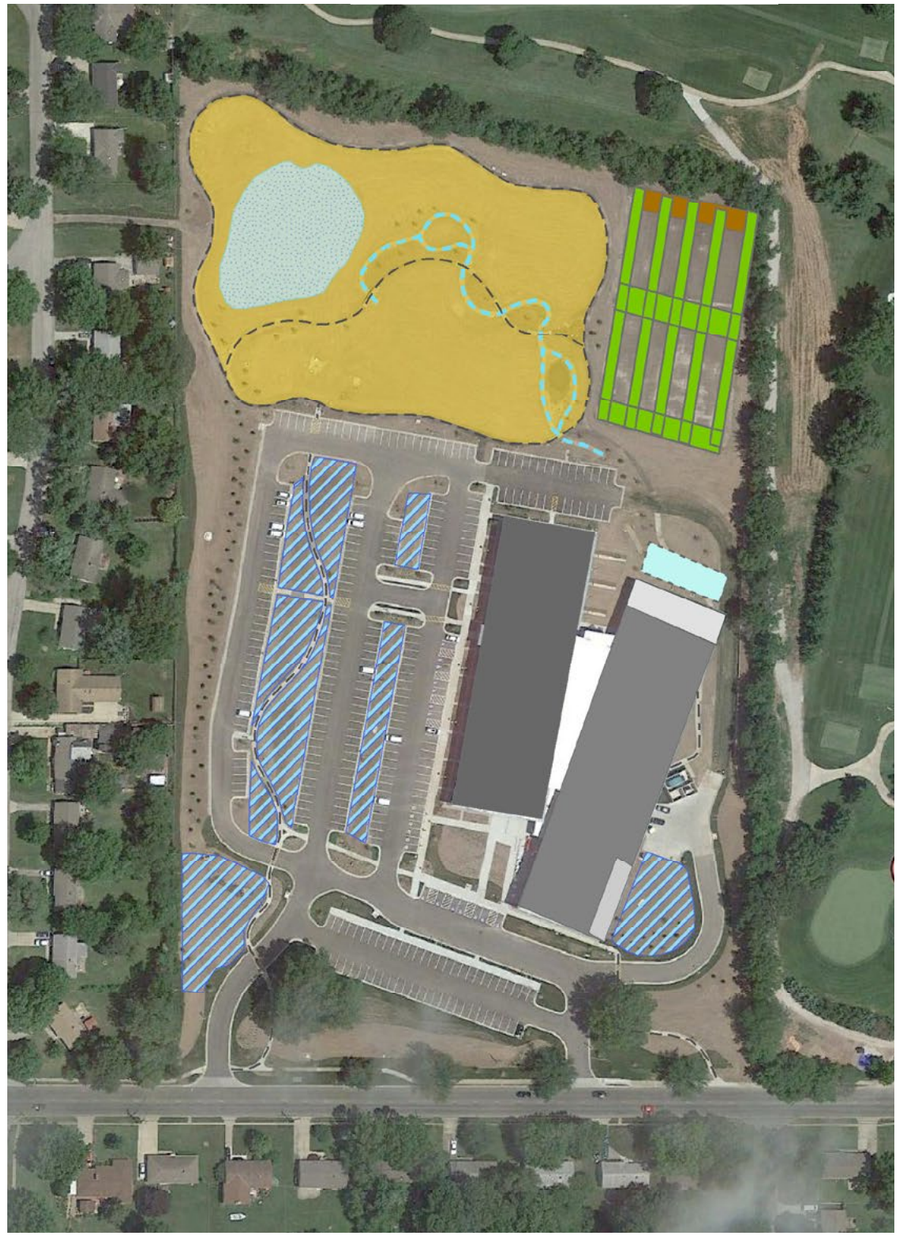
Schools offer a unique opportunity to model best practices in healthy land management and active living. The Shawnee Mission School District is unique in the Kansas City metropolitan area in its commitment to sustainability, health and well-being at the highest levels of the district administration. Mapping natural areas, waterways, and trails, modeling sustainable land management, and inviting community input into identifying ways to increase walking and connectivity via transportation alternatives will make these opportunities known and more accessible to the greater community.

CENTER FOR ACADEMIC ACHIEVEMENT

The opportunities at the Center for Academic Achievement (CAA), in particular, stem from the district's strategic plan to implement their priorities of efficiency, student achievement, and sustainability, as well as the momentum of five of the seven signature programs offered at the CAA that are related to integrated green infrastructure strategies: Engineering, Health Sciences, Biotechnology, Animation and Interactive Media, and Culinary Arts. The high presence of administrative decision-makers at this site also make the lessons exhibited here extremely accessible to an audience with the capacity to act on them.

The site includes a 1.3-acre farm that is run by students and a quarter-mile walking trail. The site is open to the surrounding community evenings and weekends year-round. Among the district's goals is to provide green infrastructure workforce training to staff and students, serving as a model for public and private land management. The students in the Culinary Arts curriculum are trained in managing the farm and all aspects of the new on-site restaurant, Broadmoor Bistro, as well as marketing produce and products at the local farmers market.

The CAA site map at right shows the current programs and green infrastructure strategies implemented. The site contains a series of strategies including a parking lot with vehicular stormwater runoff going into bioswales, a cistern collecting rainwater, and a native .landscape that contains a dry stream bed and detention pond.



GREEN INFRASTRUCTURE: 2 - Design Stage

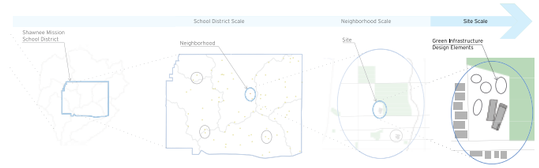
When projects are in a design phase, it is crucial to define the key points of influence within the project that focus first on where the most important human and ecological values and needs are within the defined project area. Next, identify specific design solutions that can be incorporated to adapt the design to a state of greater health, and for greater connectivity to other solutions in the future. This relies on an open and flexible mindset of existing and new design team members as well as familiarity with the solutions recommended and their impact on cost, schedule and maintenance.

PROJECT SITE

CENTER FOR ACADEMIC ACHIEVEMENT

SHAWNEE MISSION SCHOOL DISTRICT

SITE SCALE



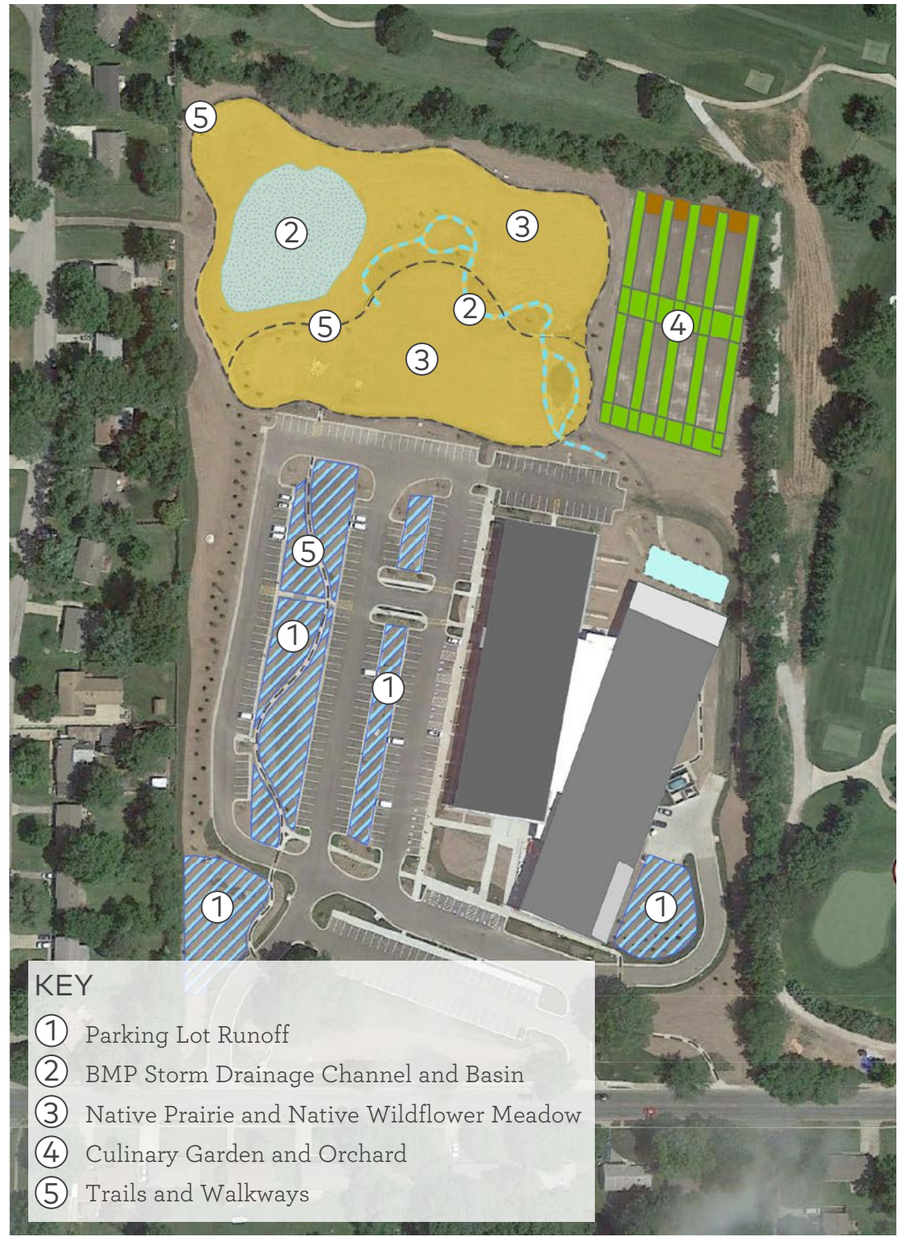
GREEN INFRASTRUCTURE IMPLEMENTATION AND ADAPTIVE MANAGEMENT

The CAA site is an example of green infrastructure implementation. As mentioned prior, an adaptive management approach provides a framework for monitoring green infrastructure installations and responding as needed when design elements are underperforming. The adjacent map and following pages identify adaptive management strategies that apply to specific issues of this site, and can be used as a tool for the school district when other school sites apply similar types of green infrastructure design elements.

Adaptive management planning for the long term at CAA can be organized by objectives as listed below. Examples of inspection issues and adaptive maintenance approaches are provided later in this document for each of the main green infrastructure features. (Note that an Establishment and Maintenance Guide was prepared by the original design team (Vireo) to cover vegetation care during establishment and years one through three.)

Objectives and monitoring parameters include:

- Direct stormwater to water quality BMPs.
  - On-site and off-site evidence of erosion, flooding extent/duration/frequency.
- Manage site water to encourage infiltration and minimize runoff.
  - On-site storage volumes and rates of infiltration in relation to weather patterns.
  - Locations and frequencies of off-site flows.
- Support healthy soils, habitat and aesthetic quality of native plant areas, farm and orchard areas.
  - Number and relative cover of non-native species; native species richness; and extent of bare ground.
  - Bird, pollinator, and insect counts and diversity.
  - Soil organic matter content across site, at depths and over time.
  - Food and native plant productivity (pounds per acre) comparisons.
  - Visitor experience and community involvement.
- Collect and share CAA's green infrastructure experience widely.
  - Extent and types of design modifications (and costs).
  - Purpose and types of educational monitoring data collected and evaluated (costs).
  - Cost per square foot of maintenance per year.



PROJECT SITE CENTER FOR ACADEMIC ACHIEVEMENT

ADAPTIVE MANAGEMENT STRATEGY

PARKING LOT RUNOFF FEATURES

Parking lot curb cuts direct water into vegetated swales. Water flowing into the entry points then needs to either be spread or directed down a channel feature into the Best Management Practices (BMP) storm drainage system.

Inspection

- Routine inspection of runoff entry points for evidence of rills or deeper gullies forming. Observe source of problem and flow patterns during rain event if possible.

Maintenance

- Use hand grading or raking to stabilize soils and establish/re-establish fine grading to meet design intent with positive drainage and without rills or gullies. Establish/re-establish vegetation and stone.
- Revegetate with seeding or replanting during growing season; note that optimal planting months may vary from traditional plants used, but March 1 through August 31 is generally recommended for native plants in Kansas and Missouri.

Adaptive Management

- If concentrated flow persists and/or is related to design issue, work with design engineer to consider additional curb cuts and/or additional spreader/pre-treatment filters. Additional stone may be necessary to reduce runoff velocities before water reaches planting.
- Erosion control measures and/or a combination of plugs and seed may be necessary for plant establishment.

GREEN INFRASTRUCTURE: 3 - Maintenance Stage

After the implementation of green infrastructure projects, there are many touchpoints to increase their benefits over time. These living systems require regular stewardship and maintenance that is very different from a more conventional approach to landscape maintenance. The adaptive landscape management plan conceptualized for Shawnee Mission School District provides a Playbook example of how to provide annually increasing benefit to both the educational curriculum as well as the health and biodiversity of the land and waterways. These increasing benefits impact not only the schools but also the connectivity of the surrounding neighborhoods and provide a how-to model for even more projects to be initiated and developed.

PROJECT SITE CENTER FOR ACADEMIC ACHIEVEMENT

ADAPTIVE MANAGEMENT STRATEGY

BMP STREAM CHANNEL AND DETENTION BASIN

Water flowing from the paved parking and catchment areas flows along channel features into detention basins.

Inspection

- At least annually and/or after large rainfall events, check buildup of sediment and debris that can clog flows.

Maintenance

- Clear relatively small debris accumulations as needed.

Adaptive Management

- If standing water persists in areas that were not designed for pools (e.g., greater than 1.5-2 feet) or sediment occupies ~20% of water quality design volume, or drainage is poor, more significant cleanout may be needed. Small pools may be drawn down to a water level that allows sediment to dry. Once dry, sediment can be removed. De-water sediment before disposal to minimize transportation costs and hazards, or spread on-site as a soil amendment if it will not re-accumulate in drainages and ponds.

PROJECT SITE CENTER FOR ACADEMIC ACHIEVEMENT

ADAPTIVE MANAGEMENT STRATEGY

NATIVE VEGETATION AREAS

The native wildflower and grass areas in the vegetated swales along the stormwater channel and basins help filter trash, pollutants and sediments. Meadow plantings provide additional habitat and aesthetic benefits along with soil health and potential to capture and store carbon. Planting adjacent to walkways is often more visible with a higher demand on fullness, vigor, and orderliness. Plant species growth habit and/or weather impacts can cause herbaceous plants to "flop" or grow over walkways.

Inspection

- Weed species (types and coverage).
- Plant vigor and diversity.
- Trail encroachment, safety considerations; assess if extent and height of overgrowth impacts circulation, user comfort, and/or aesthetics.

Maintenance

- Hand weeding/edge trimming (string trimming).
- Mow one to two times per year as needed (typically in spring and fall) to remove excess dead material (compost in farm areas). Conditions may require spot trimming or a narrow trim or mow strip adjacent to specific walkways. Trimming or mowing height, frequency, and timing should be established based on plant species and growth cycle. Trimming or mowing should also avoid seasonal nesting activity of ground-nesting birds and seasonal larval stage of pollinators. For Kansas and Missouri, the USDA recommends avoiding mowing between mid-April and the first or second week of August to protect birds and other species, although some species may nest into early September. It is highly recommended to walk areas to be mowed to visually identify nesting activities before mowing, as this is the best way to identify site-specific species and nesting patterns.
- If possible, a burn in the second or third year of establishment is recommended to control woody tree growth and enrich soils. For longevity of the site, burning should be conducted periodically, every two to five years.

Adaptive Management

- Reseed/replant wildflower zones if diversity and abundance decline over time. The planting window in this region is relatively wide, with March 1 through August 31 being applicable for most species. It may take two to five years to reach a mature community of native plants, so patience is a virtue.
- Experiment with compost types and applications to enrich soils if needed in compacted/poor quality areas. This can be done throughout the growing season.
- Engage non-traditional partners to build capacity through educational outreach, healthy living programs, "bartering" and volunteer service programs.
- Trimming or mowing height and frequency should *not* match that of turfgrass.

PROJECT SITE CENTER FOR ACADEMIC ACHIEVEMENT

ADAPTIVE MANAGEMENT STRATEGY

PAVED AREAS

Trails, sidewalks, and the interface with green infrastructure edges can require maintenance to remove silt and soil deposits, cracking and other potential safety and aesthetic concerns.

Inspection

- Inspect that soil meets specifications and correct as necessary. Testing may be necessary if warranted by inspection.
- For areas adjacent to walkways, inspect or test for soil compaction.

Maintenance

- Establish/re-establish fine grading to meet design intent with positive drainage and without rills or runnels. Establish/re-establish vegetation.

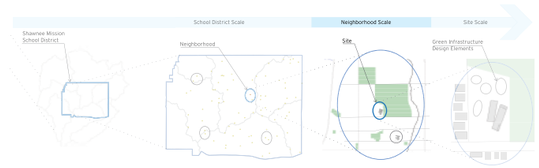
Adaptive Management

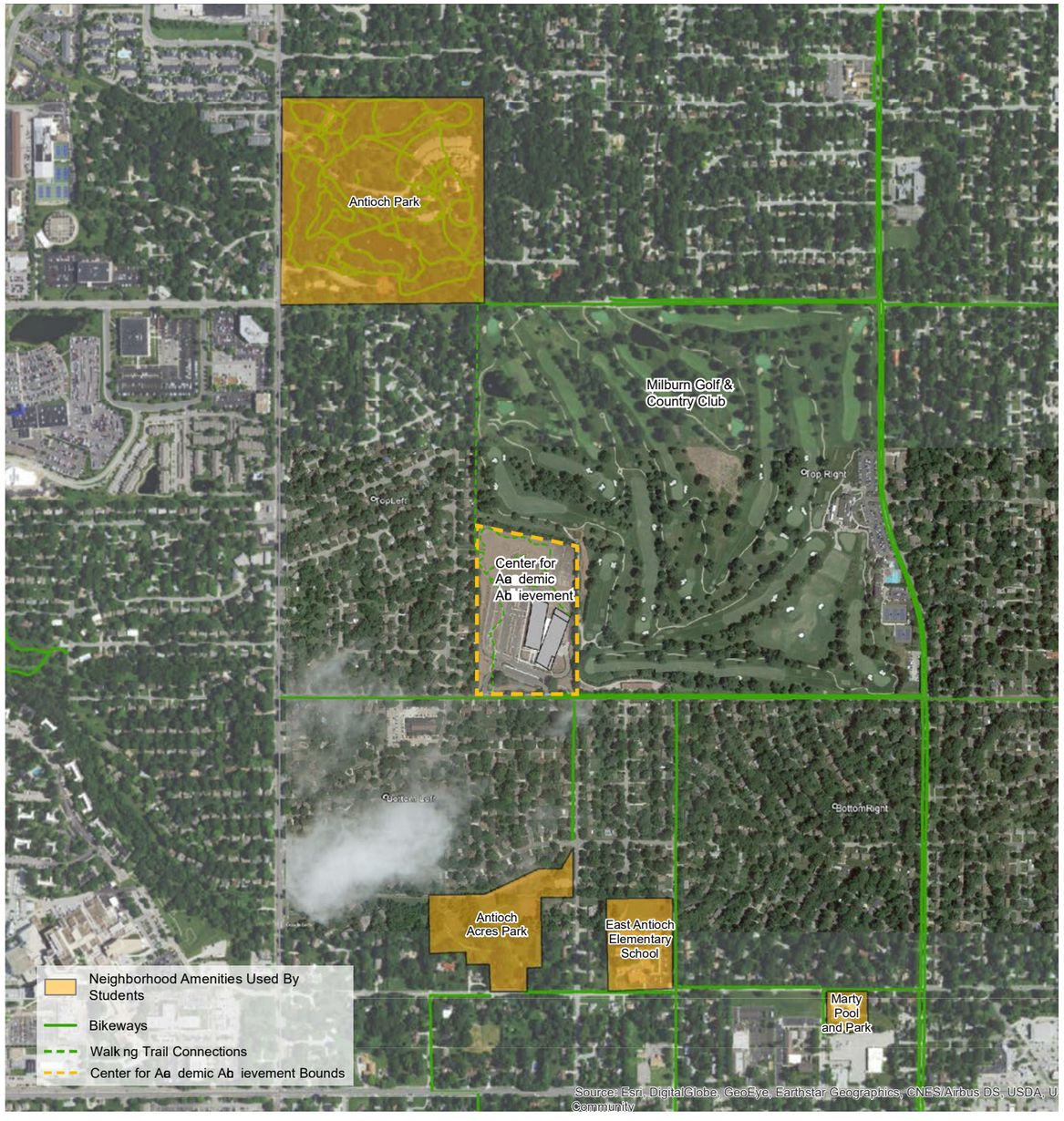
- Erosion control measures and/or a combination of plugs and seed may be necessary for plant establishment. Additional stone may be necessary to reduce runoff velocities before water reaches planting.
- Consider landscape modification to address persistent bare soil adjacent to walkways if it is more visible and has a higher aesthetic.

FOCUS AREA NEIGHBORHOOD

CENTER FOR ACADEMIC ACHIEVEMENT

NEIGHBORHOOD SCALE





NETWORK CONNECTORS

Network Connectors are green infrastructure solutions that address multiple challenges in the highlighted opportunity areas and link the areas together to strengthen the watershed-scale system of benefits. In the Shawnee Mission School District, the following opportunities are present:

1 Implement education and demonstration hubs of green infrastructure solutions (i.e., parks, schools, community centers, campuses).
2 Remove weed and landscape ordinance barriers to native plantings.
3 Coordinate parks and trail planning that prioritizes habitat connection opportunities.
4 Coordinate with state Departments of Transportation and transportation authorities to address safe multi-nodal interaction, specifically within communities and near schools.
5 Continue long-term investment in transit infrastructure such as bus rapid transit and light rail.
6 Implement green and complete streetscapes, including pedestrian and bicycle infrastructure.
7 Create replicable guidelines to address adaptive management and maintenance of school properties.
8 Create partnerships and programs for all-ages wellness programs that streamline access to healthcare, local sustainable food, and spark a culture of health.
9 Employ diverse educational programs targeted towards grounds crews, building custodians, and design and construction professionals regarding green infrastructure best practices.
10 Partner with schools and communities to promote local food production and engagement in natural systems.

SURROUNDING NEIGHBORHOOD COMMUNITY CONNECTIONS

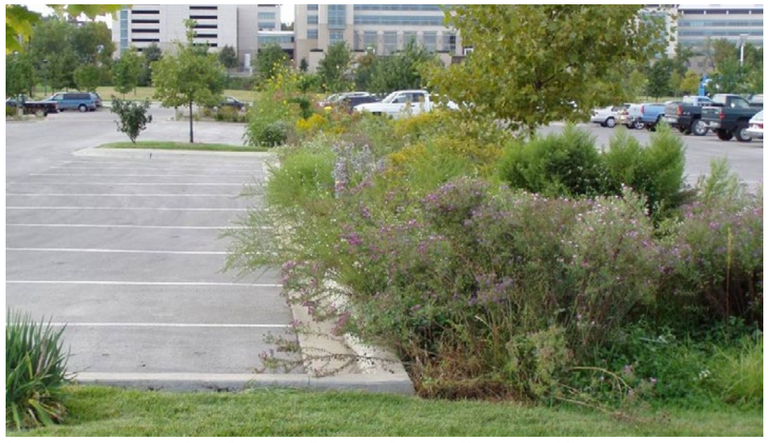
The Center for Academic Achievement site and surrounding neighborhood provide an ideal testing ground for site-specific strategies that can be replicated throughout the Shawnee Mission School District. The district's commitment to sustainability, health and well-being ensure a long-term commitment to addressing green infrastructure opportunities at both site and district scales, including:

A Vehicular Runoff with Green Infrastructure.
B Multi-Modal Interactions.
C Educational Opportunities for Students, Professionals, Community.
D Monitoring for Data-Based Cost Benefit Analysis.

These green infrastructure strategies are applicable both district-wide and throughout the metropolitan region, while demonstrating the potential for connections to the surrounding community. The following pages expand on the strategies the school district explored at the Center, ones that are closely linked with the immediately adjacent neighborhoods and which can be replicated at the site scale of individual properties and also extended into the neighborhoods and transportation systems that connect the entire Kansas City metro.

NEIGHBORHOOD COMMUNITY CONNECTIONS

CENTER FOR ACADEMIC ACHIEVEMENT



Simple bioswales at the Anita B. Gorman Discovery Center in Kansas City, Missouri capture stormwater runoff from the parking lot for retention and infiltration. The parking lots are standard asphalt with flat curbs graded to direct water into these vegetated zones, which are planted with native plant species.

Ⓐ VEHICULAR RUNOFF WITH GREEN INFRASTRUCTURE

Impervious surfaces resulting from traditional development have transformed the hydrological landscape of our region; increasing runoff volumes, changing watersheds, and introducing pollutants. All of these create impacts that are felt downstream at an ever-expanding scale. Transportation systems, especially paved streets and parking lots, account for large percentages of a city's impervious surfaces (as high as 60 percent of land cover in some urban areas). These systems therefore represent an enormous opportunity for integrating green infrastructure to minimize and mitigate negative impacts. The continued evolution of multi-modal transportation options within the Shawnee Mission School District provides an opportunity to showcase multiple methods of capturing and mitigating impacts of vehicular runoff, and these strategies can also apply to bike and pedestrian facilities.

Green infrastructure strategies must be integrated into planned repairs and improvements of transportation systems. Roadways, parking lots, and other paved vehicular surfaces should be designed to direct water into green infrastructure elements, in order to increase site infiltration, increase the capacity for short and long term storage for slow release or reuse, and to increase evapotranspiration. The design of the integrated landscape zones that capture this water not only provides the opportunity to decrease the direct impact of stormwater on aging drainage infrastructure and the impacts of soil erosion, it helps rebuild resilient and restorative landscapes that renew soil health and habitat.

A major challenge and opportunity is the training of designers, school district staff, and volunteers for implementation and maintenance of green infrastructure. Key concepts for an understanding of green infrastructure and its application to mitigate hardscape runoff include the following:

Bioretention and Biofiltration

In addition to controlling peak stormwater discharge, well designed and constructed bioretention and biofiltration zones provide benefits by using regional and local planting palettes, soils, and hydrological patterns to model pre-development conditions. This improves water quality and allows for water to infiltrate through soils to replenish groundwater. It also creates additional benefits: the rebuilding of native plant communities and habitats, improved air quality, and reduction of heat island effects caused by pavement.

PARTNERS

- City of Overland Park, Kansas
- Johnson County Health & Environment LiveWell Programs
- Johnson County Parks & Recreation
- Johnson County Stormwater Management
- Johnson County Sustainability Programs
- Johnson County Stormwater Management
- Kansas Department of Transportation
- Overland Park Public Works Department
- Shawnee Mission School District staff (including grounds crews, building custodians, etc.)

WQ WC BIO HAB ED HW CB

NEIGHBORHOOD COMMUNITY CONNECTIONS

CENTER FOR ACADEMIC ACHIEVEMENT

A bio-retention channel in Greensburg, Kansas utilizes a wide street right-of-way to capture and treat stormwater from the public street and high school property. A pedestrian bridge allows users to experience the green infrastructure as a design element.

The Kansas City, Missouri Water Services Campus parking lot is a local precedent and resource for the installation, maintenance, and performance monitoring of multiple pervious pavement systems.

Although design of green infrastructure design elements depends greatly on context and site conditions, the major components often include[1]:

- Grass buffer zones to reduce runoff velocity and remove suspended solids.
- Vegetation zones to aid in absorbing water through the process of evapotranspiration and removal of excess nutrients through nutrient cycling.
- Shallow ponding areas that provide storage of excess stormwater flows and its subsequent evaporation, and also aids in the additional settlement of particulate matter.
- Organic mulch layers that encourage micro biological degradation of petroleum-based pollutants, aids in pollutant filtration and reduces soil erosion.
- Engineered or amended soils to support vegetation growth along with nutrient uptake and provision for water storage; soils should include some clay to absorb pollutants such as hydrocarbons, heavy metals, and nutrients.
- Sand beds provide drainage and aeration of planting soil as well as an aid in flushing pollutants.
- Underdrain systems in some applications to remove excess treated water to storm drain system or receiving waters.

[1]Sources: Low Impact Development (LID) Center, Lake Superior Streams Organization

Pervious Pavements

Pervious pavements are effective in reducing runoff and improving water quality, and can greatly enhance larger green infrastructure systems. They are typically most effective in areas with light traffic levels such as low speed roads, parking lots, sidewalks and public plazas. They have been used and studied less in areas exposed to high levels of truck traffic. They are useful in dense urban areas where open space for vegetated solutions is more limited. It is also worth noting that properly designed and maintained pervious pavements have performed well in cold climates, and have even been shown to delay the formation of frost layers due to the air in the aggregate base acting as an insulating layer.

The green infrastructure benefits of pervious pavements include: the reduction of runoff quantity; a reduction of total suspended solids, phosphorus, nitrogen, metals and process oil loads flowing into receiving watersheds; and a reduction in runoff temperatures.

The most commonly used systems are permeable interlocking pavers, pervious concrete, and pervious asphalt, all of which have been effectively installed in this region. The design parameters of these pavement types are similar, with each being built on a subbase with void space to collect, store, and subsequently release or infiltrate water. Each requires specialized maintenance, including the periodic removal of sand and other materials that clog pores and reduces performance over time. Applications may differ, with pervious concrete more common in higher traffic areas where pervious asphalt and pavers are more typically used in low traffic areas. Paver systems are particularly susceptible to damage from vehicular turning motions, which should be a design consideration.

PAVING RESOURCES

Pervious Asphalt

- *Porous Asphalt BMP Fact Sheet* (Dauphin County Conservation District): *http://www.dauphincd.org/swm/BMPfactsheets/Porous%20Asphalt%20fact%20sheet.pdf.*
- *Porous Asphalt Fact Sheet* (UNH Stormwater Center): *https://www.unh.edu/unhsc/sites/unh.edu.unhsc/files/porous_ashpalt_fact_sheet.pdf.*

Pervious Concrete

- *Porous Concrete BMP Fact Sheet* (Dauphin County Conservation District): *http://www.dauphincd.org/swm/BMPfactsheets/Porous%20Concrete%20fact%20sheet.pdf.*
- *Pervious Concrete Fact Sheet* (UNH Stormwater Center): *https://www.unh.edu/unhsc/sites/unh.edu.unhsc/files/unhsc_pervious_concrete_fact_sheet_4_08.pdf.*

Pervious Paver

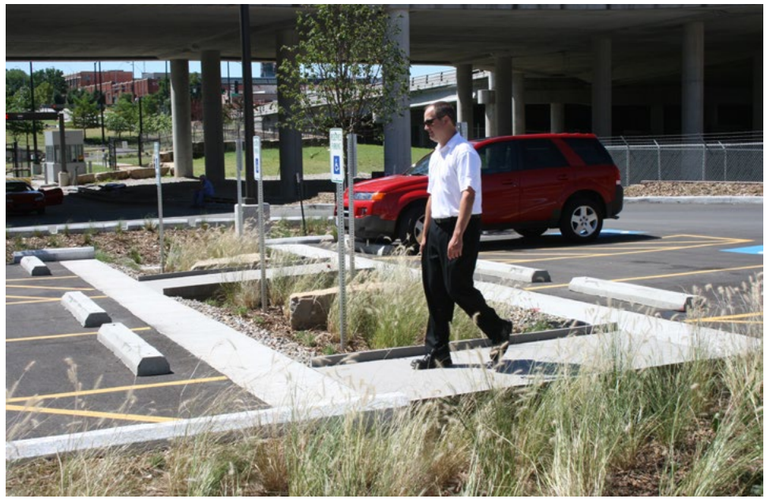
- *Permeable and Porous Concrete Pavers* (ConcreteNetwork.com): *https://www.concretenetwork.com/concrete/porous_concrete_pavers/.*
- *Hardscape and Pavers* (Portland Cement Association): *http://www.concretethinker.com/applications/Hardscape-Pavers.aspx.*

Turf Reinforcing Grid

- *Turf Reinforcement Mesh* (TYPAR): *http://www.typargeosynthetics.com/products/ground-reinforcement-mesh/turf-protecta-turf-reinforcement-mesh.html.*

NEIGHBORHOOD COMMUNITY CONNECTIONS

CENTER FOR ACADEMIC ACHIEVEMENT



Planting Strategies

Proper plant selection can help maximize the effectiveness of natural stormwater systems. Considerations include pollutant tolerance and remediation abilities, water levels, maintenance requirements, cover, slope, and site context.

During planting and establishment, invasive species, especially those adapted to wet conditions, should be identified and removed. Existing native vegetation can be worked into topsoil. Planting areas should be loose, un-compacted, and high in organic material. Leaving the surface of the graded bio-retention features rough can benefit the establishment of plants. Rye or similar plants can provide temporary cover, or specifically Virginia Wild Rye for intermediate cover, while permanent vegetation is being established. During the first year of growth, mowing down vegetation to a height of 8" can aid in establishment by reducing competition from weeds that may be faster-growing than desired native vegetation. Many excellent guides exist that can help select appropriate plants for the region.

Applications

Parking Lots and Utility Areas

Vegetated buffers, edges, and islands in these paved areas all provide opportunities for capturing, treating, and infiltrating stormwater. Using vegetated zones for stormwater capture and treatment can be more cost effective than pervious pavement systems. Parking lots in particular are opportunities to implement pervious pavement systems. These systems are often most effective in parking stall areas (where vehicular turning motions are less), and can be combined with conventional paving to create underground storage and treatment zones.

Urban Streets

Collecting stormwater off of urban streets can be accomplished with the creation of curb inlets into bioretention zones. In urban areas, these tend to be constructed as street planter elements, or as bumpouts at the ends and centers of city blocks in coordination to street parking. (See complete streets guidelines for more information). As in suburban areas, access to larger open space areas can be opportunities to collect and store larger volumes of water, with vegetated space and pervious pavement areas being equally viable options.

Suburban Streets and Roads

Similar to urban streets, the opportunity exists to capture water off of impervious vehicular zones into bioretention and biofiltration zones adjacent to roadways. Often in suburban typologies, space exists for larger, less formal bioswale structures, which can reduce costs due to reduced hardscape construction. Another potential strategy is the elimination of curb and gutter construction, which reduce costs and allow for water to flow unobstructed into green infrastructure zones. In lighter traffic areas, pervious pavement becomes a more viable option.

Federal and State Highways

Along these roads, graded swales and bio-filtration collection utilizing plantings that are appropriate for green infrastructure strategies are effective options.

PLANTING RESOURCES

- See Kansas Native Plant Initiative resources: *http://www.kansasnativeplantsociety.org/resources.php.*
- Ernst Seeds Resource Center: *https://www.ernstseed.com/resources/.*
- *Five Steps to Successful Prairie Meadow Establishment* (Prairie Nursery): *http://www.prairienursery.com/resources-and-guides/seeds-and-seed-mixes/documents/five-steps-to-successful-prairie-establishment.pdf.*
- *Native Vegetation Establishment and Enhancement Guidelines* (Minnesota Board of Water & Soil Resources): *http://www.bwsr.state.mn.us/native_vegetation/seeding_guidelines.pdf.*
- *Reconstructing a Tallgrass Prairie: A Seeding Guide for Missouri* (Shaw Nature Reserve / Missouri Department of Conservation): *http://www.missouribotanicalgarden.org/portals/0/Shaw%20Nature%20Reserve/PDFs/horticulture/NLM%20Ch1.pdf.*

NEIGHBORHOOD COMMUNITY CONNECTIONS

CENTER FOR ACADEMIC ACHIEVEMENT

Ⓑ MULTI-MODAL INTERACTIONS

The continued evolution in the development of multi-modal transportation systems in the Kansas City metro and the Shawnee Mission School District provide an important framework for implementing a broad set of green infrastructure strategies to maximize the benefits to social and ecological systems. These opportunities range from the creation of new trail connections to the retrofitting and reconstruction of neighborhood streets and larger arterials and highways. These projects must be planned and designed with an understanding of the ecological and hydrological context, and may take many forms. Within the Shawnee Mission School District, some of the key opportunities for implementing green infrastructure strategies are:

- Identification of secondary access points and ways between community amenities to increase the opportunities for more diverse connections between neighborhoods and school district facilities. The CAA is a useful precedent for this, in which a neighborhood parcel was identified to create a trail connection between the site and neighborhood sidewalks that opened access to a green infrastructure showcase to the community.
- Support for ongoing “Safe Routes to School” efforts throughout the school district and the enhancement of these efforts by identifying site and neighborhood specific design strategies to incorporate green infrastructure and practices that enhance bike and pedestrian safety. Creating green infrastructure strategies along these routes would also create powerful educational opportunities to showcase green infrastructure implementation in children’s everyday lives, and help familiarize these strategies, their appearance, and their benefits with younger generations.
- Strategies for safe vehicular, bike, and pedestrian interactions at activity nodes throughout the community, especially at trail heads, community nodes, and activity centers such as the CAA, Marty Pool, and other community centers in the area. As multi-modal transportation becomes more prevalent, the thoughtful design of these interactions becomes increasingly important.

PARTNERS

- Antioch Acres Park
- Antioch Park
- City of Overland Park, Kansas
- East Antioch Elementary School
- Johnson County Health & Environment LiveWell Programs
- Johnson County Parks & Recreation
- Johnson County Stormwater Management
- Johnson County Sustainability Programs
- Johnson County Stormwater Management
- Kansas Department of Transportation
- Marty Park / Pool
- Milburn Golf & Country Club
- Neighborhood Associations
- Safe Routes to School Program

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NEIGHBORHOOD COMMUNITY CONNECTIONS

CENTER FOR ACADEMIC ACHIEVEMENT

© EDUCATIONAL OPPORTUNITIES FOR STUDENTS, PROFESSIONALS, COMMUNITY

- Integration of broad green infrastructure principles in curriculum.
- Stewardship strategies, including connecting community to sustainable food initiatives, and cost-benefit education.
- Educational program for district-wide grounds crews and building custodians.
- Introduction to student career paths in green infrastructure and related fields through summer internship programs / jobs.
- Website for online community and web-based education geared towards professionals associated with the Shawnee Mission School District and other like professionals that are stewarding green infrastructure, including all phases of design, construction, management, education/outreach, contracting, inspections, and costing.
- On-site signage strategies for students, faculty, staff and visitors.
- Enhanced curriculum that encourages on-site participation in care of green infrastructure.

PARTNERS

- CAA Signature Programs
- East Antioch Elementary School
- Johnson County Stormwater Management
- K-State Horticulture Research & Extension Center
- Kansas State University
- Neighborhood Associations
- SMSD Faculty and Students
- SMSD Grounds Crews and Building Custodians

ED EM HW CB

Ⓓ MONITORING FOR DATA-BASED COST BENEFIT ANALYSIS

- Ecological, social, health and educational benefits of exposure to natural environment.
- Productive landscapes, including agriculture, recreation, habitat, and stormwater management.
- Research partnerships with universities focusing on the relationship between human and natural systems, efficacy of stormwater management practices, effectiveness of green and complete streets, and so on.
- Opportunities for community members to support maintenance and monitoring of grounds through partnership.

PARTNERS

- CAA Signature Programs
- East Antioch Elementary School
- Johnson County Stormwater Management
- K-State Horticulture Research & Extension Center
- Kansas Department of Transportation
- Kansas State University
- Shawnee Mission School District Faculty and Students

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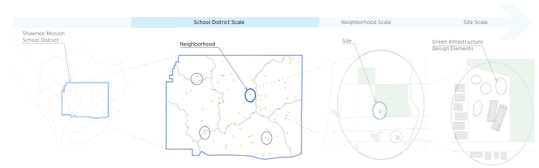
GEOGRAPHICAL ANALYSIS CONTEXT

SHAWNEE MISSION SCHOOL DISTRICT

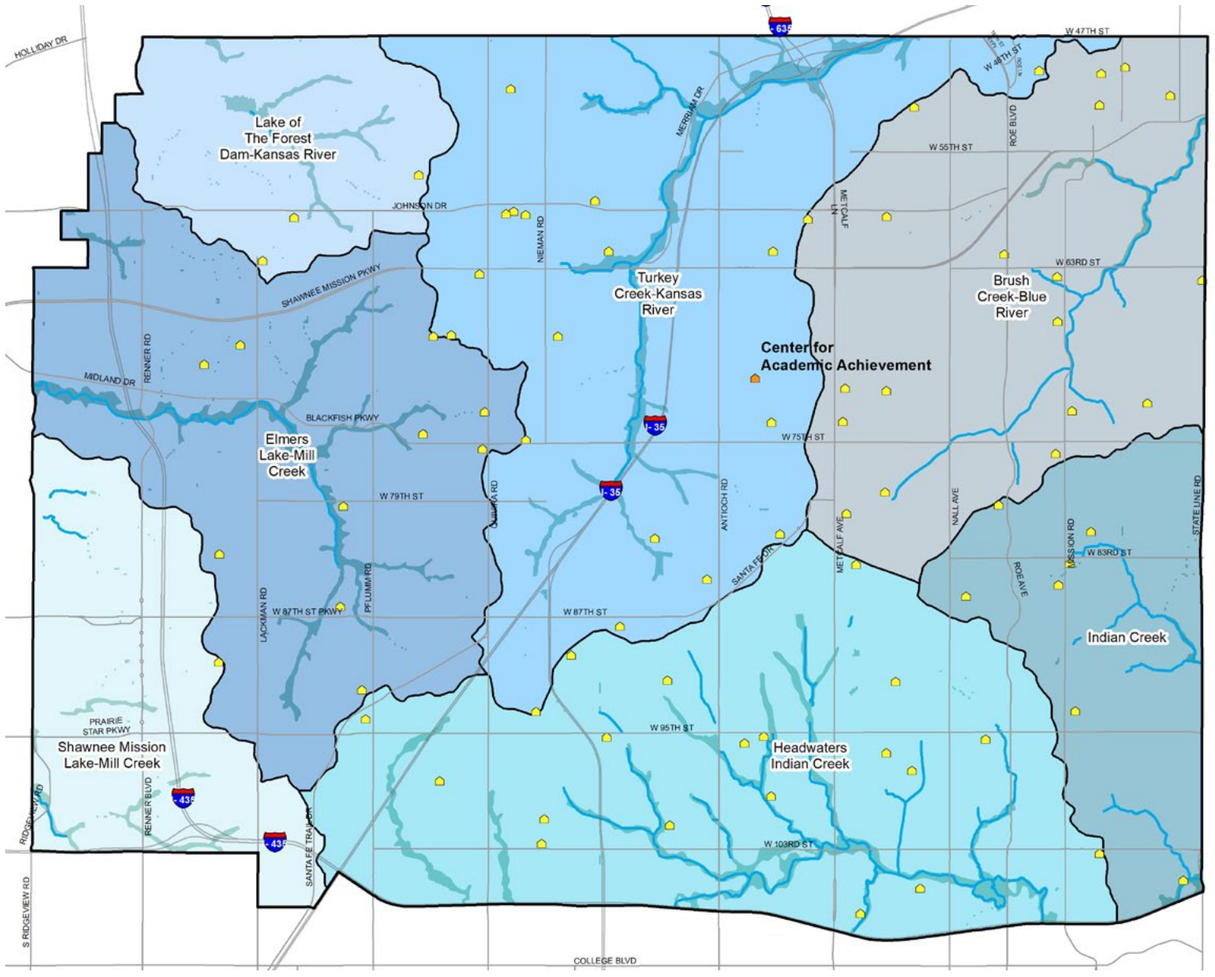
SCHOOL DISTRICT SCALE



CONTEXT OVERVIEW

The Shawnee Mission School District spans multiple watersheds and many ecological zones. The district's commitment to implementing green infrastructure on its properties has the potential to create systematic positive environmental impacts. The following part of this playbook will look at how the district can identify priority schools and other district properties for future green infrastructure projects that provide opportunities to link to nearby conservation and restoration initiatives, and evaluate the potential of green infrastructure strategies district-wide. The maps in this section illustrate the proximity and overlap of Shawnee Mission School District properties with important ecological conservation and restoration zones, providing greater regional context and clarity to the impact these projects could make.

Importantly, the Shawnee Mission School District also spans multiple municipalities and as the district leads by example in implementing projects across their district, these projects have the potential to influence many ordinances, policies, regulations, and development practices within each municipality.



Context - Watershed

Shawnee Mission School District

Shawnee Mission School District Boundary

Streams

SMSD Schools

Shawnee Mission School Sites

Center for Aa demic Ab ievement

Sub-Watersheds

Brush Creek-Blue River

Elmers Lake-Mill Creek

Headwaters Indian Creek

Indian Creek

Lake of The Forest Dam-Kansas River

Shawnee Mission Lake-Mill Creek

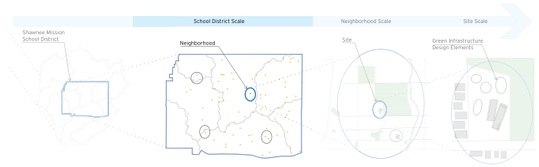
Turkey Creek-Kansas River

Wetlands

GEOGRAPHICAL ANALYSIS CONTEXT

SHAWNEE MISSION SCHOOL DISTRICT

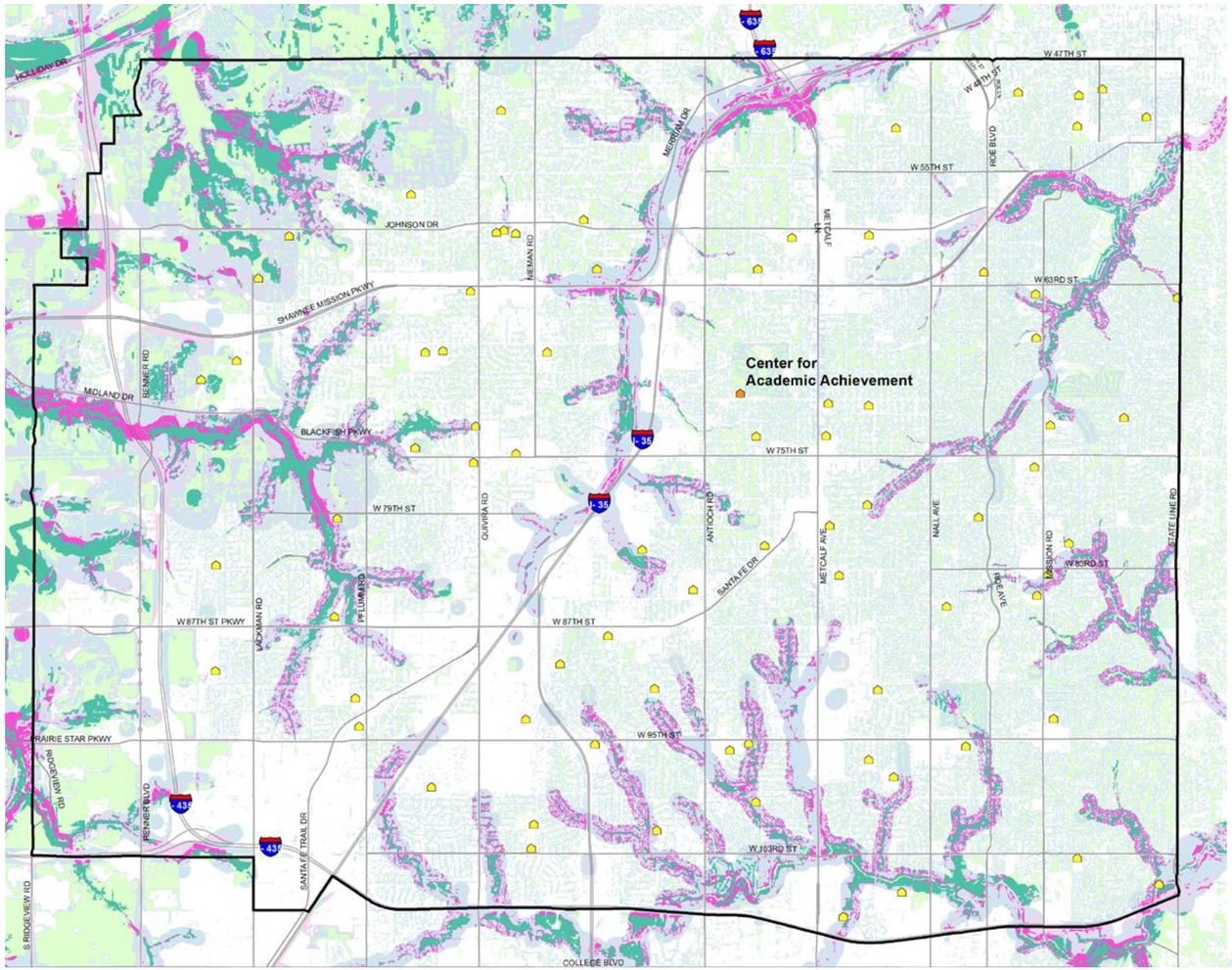
SCHOOL DISTRICT SCALE



ECOLOGICAL VALUE AREAS

This map depicts ecological conservation and restoration priority areas throughout the school district, and quantifies the amount of high value ecological area within one-quarter-mile of each school. High value ecological areas in proximity to a school provides an opportunity to functionally connect green infrastructure on school properties to nearby ecosystems and to create educational opportunities for students within a walkable distance.

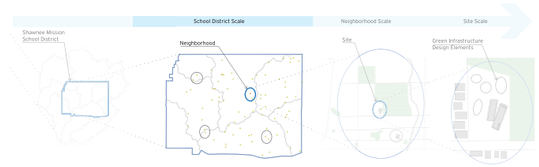
Conservation priority is defined by how many of the following conditions are present: streams, lakes, wetlands, floodplains, existing forest, large herbaceous patches, caves and karst, glades, areas providing high clean water benefits, and areas providing high wildlife benefits. A moderate conservation priority area is defined by the presence of one to two of these conditions. High conservation priority areas are comprised of three or more of these conditions. Restoration priority is defined by conservation priority areas in proximity to the following ecological impacts or needs: impervious surfaces, major roads, high forest restoration priority. In the Shawnee Mission School District, high conservation and restoration priority areas are generally concentrated along streams and rivers and their surrounding riparian floodplains. A moderate restoration priority area is defined by an otherwise moderate conservation priority area with two types of ecological impacts/needs. High restoration priority areas are comprised of otherwise high priority conservation areas with one or more ecological impacts/needs.



GEOGRAPHICAL ANALYSIS CONTEXT

SHAWNEE MISSION SCHOOL DISTRICT

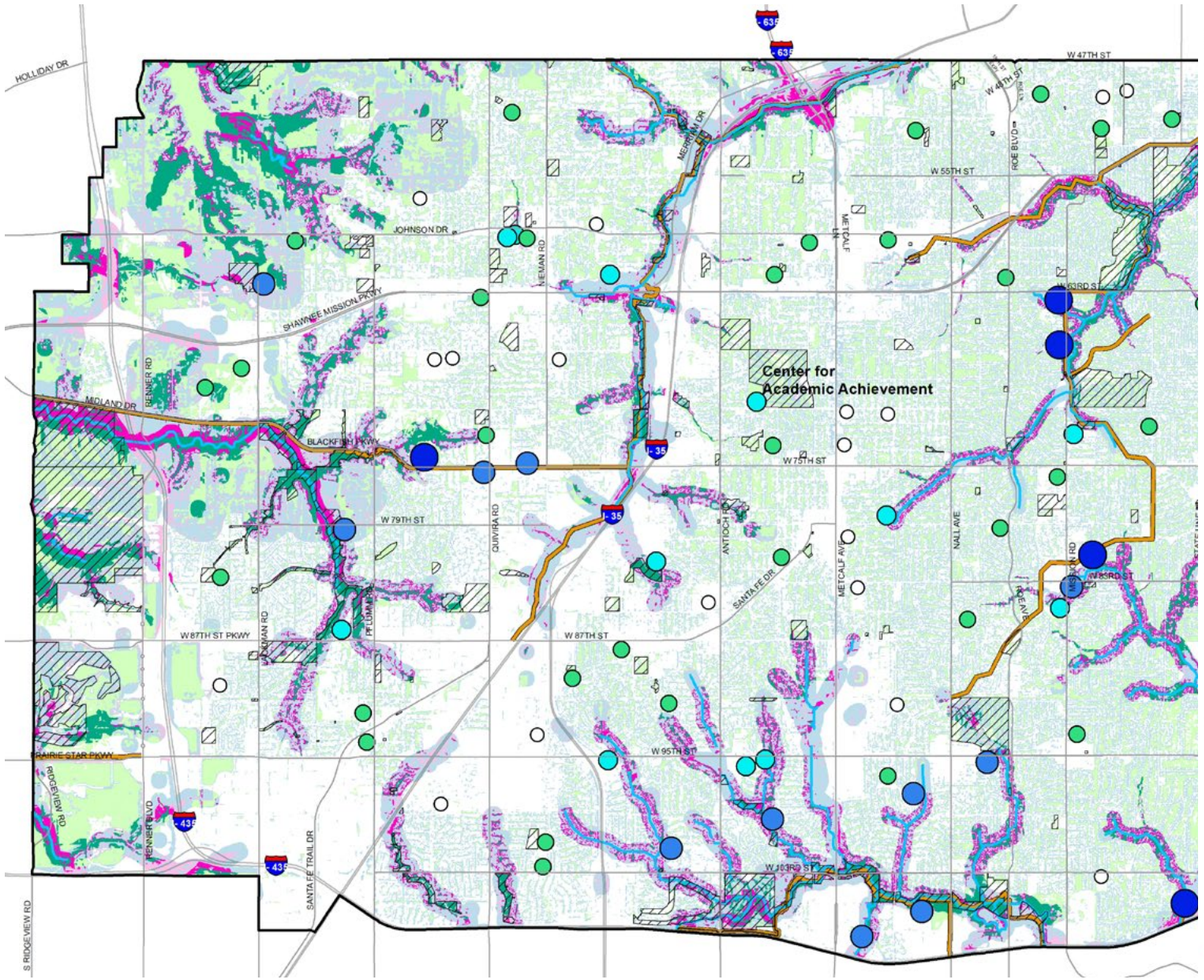
SCHOOL DISTRICT SCALE



SCHOOLS INTERSECTION WITH HIGH ECOLOGICAL VALUE AREAS

High ecological value area within one-quarter-mile of each school is defined as the presence of a high conservation priority area (as described previously), parks, land adjacent to streams (of any condition), and land adjacent to proposed MetroGreen trails. Schools with the highest acreage of nearby high ecological value area are generally in close proximity to streams and floodplains, a few are also near proposed MetroGreen trails. The CAA ranks as low to moderate in this analysis of adjacent ecological value, with 200 to 400 acres of high ecological value area, driven primarily by the tree canopy of the adjacent Milburn Country Club. However, school visitors come from a wide area, so the demonstration value of the site makes up for its somewhat lower priority location and highlights how some green infrastructure strategies will be locally opportunistic, yet still significant on a larger, regional scale.

This map can be used to help identify priority schools for future green infrastructure projects that provide opportunities to link to nearby conservation and restoration initiatives. Schools in close proximity to dark pink areas shown at right could offer opportunities for community improvements for flood control and/or service learning through restoration of natural areas. Large green patches and park sites near schools suggest locations where green infrastructure treatments could be designed to connect a network of functional areas, e.g., by creating stepping stones for pollinator habitat on school properties. A list of school addresses that have more high ecological value areas nearby are listed in the Appendix. (Some of the areas noted relate to private schools within the Shawnee Mission School District boundaries.)



OPPORTUNITY AREA SHAWNEE MISSION SCHOOL DISTRICT

ADAPTIVE MANAGEMENT APPROACH - DISTRICT SCALE

INTRODUCTION

Site design for some Shawnee Mission School District properties employed sustainable design principles including green infrastructure for stormwater management. Because these design elements are living systems, they will require stewardship and proper care to maintain, otherwise decreased functions can occur. For new sites, oversight can begin during design and installation, and with the establishment of an adaptive management program that includes monitoring. The frequency of care varies and includes preventative, routine/predictive, and reactive or emergency response. There are numerous existing resources available on green infrastructure best practices and maintenance, as provided in the adjacent resources list.

Maintenance cost is a common question during green infrastructure planning. According to a recent survey, the American Society of Civil Engineers found a wide range of green infrastructure maintenance costs. Several factors affect these costs depending on site-specific conditions and agency practices.[1] Another cost factor is the size of facilities being maintained, where larger installations were found to be somewhat more cost effective. Similarly, cost efficiencies could be achieved if management strategies are applied at a larger district scale.

The adaptive management approach recommended in this section for the Center for Academic Achievement is based on monitoring of green infrastructure installations and responding as needed when treatment elements are underperforming. The purpose of the selected strategies is to build on landscape planning conducted to date with a focus on adaptive management approaches that incorporate training, education, and capacity building for the school district and community. The recommended strategies will not only inform response actions, but will be used to increase data on functional landscapes, encourage student participation, and inform future designs adaptable to the growing body of information and anticipated shifts in climate.

The district-wide opportunity is to increase this approach to multiple facilities in an effort to build stewardship capacity, share lessons learned, and achieve potential cost efficiencies.

[1] *http://ascelibrary.org/doi/book/10.1061/9780784414897*

RESOURCES FOR ADAPTIVE MANAGEMENT STRATEGIES

There are a number of excellent existing resources for planning, design and implementation of green infrastructure practices and adaptive management strategies, including:

- *A Tale of Two Rain Gardens* (Journal of Environmental Management): *http://www.sciencedirect.com/science/article/pii/S0301479716303644?via%3Dihub*.
- *Cost of Maintaining Green Infrastructure* (ASCE Library): *https://ascelibrary.org/doi/book/10.1061/9780784414897*.
- *Ernst Seeds Resource Center*: *https://www.ernstseed.com/resources/*.
- *Five Steps to Successful Prairie Meadow Establishment* (Prairie Nursery): *http://www.prairienursery.com/resources-and-guides/seeds-and-seed-mixes/documents/five-steps-to-successful-prairie-establishment.pdf*.
- *GeoPlatform Stormwater BMP Performance Database* (U.S. EPA): *https://www.epa.gov/water-research/geoplatform-stormwater-bmp-performance-database-0*.
- *Green Infrastructure Operations and Maintenance* (U.S. EPA): *https://www.epa.gov/green-infrastructure/green-infrastructure-operations-and-maintenance*.
- *Green Values - National Stormwater Management Calculator* (Center for Neighborhood Technology): *http://greenvalues.cnt.org/national/cost_detail.php*.
- *Manual of Best Management Practices for Stormwater Quality* (APWA/MARC): *http://kcmetro.apwa.net/content/chapters/kcmetro.apwa.net/file/specifications/bmpmanual_oct2012.pdf*. See especially pp. 8-49.
- *Native Vegetation Establishment and Enhancement Guidelines* (Minnesota Board of Water & Soil Resources): *http://www.bwsr.state.mn.us/native_vegetation/seeding_guidelines.pdf*.
- *Reconstructing a Tallgrass Prairie: A Seeding Guide for Missouri* (Shaw Nature Reserve / Missouri Department of Conservation): *http://www.missouribotanicalgarden.org/portals/0/Shaw%20Nature%20Reserve/PDFs/horticulture/NLM%20Ch1.pdf*.
- *Stormwater Facility Maintenance Program* (Department of Environmental Protection, Montgomery County, Maryland): *https://www.montgomerycountymd.gov/water/stormwater/maintenance.html*.
- *Stormwater Wet Pond and Wetland Management Guidebook* (U.S. EPA): *https://www3.epa.gov/npdes/pubs/pondmgmtguide.pdf*.
- *Using Adaptive Management to Meet Conservation Goals* (USDA Natural Resource Conservation Service): *https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_013594.pdf*.

OPPORTUNITY AREA SHAWNEE MISSION SCHOOL DISTRICT

ADAPTIVE MANAGEMENT APPROACH - DISTRICT SCALE

INTRODUCTION

To expand adoption of the adaptive management approach, district-wide programs could be organized around design review and installation, routine maintanance activities, resiliency planning, and monitoring as described here.

DESIGN REVIEW AND INSTALLATION

Overall Description

Best practices for green infrastructure design are well-documented (see separate page on Design Elements), but site-specific conditions and installation issues can result in underperforming functions and undesirable aesthetics. Where green infrastructure has already been designed and installed, a retroactive design and installation review is one possibility for compiling lessons learned into a format that can be communicated across the school district.

Strategies

- Independent design reviews throughout the design development process can help identify potential weaknesses to be addressed early on. When design issues arise after installation, retrofits and modifications can help make improvements. For example, at the Center for Academic Achievement, it appears that discussions with an advisor and the designer would be useful to explore retrofits to spread flow and stabilize soils in some parking lot runoff locations where flow enters the vegetated swales.
- Contractor training and certifications are another way to help ensure that skilled installations occur and problems such as soil compaction and poor “field fitting” are prevented. Future school projects could benefit from the Center developing a list of contractor and inspector skill requirements.

ROUTINE ACTIVITIES

Overall Description

As vegetation becomes established, weeding and other establishment maintenance will be reduced, giving way to less intensive maintenance activities. These are typically activities that do not require extensive training.

Strategies

- Stormwater basin/pond trash and debris may be addressed through periodic “community cleanup days” with student and community volunteers. Similarly, weed pulls in the vegetated swales could be conducted in organized events possibly connected to the farm.
- Woody tree control can be accomplished either through burning (see below) or by hand removal on an annual basis.
- Hand weeding will be required less intensively once native plant beds are fully established, but this activity will still be important every three to four weeks during growing months. The intensity of this activity will continue to decrease annually as weeds are eliminated from the soilbank and native vegetation eliminates competition.
- Mulching should occur as needed, based on visual monitoring. This will become more sporadic as plant communities are established.
- Erosion control will also be managed based on visual inspection of the site, with the use of erosion blankets and replanting of plugs (rather than seed) being recommended in high erosion areas.
- Burning should be considered if possible, every three to five years after establishment to eliminate woody plants and enrich the soils.
- Pervious pavement, when it is utilized, should be inspected and maintained annually. Vacuuming by a professional is recommended annually to remove sediment and sand from pore space to keep pavements at optimal performance. It is also critical to communicate with winter maintenance crews to establish pavement types to avoid over-plowing and to eliminate the use of sand in winter pavement treatments.

RESILIENCY PLANNING & MONITORING

Overall Description

Given changing climate patterns, increased extreme weather events are occurring more frequently. Instead of designing for average rainfall events or 100-year flooding, some designers are beginning to plan for 500-year flood events. Regardless of the design criteria, some disturbances are natural and should be anticipated.

Strategies

- Monitoring activities could be conducted by the students including installing a climate station to relate trends in site runoff to event sizes. Monitoring parameters could include runoff volumes/duration/timing, water quality indicators, and soil health. Nearby universities may be able to assist in setting up and evaluating the precipitation monitoring.
- The Shawnee Mission School District Wellness Program may be able to establish health indicators to track benefits to visitors and volunteers after walking or working at the site. Again, nearby universities could help supplement high school student capabilities.
- For future projects, the CAA monitoring plan could be used as a template for other schools to adopt as early as during the design process. Ideally, facilities will begin the process of resiliency planning and include a monitoring plan with a list of indicators and thresholds for when response actions are required.
- Informal monitoring and citizen science participation could be facilitated through development of a mobile device app.

OPPORTUNITY AREA SHAWNEE MISSION SCHOOL DISTRICT

ADAPTIVE MANAGEMENT APPROACH - DISTRICT SCALE

NOTE: There are numerous guides available to assist with development and implementation of design elements, a small sampling of which are included here.

STORMWATER SYSTEMS

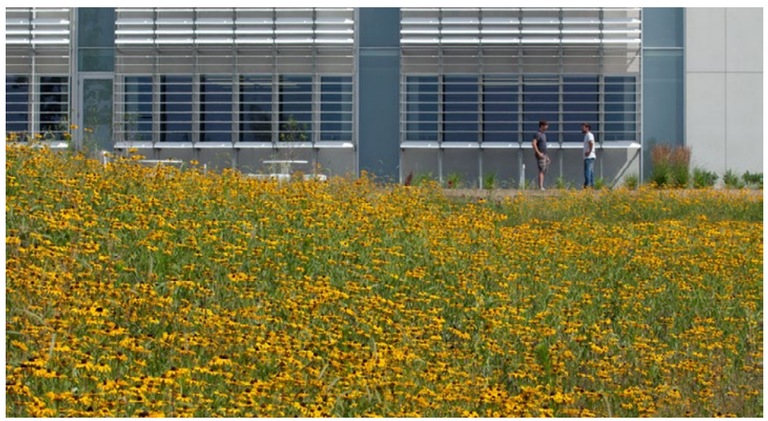
Refer to the following resources: *Manual of Best Management Practices for Stormwater Quality* (APWA/MARC), *Green Infrastructure Operations and Maintenance* (U.S. EPA), *A Tale of Two Rain Gardens* (Journal of Environmental Management).

TRAILS

Trail classes include: 1-Minimal/Undeveloped Trail; 2-Simple/Minor Development Trail; 3-Developed/Improved Trail; 4-Highly Developed Trail; 5-Fully Developed Trail. Refer to *https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=27584.wba* (specifically refer to Different Trail Design Parameters: Page 28 Appendix A).

NATIVE PRAIRIE

Refer to the following resources: *Ernst Seeds Resource Center*, *Five Steps to Successful Prairie Meadow Establishment* (Prairie Nursery), *Reconstructing a Tallgrass Prairie: A Seeding Guide for Missouri* (Shaw Nature Reserve / Missouri Department of Conservation), *Native Vegetation Establishment and Enhancement Guidelines* (Minnesota Board of Water & Soil Resources).



WILDFLOWERS & GRASSES

Refer to the following resources: *Ernst Seeds Resource Center*, *Reconstructing a Tallgrass Prairie: A Seeding Guide for Missouri* (Shaw Nature Reserve / Missouri Department of Conservation).

NATURAL STORMWATER CONVEYANCE

See *Stormwater Wet Pond and Wetland Management Guidebook* (U.S. EPA). *Also, West Virginia Stormwater Management and Design Guidance Manual, 4.2.7 Regenerative Stormwater Conveyance System (RSC) AWRA, Water Resources IMPACT, September 2009, Volume 11, Number 5.*

CULINARY GARDEN AND ORCHARD

See University of Missouri Extension "Urban Agriculture Best Practices and Possibilities": *http://extension.missouri.edu/foodsystems/documents/urbanagreport_072012.pdf*. Also, CultivateKC at: *http://www.cultivatekc.org/*.

SUMMARY
SHAWNEE MISSION SCHOOL DISTRICT

School facilities offer a unique opportunity to model best practices in green infrastructure for both the future workforce and surrounding communities. The Shawnee Mission School District has embraced the opportunity to lead by promoting sustainable landscapes and using ecological design principles to increase student achievement, improve environmental quality, and serve the community.

The adaptive management strategies created for the Shawnee Mission School District and the on-the-ground experience and lessons that will continue to be learned at the Center for Academic Achievement will position the district to adapt these strategies for other schools and facilities throughout the district. As other impactful school sites that have ecological value (both from a conservation and restoration standpoint) are identified and developed, the opportunity for incorporating and connecting these green infrastructure strategies to surrounding communities, and to other conservation and restoration initiatives, will continue to grow, expanding the network of green infrastructure strategies at a regional and increasingly impactful scale.

Shawnee Mission School District is in a unique position to influence decision-makers in their district, the municipalities that are part of their district, and other districts that look to them as a model throughout the region. As Shawnee Mission measures the benefits of sustainable landscapes and the practices to manage them, they will share these lessons learned with students, teachers, families, neighbors, elected officials, local businesses and collaborators from other districts. Through a strong educational partner, it is possible that action, measurement, and policy can go hand-in-hand to increase water quality, air quality, habitat quality, food quality, and access to safe and inspiring walking and biking paths for the region.

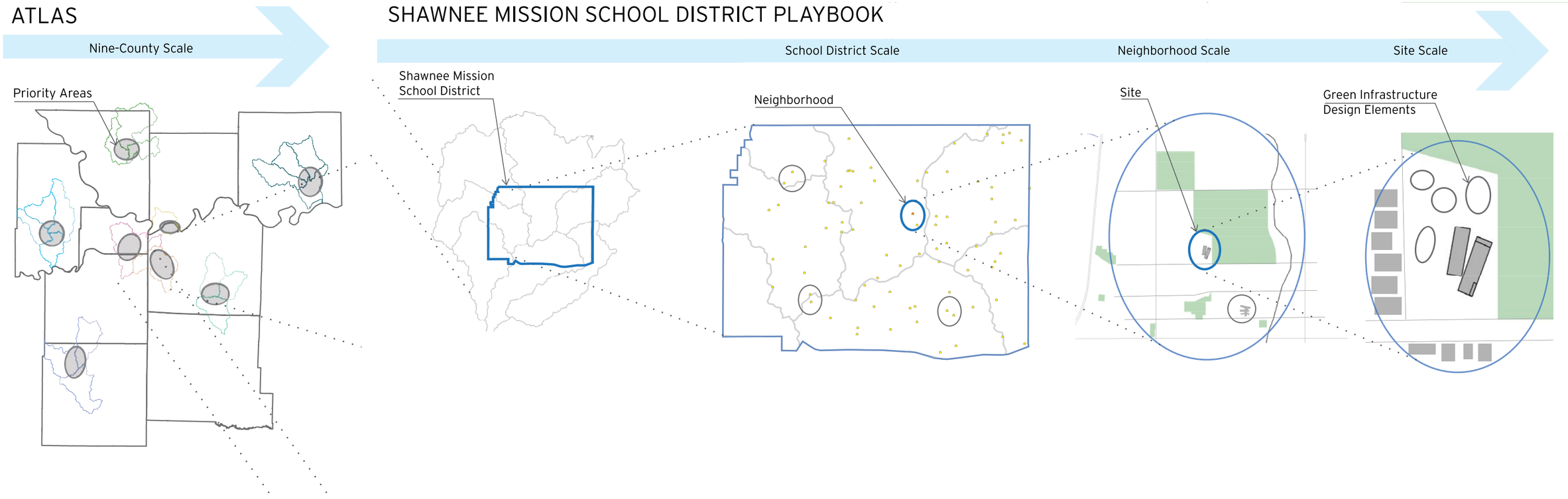
APPENDIX

STUDY OF SCALES

GREEN INFRASTRUCTURE PLAYBOOK

SCALE DIAGRAM

Below is the scale diagram for the Shawnee Mission School District, and on the following page is a glossary describing the scales and terms used throughout the Playbook.



GLOSSARY OF TERMS (ordered by scale)

Atlas: A set of maps that help identify priority areas for integrated green infrastructure strategies at a regional scale.

Playbook: A framework that demonstrates replicable approaches for implementing green infrastructure for ecological and socioeconomic benefits using nested scales of analysis.

Priority Area: Based on a watershed-scale analysis, these locations are selected for further study based on the established criteria of momentum, need, access and proximity set forth in Phase 1 of the Green Infrastructure Framework.

Watershed: Natural drainage area boundaries developed by the U.S. Geological Survey are the foundation of the Playbook because they group priority areas and partners based on ecological and hydrological relationships that go beyond municipal/political boundaries. In the first map of each playbook, multiple watershed boundaries are illustrated.

Corridor Scale: For the Rock Island playbook, this is the largest scale within multiple watersheds that identifies a common focus for infrastructure improvements along a common transit zone.

Opportunity Area: Within each priority area of a watershed, there are often multiple clusters of opportunities that merit further analysis to identify a starting point that will have the greatest potential for immediate impact. For the Rock Island playbook, this translates to the scale of a transit corridor. For the Shawnee Mission School District, this translates to the school district boundaries.

Sub-Corridor Scale: This scale is a more manageable area to comprehend the benefits of integrated green infrastructure within the context of specific neighborhoods and partnerships with local stakeholders.

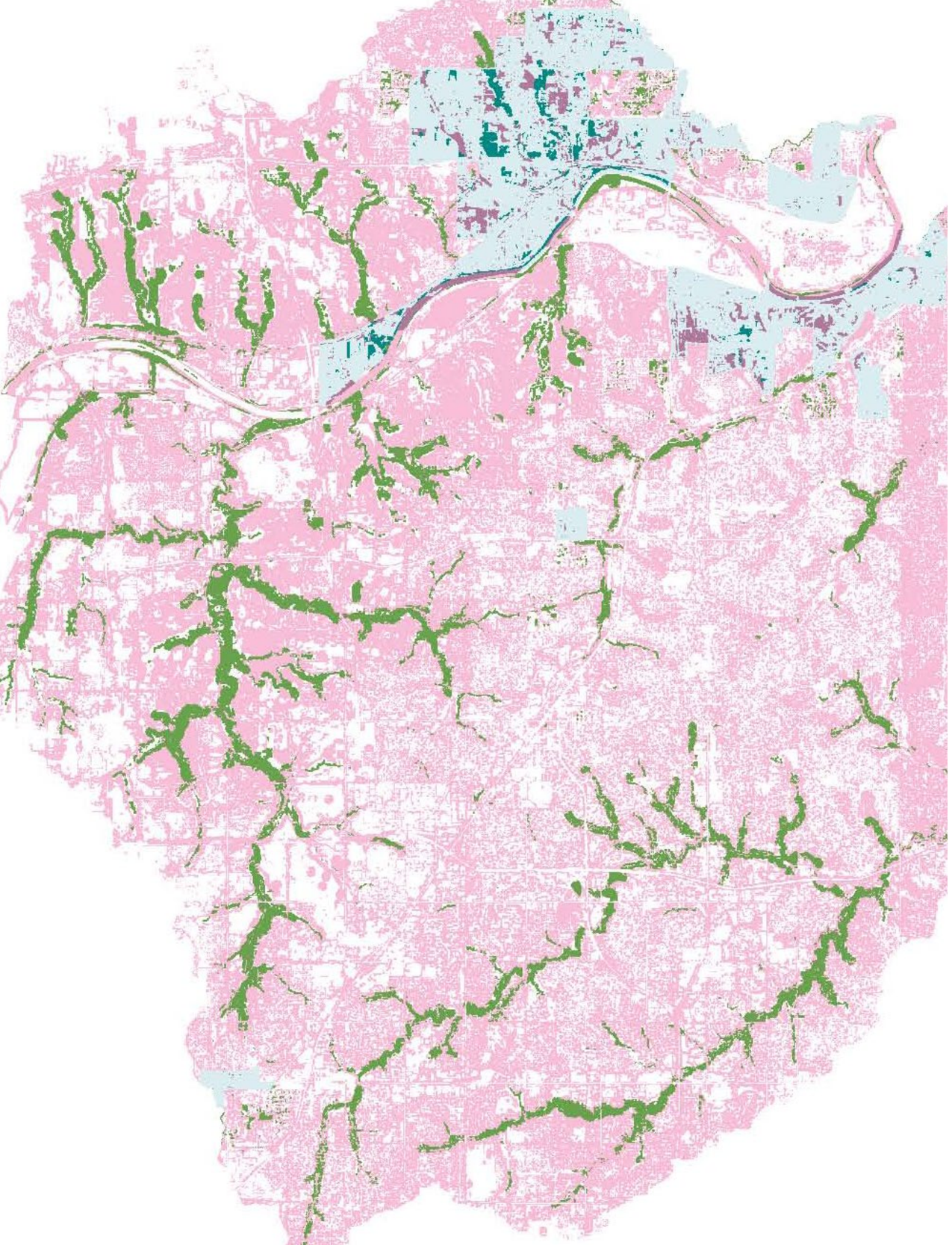
School District Scale: For the Shawnee Mission playbook, this scale allows the school administration to understand the breadth of green infrastructure implementation across their property holdings and the municipalities within which they operate.

Focus Area: Within an opportunity area, this is the neighborhood or community-scale area that is used to establish connections between projects and to develop recommendations for implementable site-specific green infrastructure strategies. Both the Rock Island and Shawnee Mission School District playbooks illustrate this scale through the context of adjacent neighborhoods.

Network Connectors: These are a list of green infrastructure solutions that work together within an area to address multiple challenges and link smaller project sites together to strengthen the network of watershed-scale benefits.

Neighborhood Scale: The neighborhood scale is critical to green infrastructure implementation because of the engagement required of local landowners and stakeholder organizations to steward the work and champion the benefits for people and nature.

Site Scale: Within a focus area or neighborhood, this scale is where on-the-ground implementation occurs for fundable projects that address site-specific needs while contributing to the integrated green infrastructure approach that is envisioned for all other scales.



GEOGRAPHIC DATA

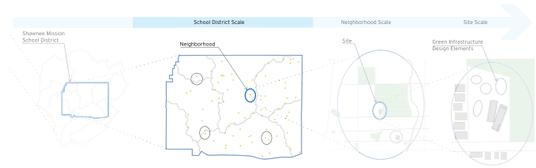
INTRODUCTION

This Appendix contains maps with geographic information for the Shawnee Mission School District project. This data was used, in conjunction with stakeholder interviews and site visits, to produce the Playbook guidance for this project. While this data is not an empirically comprehensive process of analysis, these inputs result in the design of integrated strategies that are well-suited to the place and people, and have support from local organizations for implementation.

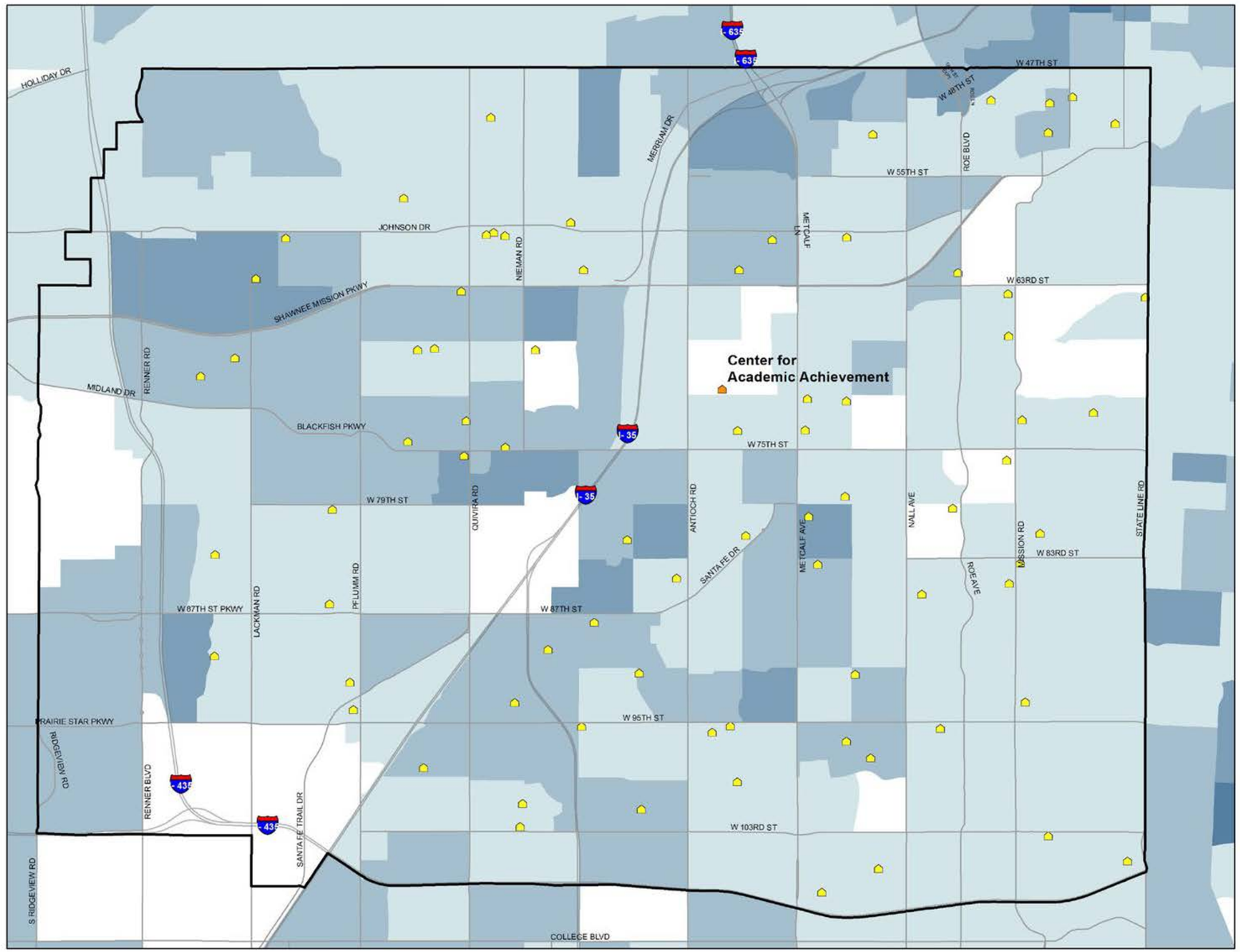
PERCENT MINORITY POPULATION

SHAWNEE MISSION SCHOOL DISTRICT

SCHOOL DISTRICT SCALE



Minority populations were mapped as one component of social need. Historically, minority communities are places of particular vulnerability, where health, education, access to opportunity and equity needs are pronounced.



Percent Minority Population

Shawnee Mission School District

Shawnee Mission School District Boundary

SMSD Schools

Shawnee Mission School Sites

Center for Academic Achievement

Percent of Minority Population

1% - 12%

12% - 27%

27% - 50%

50% - 76%

76% +

0 0.5 1 Miles

N

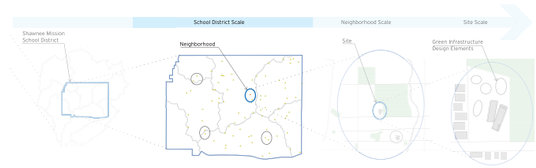
bnim Biohabitats BIKE WALK KC

Data Sources: *ACS 2015 5-year Block Group, MARC, KCMO Parcel Viewer*

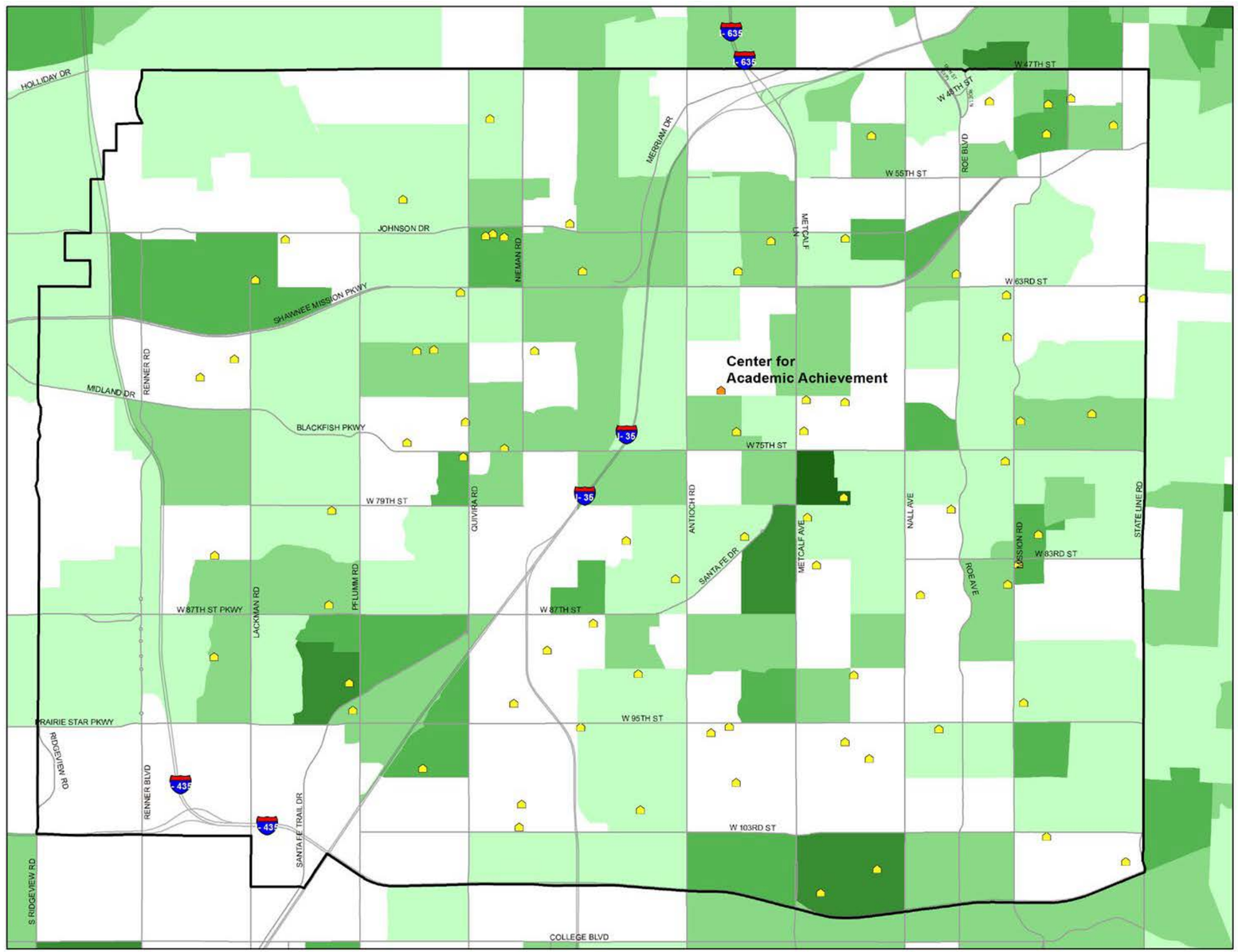
PERCENT OF ZERO-VEHICLE HOUSEHOLDS

SHAWNEE MISSION SCHOOL DISTRICT

SCHOOL DISTRICT SCALE



Zero-vehicle households were mapped as one component of social need. Zero-vehicle households are those who use alternative transportation modes by necessity rather than by choice, and so represent an important consideration when identifying connections and green infrastructure opportunities.



Percent of Zero-Vehicle Households

Shawnee Mission School District

Shawnee Mission School District Boundary

SMSD Schools

Shawnee Mission School Sites

Center for Academic Achievement

Percent of Zero-Vehicle Households

1% - 4%

4% - 11%

11% - 21%

21% -34%

34% +

0 0.5 1 Miles

N

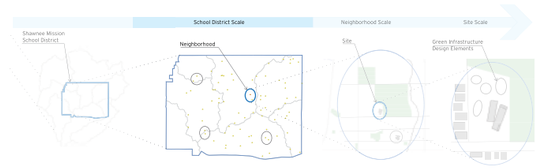
bnim Biohabitats BIKE WALK KC

Data Sources: *ACS 2015 5-year Block Group, MARC, KCMO Parcel Viewer*

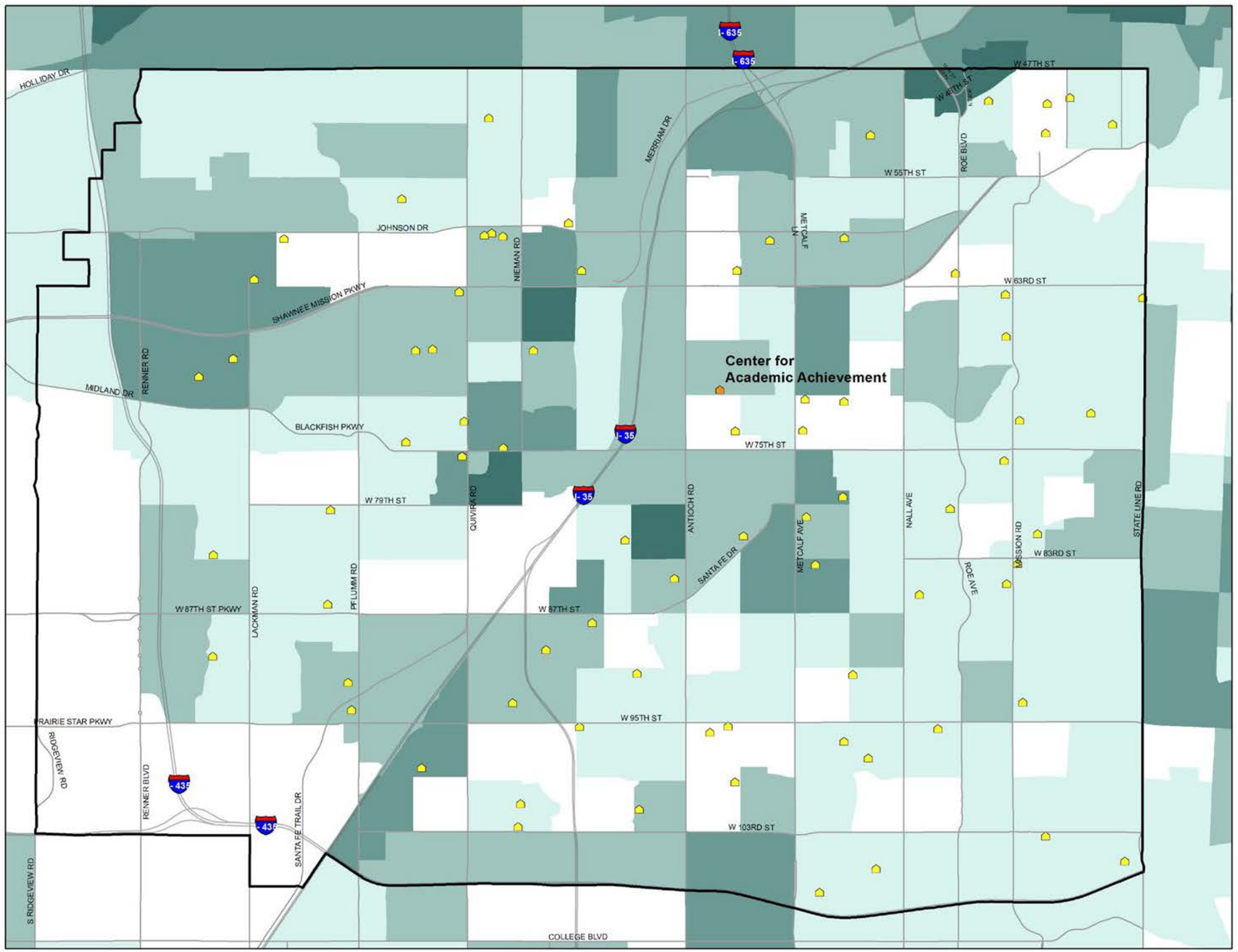
PERCENT OF POPULATION WITH INCOME BELOW POVERTY

SHAWNEE MISSION SCHOOL DISTRICT

SCHOOL DISTRICT SCALE



Poverty was mapped as one component of social need. Areas of poverty are places of particular vulnerability, where health, education, access to opportunity and equity needs are pronounced.



Percent of Population with Income Below Poverty

Shawnee Mission School District

Shawnee Mission School District Boundary

SMSD Schools

Shawnee Mission School Sites

Center for Academic Achievement

Percent in Poverty

1% - 6%

6% - 15%

15% - 27%

27% - 42%

42% +

0 0.5 1 Miles

N

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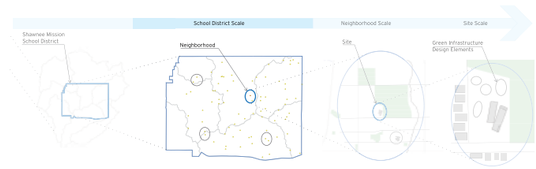
Data Sources: *ACS 2015 5-year Block Group, MARC, KCMO Parcel Viewer*

SOCIAL NEED INTERSECTION ANALYSIS

SHAWNEE MISSION SCHOOL DISTRICT

SCHOOL DISTRICT SCALE



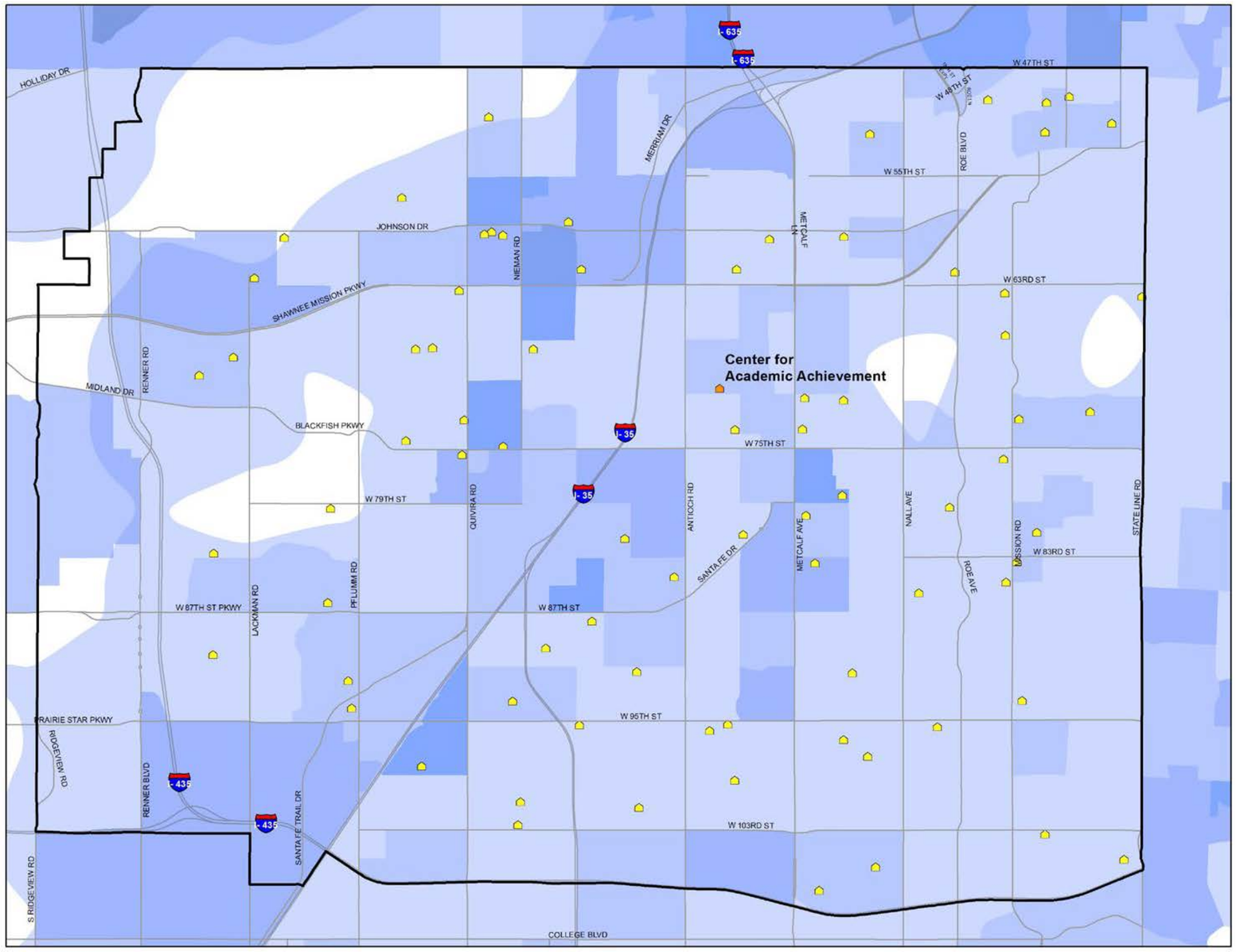
Social need was modeled along with data for the watersheds and analyzed the following social factors:

- Poverty.
- Hazardous Waste.
- Population Loss.
- Health Indicators.
- Food Deserts.
- Educational Attainment.
- Zero-Vehicle Households.
- Minority Populations.

On this map, the darker the blue the higher number of intersection/ overlap of these social factors.

The data sets of Health Indicators and Food Deserts were selected as proxies for access to healthcare and healthy environments. Hazardous waste was selected as a proxy for the nexus between land use, environmental conditions, and human health. Population loss, poverty, and patterns that imply minority segregation were selected as proxies for economic disinvestment and vulnerability. Educational Attainment was selected as a proxy for access to education. Zero-vehicle households was selected as a proxy for general access to opportunity and services. Areas identified with high levels of intersection are identified as high social need and therefore a priority for using green infrastructure to address social needs.

Data Sources: *ACS 2015 5-year Block Group, MARC, KCMO Parcel Viewer*



Intersection of Social Need

Shawnee Mission School District

0 1 2 3 4 5 6 7 8

Social Need Score

Shawnee Mission School District Boundary

SMSD Schools

Shawnee Mission School Sites

Center for Aa demic Ab ievement

0 0.5 1 Miles

N

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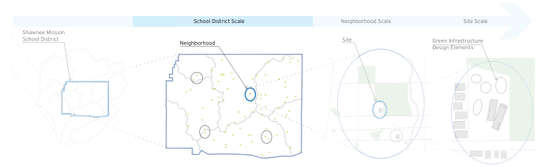
ECOLOGICAL VALUE AREAS

SHAWNEE MISSION SCHOOL DISTRICT

SCHOOL DISTRICT SCALE



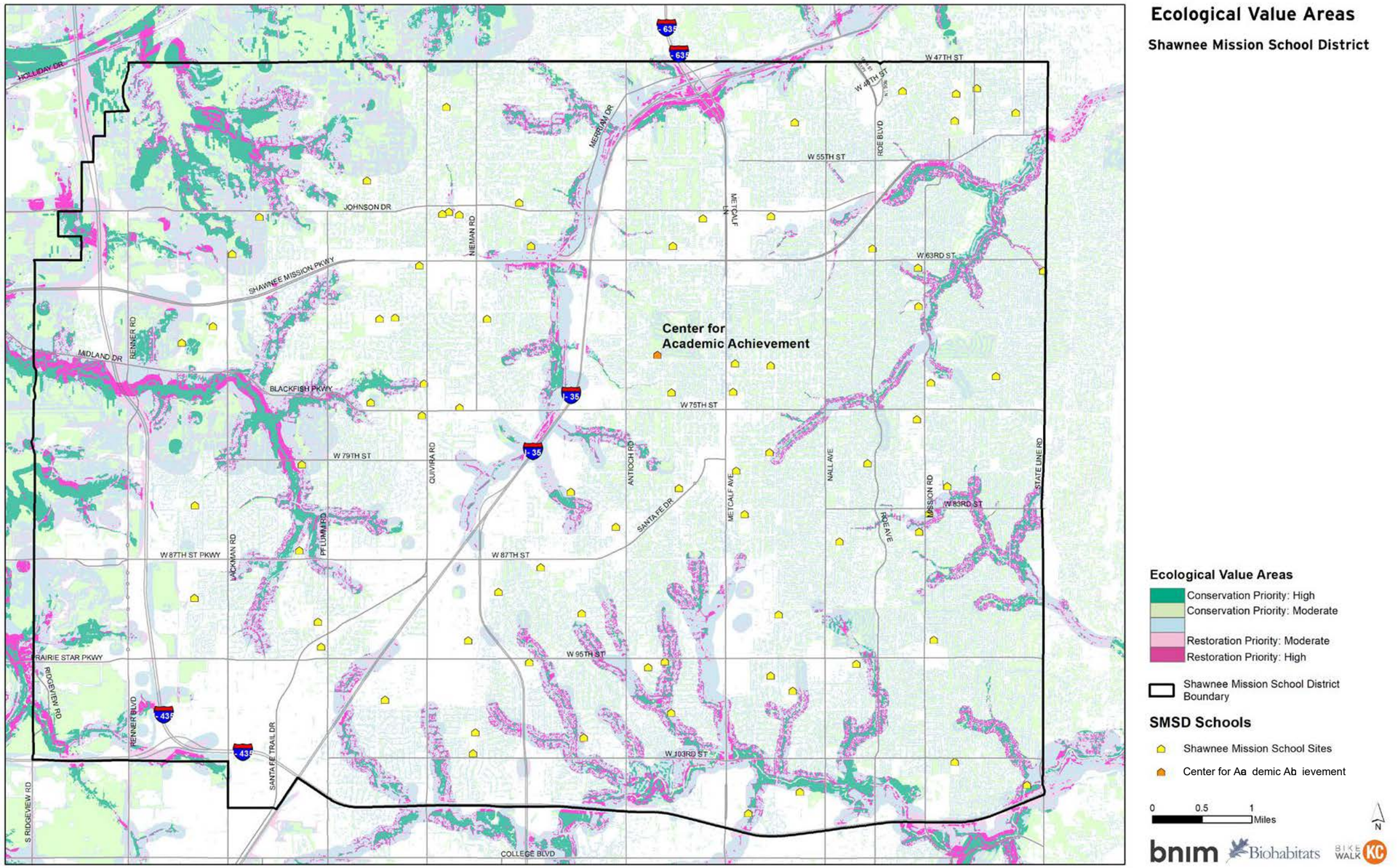
This map was created to show the intersections between value and need. Areas with moderate and high ecological value and no impacts or needs are considered a conservation priority (light and dark green). Areas with moderate and high ecological value that do have impacts or needs are considered a restoration priority (pink and magenta).

The factors of high ecological value include:

- Streams.
- Lakes.
- Wetlands.
- Floodplains.
- Existing Forest.
- Large Herbaceous Patches.
- Caves and Karst.
- Glades.
- Clean Water Benefits.
- Wildlife Benefits.

The factors of ecological impact or need are:

- Impervious Surface.
- Major Roads.
- Highest Forest Restoration Priority.



Ecological Value Areas

Shawnee Mission School District

Ecological Value Areas

- Conservation Priority: High
- Conservation Priority: Moderate
- Restoration Priority: Moderate
- Restoration Priority: High

Shawnee Mission School District Boundary

SMSD Schools

- Shawnee Mission School Sites
- Center for Aa demic Ab ievement

0 0.5 1 Miles

N

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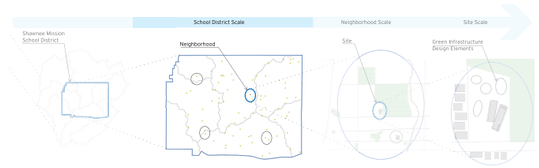
Data Sources: *ACS 2015 5-year Block Group, MARC, KCMO Parcel Viewer, The Conservation Fund*

SCHOOLS INTERSECTION WITH ECOLOGICAL VALUE AREAS

SHAWNEE MISSION SCHOOL DISTRICT

SCHOOL DISTRICT SCALE



Shawnee Mission School District schools* with high ecological value areas nearby include:

> 600 Acres

- Indian Hills Middle - 6400 Mission Road, Shawnee Mission, KS 66208
- Corinth Elementary - 8301 Mission Road, Shawnee Mission, KS 66206
- Prairie Elementary - 6642 Mission Road, Shawnee Mission, KS 66208

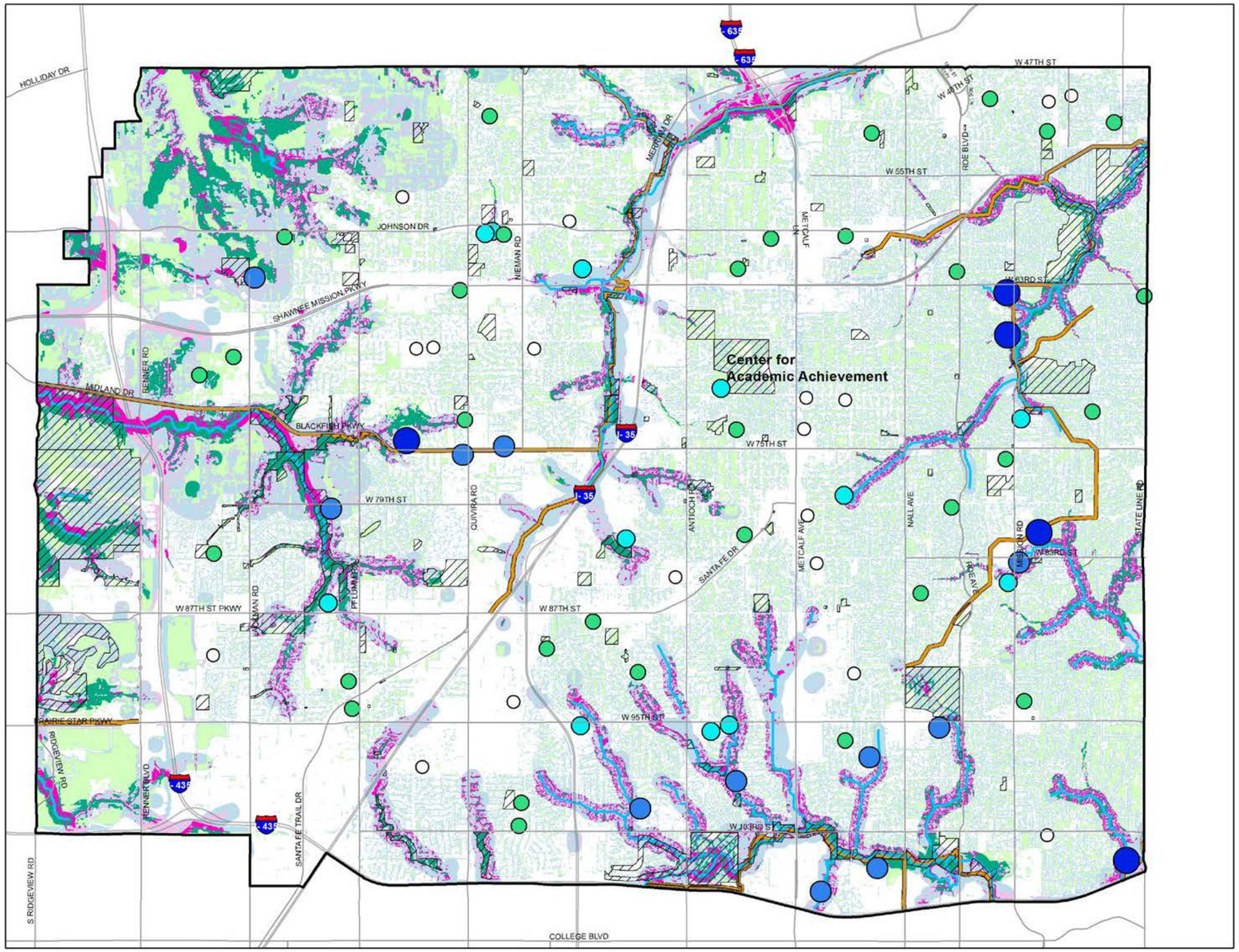
400-600 Acres

- Shawnee Mission South High - 5800 W. 107th St., Shawnee Mission, KS 66207
- Mill Creek Elementary - 13951 W. 79th St., Shawnee Mission, KS 66215
- Trailwood Elementary - 5101 W. 95th St., Shawnee Mission, KS 66207
- Brookridge Elementary - 9920 Lowell, Shawnee Mission, KS 66212
- Trailridge Middle - 7500 Quivira Road, Shawnee Mission, KS 66216
- Shawanoe Elementary - 11230 W. 75th St., Shawnee Mission, KS 66214
- Indian Woods Middle - 9700 Woodson, Shawnee Mission, KS 66207

Ecological value is only one aspect to consider as stated in the Playbook. Momentum, need, and access should also be considered around a project.

** Note: Some circles indicate private schools that fall within the Shawnee Mission School District boundaries..*

Data Sources: *ACS 2015 5-year Block Group, MARC, KCMO Parcel Viewer, The Conservation Fund*



Schools Intersection with High Ecological Value Areas

Shawnee Mission School District

Shawnee Mission School District Boundary

Schools w/ High Value Eco Areas w/in 1/4 mile

(High value eco= parks, streams, proposed Metrogreen Trails, and high value conservation areas)

- > 600 acres
- > 400 acres to 600
- > 200 to 400 acres
- > 0 to 200 acres
- Schools without High Value Ecological Areas nearby
- Parks
- Streams
- Propose d MetroGreen Trails

0 0.5 1 Miles

N

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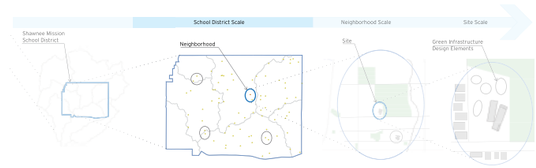
INTERSECTION OF ECOLOGICAL AND SOCIAL NEED

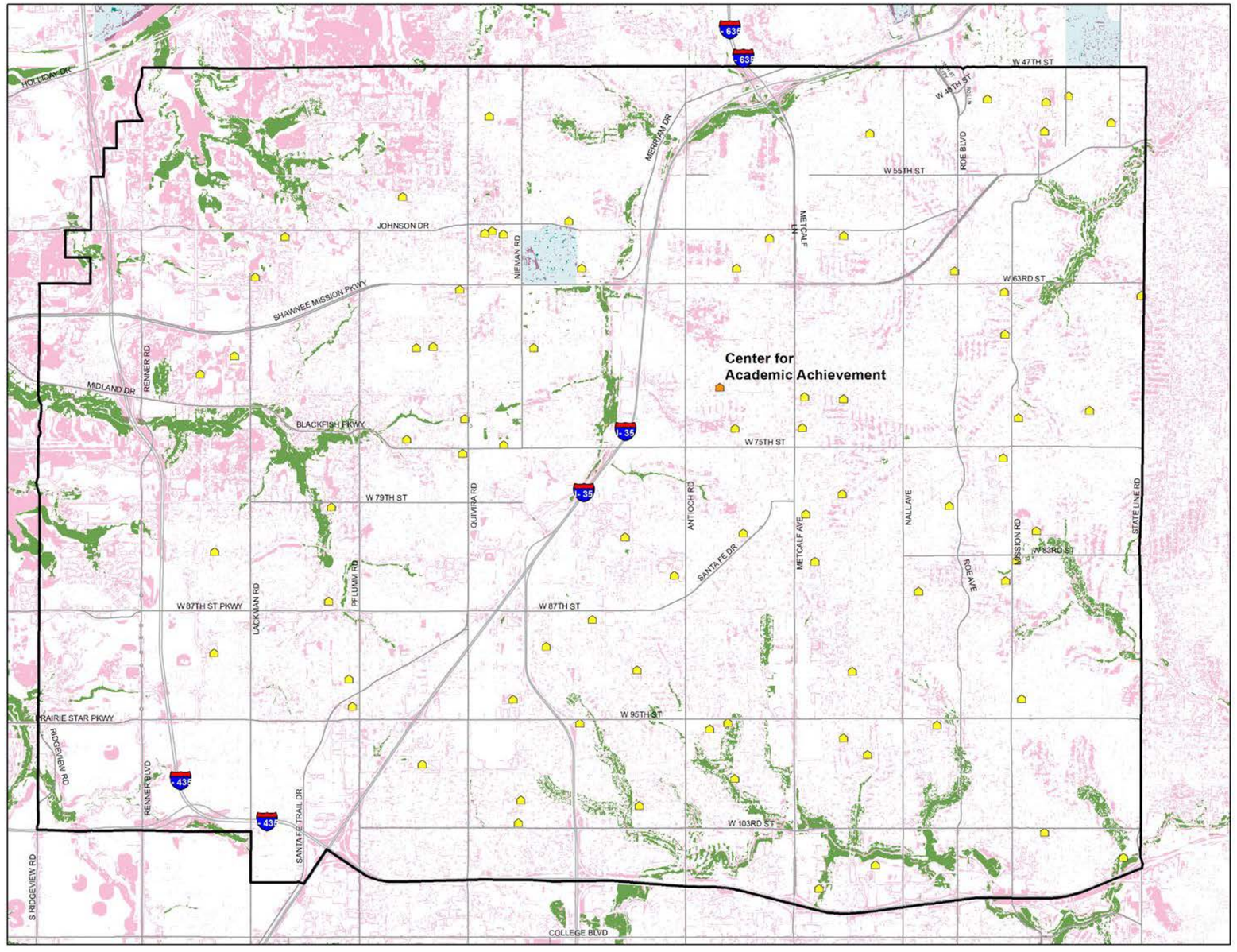
SHAWNEE MISSION SCHOOL DISTRICT

SCHOOL DISTRICT SCALE



The primary purpose of this analysis is to find areas of the greatest intersection of need, so the areas of black, dark teal, and dark purple indicate areas of high interest in this study.

The quantitative analysis used was an intersection analysis to view ecological value and need and social need jointly and holistically. This is a trivariate map, where each unique color represents a different combination of intersection. Light pink indicates the presence of high value ecological resources and conservation needs, but no other need intersection. Green and blue indicate ecological need for restoration and social need, respectively. Darker shades are used to represent greater intersection: dark teal for areas of social and restoration intersection, and dark purple for social and conservation intersection. Black indicates an intersection of all three needs, which does not occur as restoration and conservation values do not typically overlap.



Data Sources: *ACS 2015 5-year Block Group, MARC, KCMO Parcel Viewer, The Conservation Fund*