REINVENT PHOENIX

SUSTAINABLE GREEN SYSTEMS STRATEGY FOR THE DISTRICT OF SOLANO

Partners:

City of Phoenix

U.S. Department of Housing and Urban Development

St. Luke's Health Initiatives

ASU Global Institute of Sustainability, Arizona State University

Reinvent PHX

Sustainable Green Systems Strategy for the Solano District, Phoenix (2014—2040)

Report submitted to the City of Phoenix Planning and Development Department by the ASU-SOS Team for the project grant “Reinvent Phoenix – Cultivating Equity, Engagement, Economic Development and Design Excellence with Transit-Oriented Development”, funded by the U.S. Department of Housing and Urban Development (HUD)

Principal Investigators

Dr. Arnim Wiek, Dr. Aaron Golub

Faculty Affiliated to the Project

Dr. Edward Cook

Graduate Research Assistants

John Harlow, Josh Schmidt

Postdoctoral Researcher

Dr. Braden Kay

February, 2014

School of Sustainability

Arizona State University

ASU SCHOOL of SUSTAINABILITY
ARIZONA STATE UNIVERSITY

Table of Contents

Acknowledgements

This strategy report has benefited from collaboration with project partners at the City of Phoenix, including Curt Upton, Lysistrata “Lyssa” Hall, and Joel Carrasco. Graduate students at Arizona State University’s School of Sustainability, and members of Sustainability the Transition and Intervention Research Lab assisted throughout the study’s activities and events.

Executive Summary

The transition strategy in this report is a set of coordinated interventions necessary to create sustainable green systems in the Solano District. Sustainable green systems strive for fully functional stormwater, biodiversity, and resource management practices, as well as sustainable levels of thermal comfort, energy efficiency, and access to green space. The assessment of green systems indicates concern for high temperatures, low vegetation, and insufficient stormwater management. So, there are clear needs for interventions and investments to achieve sustainability goals. This strategy is based on achieving four specific goals of sustainable green systems, derived from sustainability and livability principles (HUD, 2009). The following table shows the goals with indicators, targets, and distances-to-target that the strategy covers.

Indicator	Sustainability Target	Current State Data	Distance-to-target
Goal 1 – Reduce stormwater loads and harvest water onsite			
Permeable land	80%	31%	41%
Goal 2 – Reduce potable water consumption			
Indoor residential	30 GPCD	42 GPCD	12 GPCD
Goal 3 – Reduce daytime temperatures			
Surface temperatures above 130°F	<1%	17.8%	~18%
Goal 4 – Increase green systems benefits to health, mobility, and the economy			
Vegetation coverage	25%	3.5%	21.5%
Green streets	2 miles	0 miles	2 miles

This strategy details the interventions, actions, resources, potential barriers, and specifics on investments necessary to achieve these goals. Interventions are categorized into streets, buildings and sites, and open space. The following is a summary of each intervention and a sample of related critical actions.

Streets Intervention and Critical Actions

The streets intervention invests in green streets and green parking, and will increase length of green streets in the District to two miles through the following actions:

1. Complete green street pilot projects allows 17th Avenue to connect residents to the light rail.

2. Begin major green streets investments on Camelback Road.

3. Build sustainable financing mechanisms for green streets in the District, such as a business improvement district or an in-lieu fees program for right-of-way and street improvements.

4. Support research that improves evidence for best practices in green streets and green parking implementation, including material use, vegetation and tree selection, and rainwater management.

Buildings and Sites Intervention and Critical Actions

The building and sites intervention invests in water harvesting and reuse, natural and engineered shade, and cooling. The intervention, will reduce indoor residential District potable water use by 12 gallons per person per day, and achieve other vision targets through these actions:

1. Pass code updates that create density-dependent guidelines for water harvesting and reuse, natural and engineered shade, and cooling.

2. Design, finance, build, and test green systems pilot projects along major corridors and in neighbor¬hoods.

3. Support research on next-generation water harvesting, water reuse, and engineered shade and cooling technologies.

4. Improve and develop incentive programs for cool building materials, water harvesting and reuse technologies, and energy efficiency.

Open Space Intervention and Critical Actions

Neighborhood water retention, green civic space, and green parking are the open space intervention investments. This intervention will increase permeable land by up to 500 acres in the District through the following actions:

1. Create open space pilots projects at Solano Elementary School, and Westwood Primary School to increase retention capacity with silva cells, orchards, rain gardens, and other water harvesting and retention mechanisms.

2. Renegotiate the MS4 permit to allow for next-generation stormwater solutions in the District.

3. Create long-term funding structures, such as in-lieu feeds for trees and retention, that could be part of neighborhood associations (Simpson, Washington Park, Niles, and Westwood), Business Improvement District (BID) or Community Development Corporation (CDC).

Conclusion

This strategy also includes a database of implementation tools (financing tools, partnerships, codes, capacity building, and incentives) available to implement each intervention. There is a 5-year action plan with details on achieving critical, early wins, and getting the green systems transition off to a strong start. In summary, this strategy seeks to guide the District toward green systems that naturally manage stormwater on-site, reduce daytime temperatures, and provide safe, cool spaces for citizen recreation and transportation through interventions in streets, buildings, and open space.

Correspondence to Scope of Work

Scope-of-Work Items	Corresponding Report Chapter
Task 6.2 District and Sustainable Urban Design and Infrastructure Strategies	
Daytime Temperature	Chapters 4.2; 4.3; 4.4
Potable Water	Chapters 4.2; 4.3; 4.4
Spatially-explicit investments	Chapters 3.3; 4
Catalyst investments	Chapter 4
Sub-Task 6.2.a: Green Infrastructure Investments	
Typology	Appendix
Locations	Chapters 3.3; Appendix
Estimates of impact	Chapters 4.2,4.3, and 4.4
Sub-Task 6.2: Recommended GS Investments	
Recommended incentives for city's Green Construction Code.	Chapter 4.1
Recommended zoning, landscaping, engineering, storm water, and building code changes to promote energy and water efficiency.	Chapter 4
Recommended zoning, landscaping, engineering, storm water, and building code changes to remove barriers to Green Infrastructure implementation	Chapter 4 (4.3 mostly)
Estimates of energy and water savings from recommendations	Chapter 4
Estimates of street-level ambient temperature reductions from recommended materials and techniques	Chapter 4
Annotated list of paving materials, building materials, and construction techniques to reduce day and nighttime temperatures and improve street-level thermal comfort and photo example of each material and technique	Vision Typology Document
Deliverables 6.2 Strategy Reports	
Overview of current state	Chapter 3.1
Overview of vision	Chapter 3.2
Livability outcomes	Chapter 3.2
Strategies to reduce the per-capita grid electricity consumption by at least 30 percent	Chapter 4
Strategy	Chapter 4

Chapter 1 – Introduction

1.1 Green systems challenges in the Solano District

The Solano Transit District is between 15th Avenue and 23rd Avenue, from Campbell Avenue up to Rose Lane East of 19th Avenue, and Keim Drive West of 19th Avenue (Figure 1).

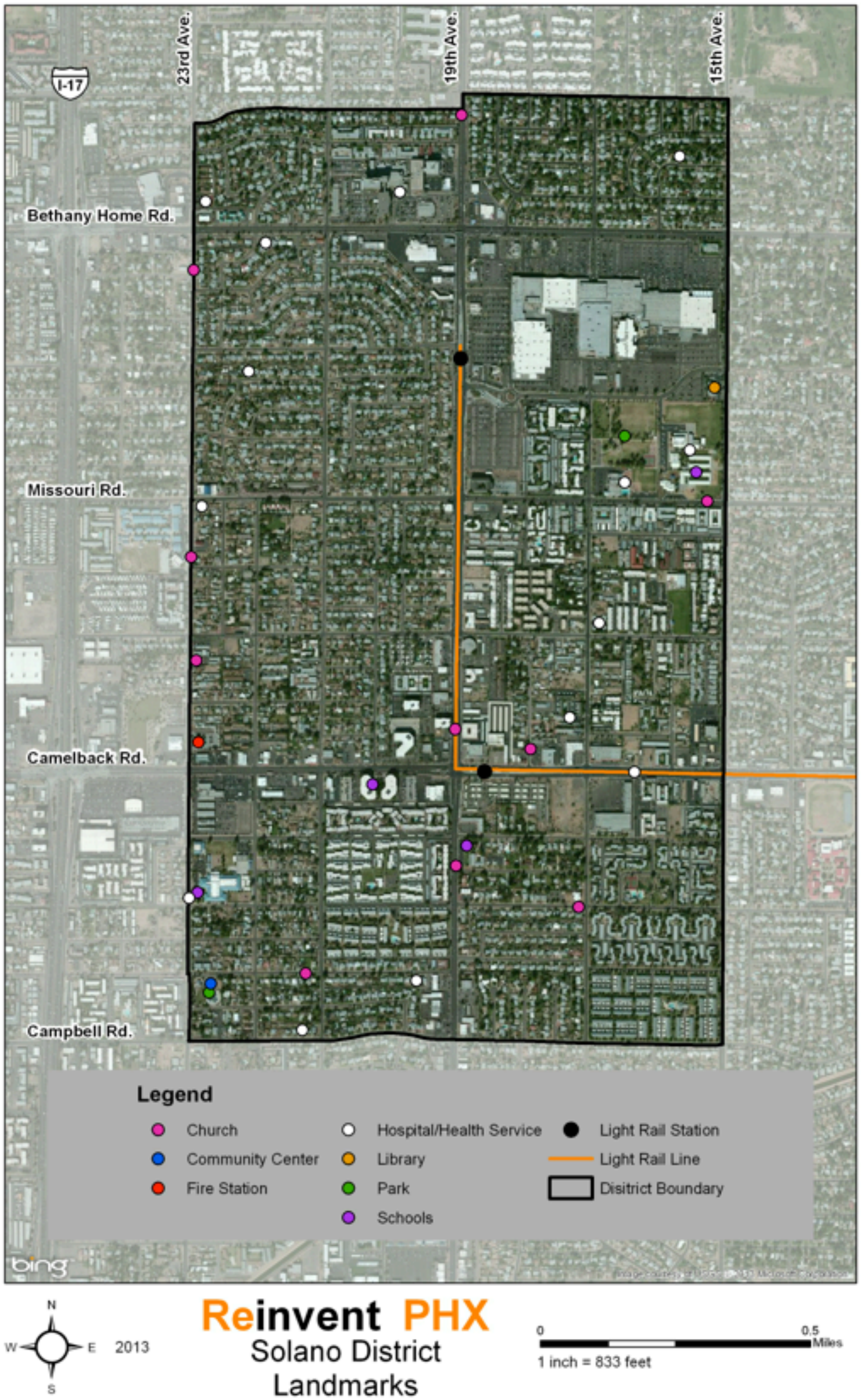

Figure 1. Major Solano District streets and landmarks

Land use in Solano consists largely of building footprints and parking areas, with some patches of landscaped area or vegetation. Thus, the District is confronted with various challenges in achieving sustainable green systems. Stormwater management and efficient water use is of particular concern, because the Valley faces an uncertain water future.

Solano faces high temperatures from the Urban Heat Island (UHI) effect. Using building footprints and heights, Figure 2 shows shade and areas exposed to direct sunlight. In the summer, it is evident that the predominant single-story buildings offer very little shade over the area. The commercial areas in the center and to the east side of the light rail tend to give more shade.

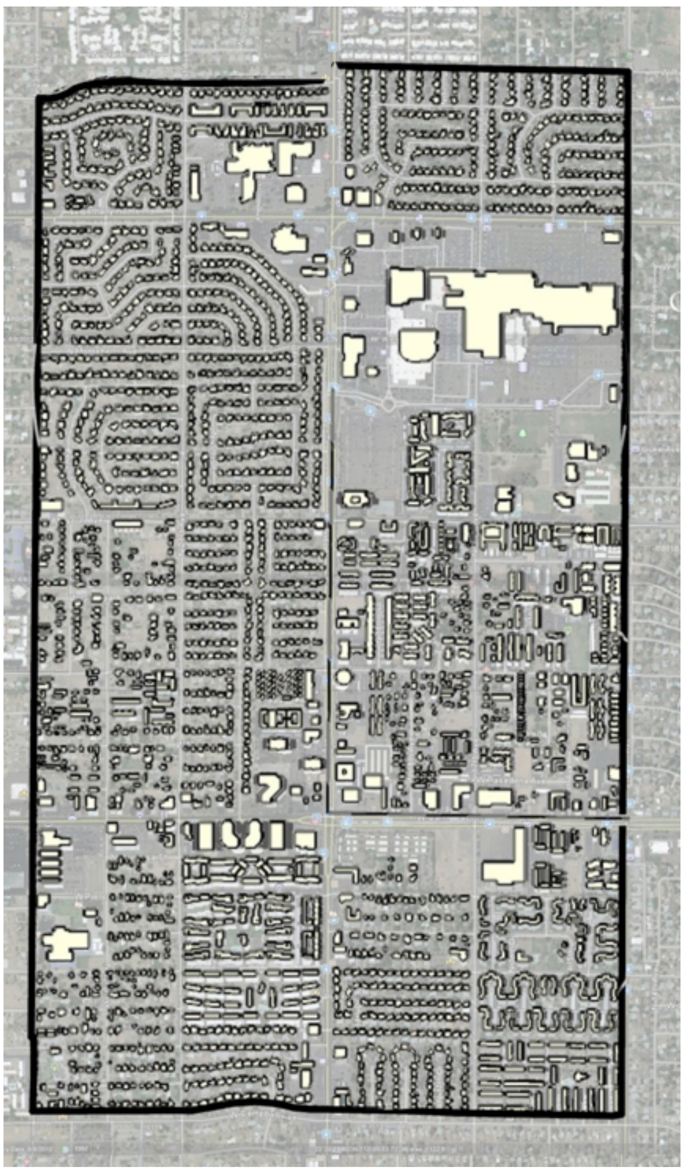

Figure 2. Composite map of summertime shade at 8 AM, 11 AM, 2 PM, and 5PM

For the most part, District markets look similar to the ones depicted below (Figure 3). Most of these sites are single story buildings surrounded by parking lots and streets. The vegetation is limited, which causes hotter surface areas (increasing the UHI effect in these areas) and limits possibilities for sustainable and effective stormwater management.

Figure 3. Asian Market in Solano

Close to I-17, there are multiple car lots in close proximity, mostly made of asphalt and located on Camelback Road, which has five lanes for traffic. There is limited vegetation for shade and no natural stormwater runoff capture. There is a large open green space to the north, but not enough vegetation to alleviate the heat of the vast parking lots.

Just south of the car lots and north of the Westwood Schools, is “Kids Street.” It is a local mural project with an open dirt streetscape and no vegetation for shade. The Westwood schools are both challenge areas and potential asset areas for UHI mitigation. The open asphalt parking and unshaded playgrounds with little vegetation contribute to higher surface temperatures.

Commercial areas across the District have high surface temperatures. Large, open asphalt parking lots radiate heat. Some of these sites (Figure 4) have limited vegetation with adjacent vacant lots. In addition, bus stops close to these sites offer little shade for pedestrians and public transit riders. The combination of asphalt, limited vegetation, and limited shade structures create uncomfortably hot and unwalkable areas. Such areas contribute to large loads of stormwater runoff that can become polluted from toxins found on the paved surfaces.

Figure 4. Vacant lot adjacent to commercial area

Christown Mall and the light rail park and ride create are large hot areas around the mall, which has little storefront vegetation. The area is dominated by open, asphalt parking lots. There are landscaped areas, and a walkway at the park and ride, but unfortunately, these areas are currently too small to mitigate the heat that radiates from the parking lots.

Solano Park is a large asset for UHI mitigation and overall green system development in Solano. The park provides large, open green spaces with mature, high water use trees. The water for the lawn and the vegetative shade creates a cooler environment for people to enjoy being outside. This area is a valuable recreational asset and can serve as a template for the development of future parks and parklets across the Solano District

Figure 5. Solano Park

Neighborhoods throughout Solano are both areas of high and low surface temperatures. Asphalt streets and yards with little to no vegetation contribute to higher temperatures. However, yards with small plantings, low water use, and immature trees are areas of lower temperatures. Similarly, fully watered yards with mature shade trees lower surface temperatures throughout neighborhoods

Figure 6. Single family home in Solano

Another area with a mix of challenge and assets is the 9-hole Palo Verde Golf Course, located northeast of Solano. This large green area contributes to lower surface temperatures in the District with the use of widespread vegetation and tree canopy. It opened in 1962 and was sowed with Bermuda grass. However, from an ecological standpoint, although golf courses are cool patches, the use of large amounts of water for irrigation presents a major challenge for sustainable green systems in the area. The large expanse of turf contributes to high commercial water use. The vegetation in this particular golf course is mature and lush, and the plants have high demand for water. Most of the trees are densely clustered around the pond, which is open to the heat of Arizona. In addition, this large open space is fenced and restricted to the public, offering limited benefits for outdoor recreation for Solano residents.

There is only one brownfield in Solano, from a laundromat. The process has moved onto stage two site cleanup, and currently, the site provides limited vegetation. In addition, the parking lot located at the site directs stormwater runoff directly into the Phoenix water management system, potentially carrying large loads of pollution into the system.

In general, the Solano District hosts a diverse mix of areas of challenges and opportunities for green system development. Some neighborhoods provide areas of potential development for shaded pathways to create cool, walkable neighborhoods. Green spaces throughout the District provide areas of value for UHI mitigation, recreational opportunities, and biodiversity support. Vacant lots scattered throughout the District contribute to higher surface temperatures due to sparse vegetation but also provide areas of opportunity for the development of small parks and open spaces for Solano residents.

1.2 Profile of the "Reinvent Phoenix" grant

"Reinvent Phoenix" is a City of Phoenix project in collaboration with Arizona State University and other partners, and funded through HUD's Sustainable Communities program. This program is at the core of HUD's mission to "create strong, sustainable, inclusive communities and quality affordable homes for all." It specifically strives to "reduce transportation costs for families, improve housing affordability, save energy, and increase access to housing and employment opportunities" and to "nurture healthier, more inclusive communities" (Office of Sustainable Housing and Communities, 2012). The program explicitly incorporates principles and goals of sustainability/livability (HUD/DOT/EPA, 2009):

1. Enhance economic competitiveness
2. Provide more transportation choices
3. Promote equitable, affordable housing
4. Support existing communities
5. Coordinate and leverage federal policies and investment
6. Value communities and neighborhoods.

In this spirit, from 2012—2015, Reinvent Phoenix aims to create a new model for urban development in Phoenix. The goals for this new model are to improve quality of life, conserve natural resources, and maintain desirability and access for the entire spectrum of incomes, ages, family sizes, and physical and developmental abilities along the light rail corridor. Reinvent Phoenix aspires to eliminates physical and institutional barriers to transit-oriented development. To do so, the grant will work to catalyze livability and sustainability through capacity building, regulatory reform, affordable housing development, innovative infrastructure design, economic development incentives, and transformational research and planning.

Participatory research design ensures that a variety of stakeholder groups identify strategic improvements that enhance safe, convenient access to fresh food, healthcare services, quality affordable housing, good jobs, and education and training programs. Reinvent Phoenix focuses on six topical elements: economic development, green systems, health, housing, land use, and mobility (corresponding to the Livability Principles). These planning elements are investigated in five transit Districts (from east to west and south to north): Gateway, Eastlake-Garfield, Midtown, Uptown, and Solano. Planning for the Downtown District of the light rail corridor is excluded from Reinvent Phoenix because of previously completed planning efforts, partly using transit-oriented development ideas.

Reinvent Phoenix is structured into planning, design, and implementation phases. The project's planning phase involves building a collaborative environment among subcontracted partners, including Arizona State University, Saint Luke's Health Initiatives, Discovery Triangle, the Urban Land Institute, Local First Arizona, Duany Plater-Zyberk & Company, Sustainable Communities Collaborative, and others. While the City of Phoenix coordinates these partnerships, Arizona State University and Saint Luke's Health Initiatives are working with residents, business owners, landowners, and other relevant stakeholders in each of the grant's five transit Districts. This effort will assess the current state of each District, as well as facilitate stakeholder expression of each District's sustainable vision for the future. Finally, motivated actors in each District will co-create step-by-step strategies to move toward those visions. Transit District Steering Committees, formed in the planning phase, will host capacity building for their members, who will shepherd their Districts through the remaining Reinvent Phoenix phases.

City of Phoenix staff and Duany Plater-Zyberk & Company will lead the design phase. Designs for canal activation, complete streets, and form-based code will complement the compilation of a toolbox for public-private partnerships to stimulate economic development along the light rail corridor. The design phase will take its cues from the public participation in the planning phase, and maintain ongoing monthly contact with Transit District Steering Committees to ensure the visions of each District are accurately translated into policy and regulations. These steps will update zoning, codes, regulations, and city policies to leverage the new light rail system as a major asset. The design phase is crucial for preparing an attractive environment for investment and development around the light rail.

Finally, the implementation phase will use the city's partnerships with the Urban Land Institute, Local First Arizona, and Sustainable Communities Collaborative to usher in a new culture of development in Phoenix. With the help of all partners, transit-oriented development can be the vehicle to renew Phoenix's construction industry, take full advantage of the light rail as a transformative amenity, and enrich Phoenix with a livable and dynamic urban fabric.

1.3. Sustainable Green Systems Research

This sustainable green systems strategy aligns with HUD's Sustainable Communities program goals, as stated above (see Livability Principles above). Sustainable green systems strive for fully functional stormwater, biodiversity, and resource management practices, as well as sustainable levels of thermal comfort, energy efficiency, and access to green space. Sustainable green systems are specified in the following four goals:

1. Reduce stormwater loads and harvest water on-site
2. Reduce potable water consumption
3. Reduce daytime temperatures
4. Increase green systems benefits to health, mobility, and the economy

In pursuit of these goals, we employ a transformational planning framework (Wiek, 2009; Johnson et al., 2011), conducting sustainable green systems research in three linked modules. We start with a thorough assessment of the current state of green systems in 2010/2012 against principles of livability and sustainability (current state assessment); in parallel, we create and craft a sustainable vision for green systems in 2040 (visioning); and finally, we develop strategies for changing or conserving the current state of green systems towards the sustainable vision of green systems between 2012 and 2040 (strategy building). The framework is illustrated below.

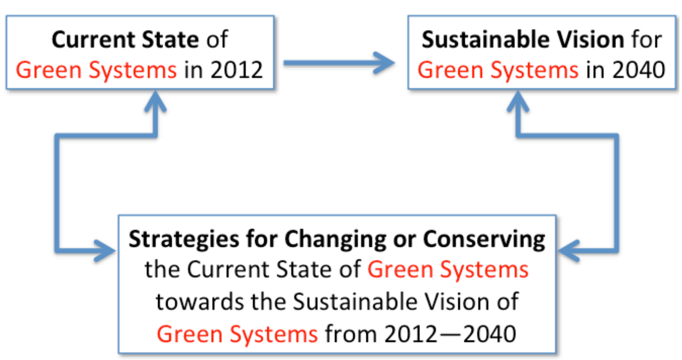

Figure 8. Transformational planning framework (Source: Wiek, 2009)

Because of the broad impacts of green systems and the close link with other planning elements, the central meaning of green systems often remains poorly defined. Green systems employ natural elements to perform ecosystem services, such as stormwater management, microclimate modification, and improvement of air and water quality, among others (Benedict & McMahon, 2006; Rouse & Bunster-Ossa, 2013). They include building footprints, rights-of-way, public streets, parking areas, landscaping, vegetation, stormwater, water use, and shade patterns affecting local climate conditions. As articulated in Phoenix's tree and shade master plan, green systems are the interconnected web of parks, streets and canals that help to sustain an active, cool, and healthy city (City of Phoenix, 2010).

Green systems range from passive water harvesting to porous pavers, and from street trees to a large District park. They provide economic, social, and environmental benefits: they reduce energy costs; improve air quality; strengthen quality of place and the local economy; reduce storm water; improve social connections; promote smart growth and compact development; and create walkable neighborhoods. Green systems are solution multipliers that solve many problems with one single investment (City of Phoenix, 2010). According to the U.S. Environmental Protection Agency (2013, website), "green infrastructure is an approach that communities can choose to maintain healthy waters, provide multiple environmental benefits, and support sustainable communities. Unlike single-purpose gray stormwater infrastructure, which uses pipes to dispose of rainwater, green infrastructure uses vegetation and soil to manage rainwater where it falls. By weaving natural processes into the built environment, green infrastructure provides not only stormwater management, but also flood mitigation, air quality management, and much more". With the intent to avoid duplications, overlap, and confusion, we follow in this report with this definition of green systems: natural and engineered systems that provide ecosystem services in a given district (Cook, 2007).

1.4. Objectives of the Strategy Study

The strategy presented in this report directly refers to the green systems challenges detailed in the assessment report (Golub et al., 2013). It proposes interventions that address these challenges, significantly improve green systems, and achieve the vision and goals of sustainable green systems in the District (detailed in the visioning report). In accordance with the mandate of Reinvent Phoenix to contribute to sustainable community development, this strategy study actively pursues the improvement of green systems conditions, following sustainability and livability principles (Gibson, 2006; HUD/DOT/EPA, 2009).

The guiding question of the sustainable green systems strategy study is: What evidence-supported interventions provide fully functional stormwater, biodiversity, and resource management practices, as well as sustainable levels of thermal comfort, energy efficiency, and access to green space in the District?

The specific objectives are:

1. Link sustainable green systems goals and targets to evidence-supported interventions and investment options.

2. Detail interventions with the actions, actors, assets, and coping tactics (for barriers) needed to achieve sustainable green systems goals and targets.

3. Highlight investment options designed to achieve sustainable green systems goals and targets.

4. Compile a set of exemplary implementation tools for the investment options.

5. Outline a five-year action plan to implement the interventions and investment options.

Additional objectives include:

1. To develop a process and content template for sustainable strategy development research that can be reproduced in the other four transit districts and thus guide the Reinvent Phoenix strategy development activities.

2. To enhance capacity in strategy development among planning professionals and collaborating partners to use in subsequent initiatives and projects.

3. To enhance capacity in strategy development for students and faculty to use in other research projects, teaching programs, and professional projects.

Chapter 2 – Research Design and Data Sources

We acknowledge that the term strategy is being used in a variety of contexts. In context of Reinvent Phoenix, a strategy is defined as a set of *interventions coordinated among different stakeholders with the intent to transforming the current state of a system* (e.g., a city, a neighborhood, a company) into a sustainable one (Wiek & Kay, 2013). The following document details the coordinated interventions necessary to achieve a sustainable state for green systems in the District. Each intervention includes investments and implementation tools that residents, businesses, organizations, and city government need to employ in order to achieve the desired outcomes. Conceptually, we differentiate different levels of the strategy, including interventions, investment types, and investment tools (Fig. 3). The strategy is composed of several (coordinated) interventions. An Intervention offers several investment types. For realizing an investment types, different implementation tools can be used.

The specific procedures for building a transition strategy have been detailed in Wiek and Kay (2013) and Kay et al. (2013), and are here applied to green systems as follows:

1. Summarizing the inputs or ingredients for the strategy, i.e., the current state assessment, the vision, and a theory of change. All three elements need to be specified such that progress can be measured. Key information pertains to the gaps between the current state and trends for green systems on the one hand, and future goals and targets (vision) on the other hand. For example, for the indicator "indoor residential potable water use," the current state might be 46 gallons per capita per day, but the target is 30 gallons per capita per day. The 16-gallon gap between the current state and the target state specifies the gap the strategy needs to bridge.

2. Developing a set of coordinated interventions to achieve desired outcomes. Each of the specific goals for sustainable green systems requires specific interventions. For example, to achieve the goal of reducing daytime temperatures, the intervention of shade and cooling on streets and parking lots seems promising. The transformational planning framework is goal oriented and thus the vision, the current state assessment, and the strategy all start with stating the goals of sustainable green systems. Yet, the strategy

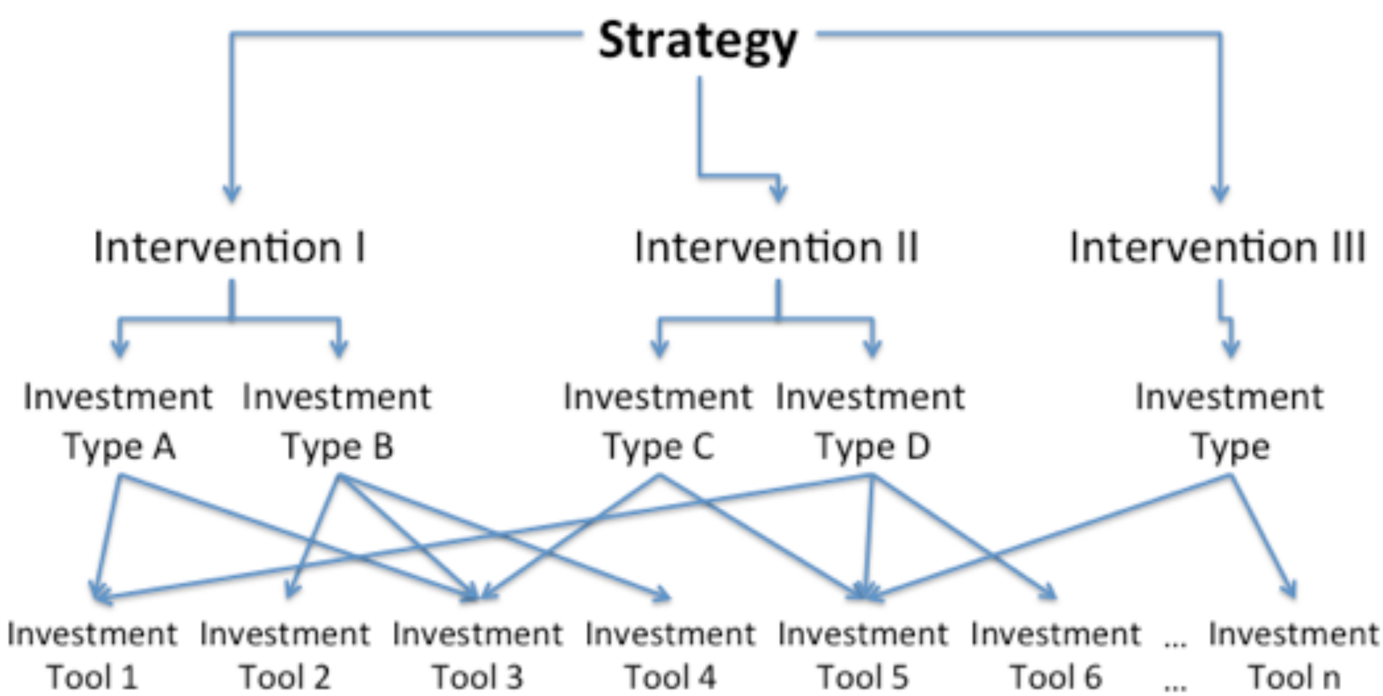

Figure 9. Hierarchical structure of the strategy for sustainable green systems

aims at coordinating interventions that achieve multiple objectives at the same time. For example, shade and cooling on streets and parking lots does not only pursue reduced daytime temperatures, but can also contribute to stormwater management with vegetative shade. Thus, from the perspective of implementation it is more useful to use the interventions as organizing principle, and design interventions in ways that they contribute to as many goals as possible. Thus, we describe each major intervention separately by:

a. Stating the goals and targets the intervention pursues.

b. Identifying the intervention points, i.e., drivers that cause the problematic current state. Systemic relevance of the intervention point and feasibility of intervention at this point are important criteria for the selection of intervention points. A potential intervention point could be building codes that lack to incentivize cooling technologies.

c. Specifying key components of each intervention, i.e., intervention actions, actors, available assets, resources needed, potential barriers, and implementation tools. Components can be identified through using best practices examples across the United States, interviews with city staff, residents, local experts, and academic literature.

d. Describing specific investment types that offer different pathways within an intervention. For example, the streets intervention captures both green streets and green parking (two different investment types). For realizing an investment type, different implementation tools can be used.

e. Describing implementation tools, clustered in tools for financing, capacity building, partnerships, rules (codes), and incentives. We provide key information on the implementation tools, so that residents, developers, and city staff are able to select among available tools. Similar to interventions and investment types, the majority of tools can be used to implement multiple investments. For example, a community development corporation can be used to support green streets efforts.

3. Providing evidence for the effectiveness and efficiency of the proposed interventions, investments, and implementation tools. Evidence is required to ensure that intervention, investments, and implementation tools are selected that are likely to be capable of "getting the job done." Evidence can be provided by local experts, academic literature, or cases of other cities.

4. Detailing actions for a specific 5-year action plan that specify the roles and responsibilities for residents, developers, and city staff, as well as for the Steering Committee.

Data for this strategy document comes from two primary sources:

1. Data inputs for the strategy are drawn from multiple sources as this study builds from the current state assessment and the visioning study.

2. Data about the core components of the strategy is based on input from local experts (see acknowledgements, above) and academic literature.

Chapter 3 – Strategy Inputs

The following chapter includes a summary of the current state and the vision for sustainable green systems in the Solano as well as a specific theory of change that are the inputs for the strategy.

3.1 Summary of the Current State Assessment of Green Systems in Solano

The current state assessment is based on four goals of sustainable green systems, derived from sustainability and livability principles (HUD, 2009):

1. Reduce stormwater loads and harvest water on-site

2. Reduce potable water consumption

3. Reduce daytime temperatures

4. Increase green systems benefits to health, mobility, and the economy

The current green systems conditions in the Solano District are very poor overall. Of particular concern are high temperatures, unsustainable water management, and lack of trees. The Solano District struggles with unsustainable states in each of the four goal domains, while there are few positive aspects.

1. *Insufficient stormwater is managed on-site by green systems.* Natural systems capture less than a third of stormwater run-off, and there is nearly no rainwater harvesting in the District.

2. *Sustainability of potable water consumption is low*. Indoor residential potable water use is double sustainable levels, though outdoor use is comfortably within the sustainable range. Given commercial and industrial diversity, water consumption targets for these sectors were unattainable.

3. *Daytime temperatures are very high*. Only 7.8% of Solano has temperatures below 105ºF, and high temperatures, asphalt parking, and white roofs all fail to meet sustainable targets. Those areas with high temperatures worsen the Urban Heat Island (UHI) effect, and cause a variety of health problems.

4. *The health, mobility, and economic benefits of green systems can improve significantly.* The District has no green streets and very low tree canopy cover. Adding green streets, shade, and strategically placed parks to the District would help achieve the preceding goals, as well as improve health, mobility, and the economy.

In summary, the District is desperately in need of green systems that reduce daytime temperatures, naturally manage stormwater on-site, and provide safe, cool spaces for citizen recreation and transportation Thereby, tradeoffs between different green systems features require special attention when crafting sustainable green systems visions and strategies. For example, vegetation that cools and beautifies residential homes also increases water use.

Data from Solano stakeholder engagement efforts confirm that more shade is needed to address concerns about walkability and extreme heat. There is support for shaded green streets that increase walkability, especially along Camelback Road, 15th Avenue, and 19th Avenue. Some residents feel that Solano could improve storm water management in order to further cool the neighborhood, especially in areas that have flood irrigation (parts of Simpson and Washington Park). In concert with safety concerns (Hager et al., 2013), these factors make green systems in Solano insufficient to provide safe and comfortable recreation and mobility for citizens throughout the District. Stakeholder input prioritized temperatures and shade over other concerns.

HUD has operationalized its mandate through *Livability Principles* (2009). Interpreting the assessment results in light of the livability principles indicates the following set of priorities:

Stormwater management, high temperatures, green space, green streets, and shade are indicators that have a high distance to target, and are closely tied to the principles.

- Livability Principle 1 aims at *providing safe transportation options*. The current state data indicates insufficient shade for comfortable bus stops, which may reduce ridership. There are also no green streets in the District.

- Livability Principle 3 aims at *economic competitiveness*. Green systems provide higher quality of life through better health outcomes, increased recreation options, and better urban aesthetics. Current state data shows low tree canopy cover and no green streets, leading to economic disadvantages relative to places with more robust green systems.

- While Livability 6 aims at *valuing communities and neighborhoods*. Current state data for the Solano District paint an un-shaded, hot, un-walkable picture, in direct contradiction to HUD's wish to "invest in healthy, safe, walkable neighborhoods."

Finally, the analysis of the driving forces behind the unsustainable states summarized above suggest a variety of economic, social, legal, and other promising intervention points. These insights were used to craft the Sustainable Green Systems Strategy Report for the Solano District.

3.2. Summary of the Vision for Green Systems in Solano

The vision for green systems in the Solano District is to sustain a network of buildings, open spaces, streets, and canals that support healthy and prosperous neighborhoods through vegetation, building materials, quality design, and water management. The vision for green systems is part of the overall vision for the Solano District (Wiek et al., 2013), which describes a sustainability future for the District. Key excerpts are provided below:

In 2040, the Solano District has vibrant and diverse neighborhoods, and attracts visitors to its culturally diverse small business corridor and regional retail center. Preserved single-family homes, revitalized multi-family housing, and new construction near light rail stations make up housing diversity that caters to all ages, incomes, and cultures. Significant investment in new mixed-use buildings along Camelback Road has attracted new residents. Affordable housing options, job training, and small business incubation has maintained the District's diversity of cultures, reflected in the variety of local businesses and restaurants. The 1950s character of suburban neighborhoods has transformed into a collage of urban living for a broad spectrum of Phoenicians.

The specific vision for sustainable *green systems* in the Solano District is derived from this vision and is aligned with the five sustainable green systems goals mentioned above (1.3). It reads:

In 2040, safe and comfortable walking and biking environments on Camelback, 15th, and 17th Avenues create a vibrant, comfortable mobility network in the District. Major improvements to crosswalks and public safety have transformed 19th Avenue and Camelback into the safe, clean, and welcoming core of the District. 15th Avenue has easy pedestrian and bike access to the Grand Canal and to Downtown Phoenix. 17th Avenue offers convenient routes to Solano Park and the Christown Mall. The Solano Park and new open space on Camelback Road provide additional recreational opportunities to the busy Marc Atkinson Recreation Center, which serves the southern third of the District.

In 2040, serious investments have cooled parking lots and streets with temperatures previously exceeding 130°F. Major streets are beautiful, lined with low-water, desert trees that shade pedestrians, and solar-panel covered parking areas. Simpson, once very hot, now boasts beautiful trees, and residents looking down Montebello Avenue can see solar panels above the Christown Mall parking lots. Safe, cool neighborhoods and corridors spurred housing development, and are major reasons that Solano attracts and retains residents in 2040.

Through the visioning process, three transition areas were selected in which to make the vision spatially explicit:

Christown - Christown's 2040 residents are a healthy crew. Increased walking, biking, and transit use has decreased transportation and medical costs for residents. Christown is just a great place to be outside. Traffic calming, crosswalks, and shade trees have improved the walking experience on 15th, 19th, Missouri, and Montebello Avenues. Solano Elementary School and the YMCA support a healthy area where people jog, play sports, and spend their time outside.

Family-friendly parks provide a safe space for kids to play, adults to barbeque, and older folks to play chess and bocce ball. Solano Park is beautiful, often crowded with pick-up games, community events, and celebrations. There are also some pocket parks near mixed-use apartment complexes. Regardless of size, these spaces provide locals with open space to relax. Public safety measures around Christown (community policing, lighting, and block watches) keep folks feeling safe. Even with population growth from new construction, the area is safer and more enjoyable than years ago.

Camelback - Well-designed, energy-efficient, and colorful buildings line Camelback Road, hosting a hip, lively environment that is safe and welcoming to new residents. People also come to Westwood, Simpson, and Niles for the quality schools (Solano and Westwood Elementary Schools), good city services, and better access to jobs. Non-profits and residents work hard to maintain diverse neighborhoods, and conflict resolution workshops ensure conflicts do not detract from the livability and economic vibrancy of the corridor.

Because of continuous precaution and prevention efforts, the area experiences only low levels of crime and conflict. Residents of the area enjoy walking, biking, and public transit options that have decreased transportation costs. Investments to improve public safety and walkability at 19th Avenue and Camelback Road have attracted in kind support from the private sector. The housing market has boomed, driving the colorful, youthful, and vibrant corridor. Cultural and housing diversity provides stability in 2040, ensuring every household can enjoy the area.

A more detailed map captures desired green systems development in three interventions: *streets, buildings and sites, and open space.*

In order to craft actionable strategies, the qualitative descriptions of a sustainable state for green systems in the Solano District should include quantitative targets. For each of the four green systems goals, Table 1 contains one or two critical targets that the strategy is designed to achieve.

Table 1. Greens systems vision target table

Indicator	Sustainability Target	Current State Data	Distance-to-target
Goal 1 – Reduce stormwater loads and harvest water onsite			
Permeable land	80%	31%	41%
Goal 2 – Reduce potable water consumption			
Indoor residential	30 GPCD	42 GPCD	12 GPCD
Goal 3 – Reduce daytime temperatures			
Surface temperatures above 130°F	<1%	17.8%	~18%
Goal 4 – Increase green systems benefits to health, mobility, and the economy			
Vegetation coverage	25%	3.5%	21.5%
Green streets	2 miles	0 miles	2 miles

3.3. Theory of Change

The theory of change of this strategy is that additional investments in green systems can support increased vegetation, which can decrease surface temperature and support quality of life and economic development in the Solano District. This strategy includes interventions of streets, buildings and sites, and open space.

Streets, vacant lots, and open spaces are intervention points where rainwater retention, cooling capacity, and social benefits can be increased with green systems investments. The desired outcome of increase permeable surface, reduced daytime temperatures, increase vegetation coverage can be achieved through the interventions of streets, buildings and sites, and open space.

Investments in improving the stormwater collection on streets, and cooling highly trafficked corridors are important early priorities that will move the District towards the permeable surface target. Investments in using open space for District water retention, incorporating next-generation cooling technologies, and moving towards storing and/or using all stormwater on site may take more time to implement, but could have significant impact on achieving the green systems sustainability targets, such as reaching the desired reduction in surface temperatures. The following strategy will describe how these interventions and corresponding investment types can be enacted over the next 30 years to produce sustainable green systems in the Solano District.

Chapter 4 – Sustainable Green Systems Strategy for the Solano District

4.1. Linking Sustainable Green Systems Goals to Interventions and Investment Options

As described before, the overall and specific sustainable green systems goals are the reference point for developing the strategy and its interventions. Yet, the strategy aims to coordinate interventions that achieve multiple objectives at the same time. The interventions of streets, buildings and sites, and open space all contribute to achieving the four goals of sustainable green systems. Thus, from the perspective of implementation it is more useful to use the interventions as organizing principle, and design them in ways that they contribute to as many goals as possible. Therefore, we describe each intervention separately in the subsequent sections, detailing the specific investments, actions, resources, implementation tools, etc.

Goal	*Strategy*		
	Streets Intervention	*Buildings and Sites Intervention*	*Open Space Intervention*
1. Reduce stormwater loads and harvest water onsite	Widespread use of porous materials, and right-of-way bioswales will reduce impervious surfaces, will allow rainwater to be stored in the right of way.	Water capture and reuse is critical throughout the District, but will look different in different areas. Shade and cooling investments can capture and store excess rainwater.	Neighborhood water retention, green parking, and green civic spaces can reduce rainwater loads.
2. Reduce potable water consumption	Green streets and street parking will reuse rainwater, lower reliance on irrigation, and lower temperatures and UHI.	Next generation living buildings use rain and greywater. Shade and cooling investments can capture and store excess water on site, reducing potable water irrigation. Water-saving appliances can also contribute to reducing indoor potable water consumption	Green civic spaces and parking investments on open space will lower reliance on potable water irrigation. Lower temperatures might also reduce water consumption.
3. Reduce daytime temperatures	Green streets, shade, and cooling (including using cool construction materials) can all reduce daytime temperatures. Zoning and codes can cool hot blocks though promoting shade, and cool material usage.	Engineered and natural shade and cooling (e.g. white roofs) can reduce temperatures	Natural and engineered shade and cooling used in green civic space and green parking lots can reduce temperatures.

4.2. Streets Intervention

Street and right-of-way improvements are critical interventions for the Solano sustainable green systems strategy. Green streets and green parking investments manage stormwater and increase permeable land, vegetation, and cooling capacity.

4.2.1. Core Components

The following describes the impacts, actions, resources needed, potential barriers, and timeline for the streets intervention.

Aspired Sustainability Impacts

Through this streets intervention, the following *specific* sustainable green systems targets will be achieved by 2040:

- 2 miles of green streets
- 300 more acres of permeable land
- 5% increase of District vegetation coverage
- Less acres of temperatures greater than 130°F

Intervention Points

Currently, the extensive street system contributes to high temperatures (urban heat island), and reduced economic and social activity in the Solano District. By promoting cooling, the streets intervention creates more walkable corridors. The streets intervention can also divert water from the streets, buildings, and sites to bioswales in the right-of-way and in neighborhood water retention areas.

Intervention Actions

The following actions are critical for accomplishing the targets outlined above. These are critical actions that will likely need to take place in the first ten years of the transition. Further details on the actions necessary in the first five year are available in Section 3.5. The following actions are critical in meeting the milestones set in the timeline below.

- Complete green streets that connect 17th Avenue to Camelback to connect Solano Elementary and Solano Park.

  a. Complete the 17th Avenue green street pilot project with Osborn Schools

  b. Work with Westwood, Solano and Simpson Schools to create model green streets near and on each campus and develop green parking on existing parking lots.

- Make major green streets investments on Camelback Road

  a. Seek city, state, and philanthropic funding for Camelback Road improvements and create a long-term maintenance and street conversion fund with adjacent property owners.

  b. Market importance of the investment of a green street connection from Central to 19th Avenue to incentivize development and services along Camelback Road.

- Build sustainable financing mechanisms for green streets in the Solano District.

  a. Create a business improvement district (BID) along Camelback Road and 19th Avenue that can pool money from local businesses, landowners, and organizations to pay for addition street improvements.

  b. Neighborhood associations (Simpson, Washington Park, Niles, and Westwood) contribute to creating street water retention systems with shade trees (building off the 9th Street example in the Garfield neighborhood with the support of Watershed Management Group).

- Support research that improves evidence for best practices in green streets and green parking implementation, including material use, vegetation and tree selection, and rainwater management.

- Design and seek funding to develop green street projects that build off successes along Camelback and near schools.

  c. Build off of success of Camelback to finance and design 23rd Avenue, 21tst Avenue, Montebello Street, and 3rd Avenue green street improvements.

d. Produce a feasibility study for green streets and parking near local schools, and parks.

- Create educational programming on the multiple benefits of green streets and parking at Phoenix College and local elementary schools, businesses, and non-profits.

Resources

The following resources are needed to support the streets intervention. Assets (resources that already exist) are in italics:

- *Arizona Public Service (APS) and Salt River Project (SRP) Tree and Shade Program*
- *City of Phoenix Departments*
    - o *Neighborhood Services (NSD) to work with schools and neighborhoods*
    - o *Streets and Transportation (STD) to work on design and engineering*
- *Educational Institutions that can be involved in pilot projects*
    - o *Simpson, Solano and Westwood Schools*
    - o *The Global Institute of Sustainability (GIOS)*
- *MAG funding to study green street interventions on Van Buren Street*
- *Simpson, Washington Park, Niles, and Westwood Neighborhood Associations (Can support pilot projects)*
- *Local First Arizona (Represents area small businesses)*
- *Christown Mall*
- *Phoenix Baptist Hospital*
- *Watershed Management Group (WMG) (Can support pilot projects)*
- More staff and capacity for organizations like WMG that can support and develop funding for pilot projects
- Development of state and federal funding streams for street improvement, air quality mitigation, and urban heat island reduction

Barriers

- Lack of a funding mechanism to design, build, and maintain green streets
- Current codes and standards that include restrictive rules (i.e. concerning water harvesting)
- Concerns that street retrofits will disturb automobile flow
- Concerns about rain water management in streets
- Existing infrastructure and utilities often prevent planting trees and shaping basins/swales
- Lack of education and understanding about green streets

Intervention Timeline

This timeline outlines a transition towards Solano's sustainable green systems vision driven by streets over the next 30 years. Much can change during this time; thus, this transition strategy must be revisited and updated. Some of the actions listed as happening by 2025 or 2030 may be feasible before the stated date and could possibly be addressed sooner. The purpose of this timeline is to demonstrate a possible sequence (pathway) to achieve the 2040 vision, with the recognition that some things may come faster or slower. The "By 2020" section includes major milestones that could be accomplished if all of intervention actions in the list above are implemented or at least underway.

By 2020

- Make Camelback Road a regional model for green streets and green parking.
- Design and finance green street improvements on 17th Avenue and Montebello Street.
- Include durable green parking materials in the above projects.

By 2025

- Neighborhood associations and the Camelback BID have their own green street programs that have privately funded several green streets
- Complete 23th Avenue and 15th Avenue green street improvements.
- Green streets around Van Buren Street are demonstrating positive impacts.

By 2030

- Design and finance green street improvements 21st Avenue, Bethany Home Road, and 19th Avenue.
- Local BID and neighborhood associations have designs and financing models to finish all target green streets by 2040.
- All street parking in the District is green parking due to material used and proximate shade trees.

4.2.2. Investment Types

4.2.2.1. Green Streets

Green streets use small-scale, vegetated bioswales along streets to help control stormwater. These constructed elements create on-site infiltration, while providing attractive streetscapes, increased canopy coverage, lower temperatures, and supporting biodiversity. They also improve a neighborhood's livability by adding park-like elements that serve as urban greenways.

Green Streets can support an increase in permeable surfaces, on-site infiltration, and improved stormwater quality. Green streets have the added benefits of providing attractive streetscapes, increased canopy coverage, lowering temperatures and supporting biodiversity.

Implementation Tools (See Section 4.5. for details on each tool)

- *Financing* - Capital investments, Department of Transportation (DOT) funding (i.e. TIGER grants), and private investment
- *Partnerships* - BIDs and neighborhood initiatives
- *Codes* - Right-of-way codes
- *Capacity Building* - Watershed management training
- *Incentives* - Tax credits and expedited permitting

4.2.2.2. Green Parking

Green Parking is on-street or on-site parking that redirects and/or stores stormwater, usually through the use of pervious surfaces. Green parking can include stormwater management tools such as bioswales and rain gardens. Green parking offers a cleaner alternative to traditional parking lots that contribute to poor water quality and flooding.

Green parking can significantly increase pervious surfaces, and contribute to better stormwater quality. Green parking can also support shade and cooling efforts.

Implementation Tools (See Section 4.5. for details on each tool)

- *Financing* - Capital investments, DOT funding (i.e. TIGER grants), BIDs, Community Development Block Grants, HOME Investment Partnerships Program, and private investment
- *Partnerships* - CDCs and neighborhood initiatives
- *Codes* - Land use ordinance, capacity building, and watershed management training
- *Incentives* - Tax credits and expedited permitting

4.3. Buildings and Sites Intervention

The building and sites intervention for the Solano sustainable green systems strategy addresses the significant potable water use, and contributions to high surface temperatures from buildings and sites. Water harvesting and reuse, and natural and engineered shade and cooling systems are important investments that can be made in new construction and retrofits of buildings to reduce potable water use, and surface temperature, and increase vegetation and social benefits.

4.3.1. Core Components

Aspired Sustainability Impacts

Through the buildings and sites intervention, the following sustainable green systems targets will be achieved in Solano by 2040:

- Potable water use reduction of 12 gallons to 30 gallons per capita per day
- 300 more acres of permeable land
- 10% increase of District vegetation coverage
- Less acres with surface temperatures greater than 130°F

Intervention Point

Buildings are a good mechanism for engineered shade and cooling, while sites are excellent opportunity for natural shade and cooling. Building and sites present important intervention points for reducing potable water consumption, partially through well-designed rainwater harvesting and reuse mechanisms. Building and sites that use natural and engineered shade and cooling investments have the opportunity to produce positive environmental, social, and economic benefits, such as meeting places, enjoyable retail opportunities, and increased biodiversity.

Intervention Actions

The following actions in the first ten years of the transition are critical for accomplishing the impacts listed above. Further details on the actions necessary in the first five years are available in Section 3.5. The following actions are critical in meeting the milestones set in the timeline below.

- Pass code updates that create density dependent guidelines for water harvesting and reuse, and natural and engineered shade and cooling that is dependent on the density of the area. Form-based codes designate transect zones densities from 1 (least dense) to 6 (most dense).
- Design, fund, and build strong examples of water harvesting and shade and cooling investments on private property.
    a. Create clear urban examples of onsite retention and cooling in transect zones 3—6.
    b. Market building and sites green systems success stories.
    c. Deliver education and capacity building programming that uses pilot projects to teach the benefits of water harvesting and reuse, and natural and engineered shade and cooling.
- Create an awards program that honors the most successful uses of the new code.
- Use the success of pilot projects to pass more progressive building and site codes for the District.
- Support research into next-generation water harvesting, water reuse, and engineered shade and cooling technologies.
- Improve and develop incentive programs for cool building materials, water harvesting and reuse

technologies, and energy efficiency.

- Experiment with additional benefits of natural shade and cooling, such as food production, (e.g. on-site citrus or mesquite groves).

Resources

The following resources are needed to support the building and sites intervention. Assets (resources that already exist) are in italics:

- *City of Phoenix Departments*
  - o *Planning and Public Works for code updates*
  - o *Neighborhood Services for enforcement*
- *Reinvent PHX for new code*
- *Private property owners for investment*
- *American Society of Landscape Architects (ASLA) for design and developer consultations*
- Research to prove impact of water harvesting, and shade and cooling investments
- Training for builders and tradesman
- Incentive structures such as tax credits for use of certain materials or water systems

Barriers

- Lack of financing mechanisms
- Current codes
- Lack of education and understanding (designers & city staff)
- Climate change including increasing UHI impacts could make using natural vegetation more water intensive
- Lack of resources for maintenance
- Expense of cooling technologies

Intervention Timeline

This timeline outlines a transition towards the District's sustainable green systems vision driven by building and sites over the next 30 years. Much can change during this time; thus, this transition strategy must be revisited and updated. Some of the actions listed as happening by 2025 or 2030 may be feasible before the stated date and could possibly be addressed sooner. The purpose of this timeline is to demonstrate a possible sequence (pathway) to achieve the 2040 vision, with the recognition that some things may come faster or slower. The "By 2020" section includes major milestones that could be accomplished if all of intervention actions in the list above are implemented or at least underway.

By 2020

- A new form-based code with effective rules and regulations for water harvesting and reuse, and natural and engineered shade and cooling
- Successful engineered cooling, and water harvesting pilot projects for single-family homes in the Simpson neighborhood, and mixed-used developments along 19th Avenue and Camelback Road.
- A marketing campaign that includes awards for effective implementation of water harvesting and reuse, and natural and engineered shade and cooling.
- Funding secured for Arizona State University for research on next-generation technologies (for water harvesting, and engineered cooling), with some money for smaller scale research projects at elementary schools in the District.

By 2025

- New projects that test the effectiveness of next generation technologies, such as nanotechnology enhanced cooling materials, and innovative building monitoring systems
- Experiments with multi-functional natural cooling systems, such as school based mesquite groves and citrus orchards.
- Research relative educational outcomes for schools investing in building and site green systems, and

relative talent retention of businesses that make similar investments.

- Creation of an incentive program that promotes the use of best available technologies.

- A marketing campaign that highlights the second phase of successful pilot projects and experiments in the District.

By 2030

- Updated code that builds upon lessons learned from pilot projects and uses new heat mapping to target areas in the District where aggressive cooling investments are needed.

- A regenerative code that adjusts standards for cooling and water management projections.

4.3.2. Details on Investment Options for Buildings and Sites

4.3.2.1 On-Site Reuse and Harvesting

Bioretention basins, tree pockets, water harvesting, and greywater systems are landscape and building elements that collect, filter, and slowly release water. Reusing "greywater" from non-toilet inside uses and capturing and "harvesting" rainwater both reduce potable water use in and around buildings. Greywater includes wastewater from bathtubs, showers, bathroom sinks, washing machines, and laundry tubs. (It does not include wastewater from kitchen sinks, photo lab sinks, dishwashers, or laundry water from soiled diapers.) Greywater is typically used for landscaping outside, or for flushing toilets inside. Water harvesting captures and stores rainwater for later use in landscaping around the building.

This investment contributes to potable water use reduction with appliances that use less water, and substituting the use of outdoor potable water with stormwater and greywater when possible. This investment can also increase permeability promote cooling. In general, properly designed and constructed retention cells achieve excellent removal of heavy metals, moderate storm water discharge, enhance wildlife habitats, and act as windbreaks and noise absorption.

Implementation Tools (See Section 4.5. for more details)

- *Financing* - Capital investments, Maricopa County flood control funding

- *Partnerships* - BIDs and neighborhood initiatives

- *Codes* - Building codes (plumbing requirements)

- *Capacity Building* - EPA training, Water Use it Wisely Campaign

- *Incentives* - Tax credits

4.3.2.2. Natural Cooling and Shade

Trees and other vegetation help cool the environment and reduce UHI. They help lower surface and air temperatures, with shaded surfaces 20—45 °F cooler than areas without shade. Trees and other plants are most useful when placed in strategic location where they shade buildings and fenestrations. They may also be placed in parking lots and along the street where surfaces may be hotter.

Trees and vegetation can reduce surface temperatures and support thermal comfort. Cooling effects can reduce UHI and energy use.

Investment Tools (See Section 4.5. for more details)

- *Financing* - Private financing
- *Partnerships* – BIDs and neighborhood initiatives
- *Codes* - Building codes
- *Capacity Building* - APS and SRP Tree Programs
- *Incentives* - Tax credits

4.3.2.3. Engineered Shade and Cooling

Mitigation strategies start with the location of buildings, and their orientation to the path of the sun. Facades can limit sun exposure where necessary. The placement of buildings may also create passive cooling systems, which reduce the demand for energy. Engineered cooling materials and practices also include choice of materials, vegetation, and other green infrastructure components (Giguere, 2009). Green roofs, walls and parking lots may be both reflective and pervious, especially in parking lots (Giguere, 2009). Cool zones with misters and other engineered cooling technologies can also be used. All of these components help provide shade and reduce energy demand and temperatures. Shade prevents heavier materials from absorbing the sun's energy and contributing to UHI.

Engineered shade and cooling can support thermal comfort and reduce surface temperatures, energy use, and UHI.

Investment Tools (See Section 4.5. for more details)

- *Financing* – Capital investments, and private investment
- *Partnerships* – BIDs and neighborhood initiatives
- *Codes* – Building codes (cool material and shade requirements)
- *Capacity Building* – Cool material training
- *Incentives* – Tax credits

4.4. Open Spaces Intervention

The open space intervention refers to investments at large sites including parks, parking lots (or other underutilized lots), and open space on publicly-owned land, such as hospitals and schools.

4.4.1. Core Components

Aspired Sustainability Impacts

Through the open space intervention, the following sustainable green systems targets will be achieved by 2040:

- 500 more acres of permeable land
- 10% increase of District vegetation coverage (~60 acres)
- Less acres with temperatures greater than 130°F

Intervention Points

Open spaces are a critical point of intervention to cool the District, provide social and economic benefits, and retain rainwater runoff. Given that open space is often publicly owned, it is possible to make the argument that this space needs strong investments to maximize its benefit to residents, and businesses in the Solano District. Schools, hospitals, and new construction of large-scale mixed-use development are important open spaces to make initial investments.

Intervention Actions

The following actions are critical in the first ten years of the transition for accomplishing the impacts listed above.

Further details on the actions necessary in the first five years are available in Section 3.5. The following actions are critical for meeting the milestones set in the timeline below.

- Create pilot open space projects at Simpson, Washington Park, Niles, and Westwood Schools to increase retention capacity with silva cells, orchards, rain gardens, and other water harvesting and retention mechanisms.

- Design, finance, and construct a civic space pilot project using silva cells that tests capacity for structured water management in a dense area of the District, such as 19th Avenue and Camelback Road.

- Fund research on the effectiveness of technologies and vegetation in pilot projects.

- Commence a campaign to market pilot project successes, emphasizing the importance of water management and the need for increased public space.

- Renegotiate MS4 permit to allow for next-generation stormwater solutions.

- Create long-term funding structures, such as in-lieu feeds for trees and retention, which could be part of a neighborhood association (i.e. Simpson, Washington Park, Niles, and Westwood), BID (along Camelback Road), or CDC (i.e. Native American Connections).

- Produce a feasibility study for neighborhood water retention on green civic spaces at parks and hospitals.

Resources

The following resources are needed to support the open space intervention. Assets (resources that already exist) are in italics:

- *Reinvent PHX* to provide goals, and best practices

- *APS & SRP shade tree program* for increase trees

- *Global Institute of Sustainability (GIOS)* to research effectiveness of investments

- *Watershed Management Group* to develop pilot projects

- *American Society of Landscape Architects* to design projects and create an awards program

- Private capital

- Nurseries for discounted trees and vegetation

- Schools (Westwood, Simpson and Solano) to grow additional plants

- Construction companies for discounted or pro bono work to reduce grade

Barriers

- Labor and time requirement to regrade schools and parks

- Existing infrastructure (expensive and challenging to retrofit existing spaces)

- Lack of capacity and understanding of developers who favor cost-cutting mechanisms

- Lack of current organizational capacity (BIDs, CDCs, and neighborhood associations) to manage and finance needed investments

Intervention Timeline

This timeline outlines a transition towards Solano's sustainable green systems vision driven by open space over the next 30 years. Much can change during this time; thus, this transition strategy must be revisited and updated. Some of the actions listed as happening by 2025 or 2030 may be feasible before the stated date and could possibly be addressed sooner. The purpose of this timeline is to demonstrate a possible sequence (pathway) to achieve the 2040 vision, with the recognition that some things may come faster or slower. The "By 2020" section includes major milestones that could be accomplished if all of intervention actions in the list above are implemented or at least underway.

By 2020

- A new form-based code with effective rules and regulations for water harvesting and reuse, and natural and engineered shade and cooling that supports using open space for green systems (e.g.

using open space as retention for zones 5—6)

- Successful pilot projects at parks and schools that lower the grade of large portions of each property to improve its water retention capacity

- A marketing campaign including awards for effective implementation of silva cell-based civic space, neighborhood water retention, green parking on open space

- New MS4 permit that allows for neighborhood retention

By 2025

- Experiments with multi-functional natural cooling systems and water retention, such as school based mesquite groves and citrus orchards

- Updated code that builds on lessons learned from pilot projects and uses new heat mapping to target areas in the District where aggressive cooling investments are needed

- Invest in 2—3 new open space opportunities, such as an urban forest in vacant land near Central

By 2030

- A regenerative code that adjusts standards for cooling and water management projections

- A new marketing campaign that highlights successful the second generation pilot projects and experiments in the District, and gathers support for public investment in open space projects critical for ensuring cooling targets will be met by 2040

4.4.2. Details on Investment Types for Open Space

4.4.2.1. Neighborhood Retention Basins

Neighborhood retention basins are landscape elements that collect large amounts of water (e.g. parks, golf courses, or other uses). They filter water and slowly release it back into ground water. This investment can be placed near a dense urban area where on-site retention is not possible due to building density.

This investment contributes to permeability, and can be used to promote cooling. In general, properly designed and constructed retention cells achieve excellent removal of heavy metals, moderate storm water discharge, enhance wildlife habitats, and act as windbreaks and noise absorption.

Implementation Tools (See Section 4.5. for more details)

- *Financing* – Capital investments and Maricopa Flood control funding

- *Partnerships* – BIDs, CDCs, and neighborhood initiatives

- *Codes* - Land use ordinances, capacity building, watershed management training

- *Incentives* - Tax credits and expedited permitting

4.4.2.2. Green Civic Spaces

Green civic spaces include parks, plazas, open space, and public greens that redirect and/or store stormwater with pervious surfaces, bioswales, rain gardens, and vegetation (including trees). Green public spaces allow the Eastlake-Garfield District to be intentional in using open space and stormwater to beautify and contribute to cooling.

Green open space can significantly increase the amount of pervious surfaces in a District, and can contribute to higher stormwater quality. Green open space can also support shade and cooling efforts.

Implementation Tools (See Section 4.5. for more details)

- *Financing* - Capital investments, DOT funding (i.e. TIGER grants), BIDs, and private investment
- *Partnerships* - CDCs and neighborhood initiatives
- *Codes* - Land use ordinances
- *Capacity Building* - Watershed management training
- *Incentives* - Tax credits and expedited permitting

4.5. Details on Implementation Tools for Green Systems

Technical Program Title	Sub Type	Intervention Investment Option	Source	Applicant	Beneficiaries Resident Type	Location	Sources / Examples / Links	Reduce Stormwater Loads and harvest water on site	Reduce potable water consumption	Reduce daytime temperatures	Improve the social and economic benefits of green systems
FINANCING											
Community Development Block Grant Program	Grant	Buildings, open spaces	Federal	State / City	Any	Unspecified (Locate near transit to reduce transportation cost burdens)	http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs	X	X	X	X
New Market Tax Credits	Tax Credit	Buildings, open spaces	Federal	CDC / Community Development Entity	Any	Distressed Areas – HUD Desiganted Renewal Communities (RCs), Empowerment Zones (EZs) and Enterprise Communities (ECs)	http://www.communityfundinggroup.org/nmtc-overview.html	X	X	X	X
Program Energy Innovation Fund	Loans	Buildings, open spaces	Federal	Homeowners or property owners	Any	Unspecified	*portal.hud.gov/huddoc/2010eif-psp-nofa.pdf*			X	X

Technical Program Title	Sub Type	Intervention Investment Option	Source	Applicant	Beneficiaries Resident Type	Location	Sources / Examples / Links	Reduce Stormwater Loads and harvest water on site	Reduce potable water consumption	Reduce daytime temperatures	Improve the social and economic benefits of green systems
PowerSaver Pilot 203(k) Program											
Neighborhood Stabilization Program	grant	All	City	Homeowners or property owners	Any	Unspecified	http://www.nhsphoenix.org/neighborhood_stabilization.html	X	X	X	X
PARTNERSHIPS											
Community Land Trust	Resident-based	All	Local	Residents	Any	Unspecified (Locate near transit to reduce transportation cost burdens)	http://www.newtowncdc.org/?page_id=168	X	X	X	X
Community Development Corporations	Business- or resident-based	All	Local	Residents and/or businesses	Any	Unspecified (Locate near transit to reduce transportation cost burdens)	http://www.phxrevitalization.org/aboutus.htm	X	X	X	X
Condos with a Homeowner	Resident-based	All	Local	Residents and/or	Any	Unspecified		X	X	X	X

Technical Program Title	Sub Type	Intervention Investment Option	Source	Applicant	Beneficiaries Resident Type	Location	Sources / Examples / Links	Reduce Stormwater Loads and harvest water on site	Reduce potable water consumption	Reduce daytime temperatures	Improve the social and economic benefits of green systems
Association				businesses							
Neighborhoods and Associations	Residen t-based	Open spaces, streets	Local	Residents	Any	Unspecified		X	X	X	X
Partnerships for energy efficiency in multifamily housing	Property -owner based	Buildings	Local	Residents and/or businesses	Any	Unspecified	http://www.cntenergy.org/media/Engaging-as-Partners-in-Energy-Efficiency-MF-Housing-and-Utilities-Final-012512.pdf			X	X
Code and guidelines Enforcement	City	All	City	Residents, Contractors, Developers, Landlords, Property Managers	Any	Unspecified	http://phoenix.gov/pdd/devcode/buildingcode/index.html	X	X	X	X
Community Benefit Agreements	Contract between developer, city and	All	City	City, Developers, Neighborhood	Any	Unspecified	http://communitybenefits.blogspot.com/ http://www.azcentral.com/news/election/topstories/articles/	X	X	X	X

Technical Program Title	Sub Type	Intervention Investment Option	Source	Applicant	Beneficiaries Resident Type	Location	Sources / Examples / Links	Reduce Stormwater Loads and harvest water on site	Reduce potable water consumption	Reduce daytime temperatures	Improve the social and economic benefits of green systems
	neighborhood						0630jacksonstreet0630-CP.html				
Community Amenities (Parks, community centers, libraries)	Amenities	Open Spaces	City	City, Developers, Neighborhood	Any	Unspecified (Locate near transit to reduce transportation cost burdens)		X		X	X
Support for Neighborhood Events	Programs	Open Spaces	City	City, Neighborhood	Any	Unspecified					X
CODES											
Frontage Codes	Zoning Codes	Buildings, open spaces	City	Planning Department	Any	Unspecified	http://www.formbasedcodes.org/taxonomy/term/21	X	X	X	X
City of Phoenix Street Planning and Design Guidelines	Guidelines	Streets, Open Spaces	City	City	Any	Unspecified		X		X	X

Technical Program Title	Sub Type	Intervention Investment Option	Source	Applicant	Beneficiaries Resident Type	Location	Sources / Examples / Links	Reduce Stormwater Loads and harvest water on site	Reduce potable water consumption	Reduce daytime temperatures	Improve the social and economic benefits of green systems
City of Phoenix Streets and Sidewalk	Standards	Streets, Open Spaces	City	City, Developers, Contractors, Residents	Any	Unspecified	http://www.codepublishing.com/AZ/phoenix/html/Phoenix31/Phoenix31.html	X		X	X
City of Phoenix Subdivision Code	Zoning Codes	All	City	Developers, Contractors, Residents	Any	Unspecified	http://www.codepublishing.com/AZ/phoenix/html/Phoenix32/Phoenix32.html	X	X	X	X
City of Phoenix Stormwater Policies and Standards	Standards	All	City	Developers, Contractors, Residents	Any	Unspecified	http://www.codepublishing.com/AZ/phoenix/html/Phoenix32C/Phoenix32C.html	X		X	X
City Shade Standards	Standards	All	City	Developers, Contractors, Residents	Any	Unspecified		X		X	X

Technical Program Title	Sub Type	Intervention Investment Option	Source	Applicant	Beneficiaries Resident Type	Location	Sources / Examples / Links	Reduce Stormwater Loads and harvest water on site	Reduce potable water consumption	Reduce daytime temperatures	Improve the social and economic benefits of green systems
Grey water ordinances	Standards	All	City	Developers, Contractors, Residents	Any	Unspecified	http://cms3.tucsonaz.gov/files/dsd/Codes-Ordinances/Ordinance11089.PDF http://cms3.tucsonaz.gov/pdsd/codes-ordinances/building-codes		X		
City of Phoenix Green Construction Code	Standards	Buildings	City	Developers, Contractors, Residents	Any	Unspecified		X	X		
Capacity Building (Knowledge)											
Shade Tree programs	Skills, materials, and knowled	All	City or County	Property owners	Any	Unspecified	http://www.aps.com/en/residential/savemoneyandenergy/coolingheating/Pages	X	X	X	X

Technical Program Title	Sub Type	Intervention Investment Option	Source	Applicant	Beneficiaries Resident Type	Location	Sources / Examples / Links	Reduce Stormwater Loads and harvest water on site	Reduce potable water consumption	Reduce daytime temperatures	Improve the social and economic benefits of green systems
	ge						/shade-tree-program.aspx				
Solar Systems Residential Guidelines	Knowledge	Buildings	City	Developers, Contractors, Property owners	Property owner, renter	Unspecified	http://phoenix.gov/webcms/groups/internet/@inter/@dept/@dsd/@trt/documents/web_content/dsd_trt_pdf_00367.pdf			X	
Water Conservation Education	Knowledge	All	City, County, State	Property owner, renter	Property owner, renter	Unspecified	http://www.azwater.gov/azdwr/StatewidePlanning/Conservation2/	X	X		
Landscape Design Review Guidelines (Residential)	Knowledge	All	City	Developers, Contractors, Property owners	Property owner, renter	Unspecified	http://phoenix.gov/pdd/development/sitecivil/landscape/index.html	X	X	X	X
Landscape Design Review Guidelines(Commercial)	Knowledge	All	City	Developers, Contractors, Property owners	Property owner, renter	Unspecified	http://phoenix.gov/pdd/development/permits/residential/resdocs/resguides/in	X	X	X	X

Technical Program Title	Sub Type	Intervention Investment Option	Source	Applicant	Beneficiaries Resident Type	Location	Sources / Examples / Links	Reduce Stormwater Loads and harvest water on site	Reduce potable water consumption	Reduce daytime temperatures	Improve the social and economic benefits of green systems
							dex.html				
Phoenix Tree and Shade Master Plan	Knowledge	All	City	Developers, Contractors, Property owners	Property owner, renter	Unspecified	http://phoenix.gov/parks/shade.html	X	X	X	X
Incentives											
Green Construction Incentives	Financial	Buildings	City	Developers, contractors or property owners	Any	Unspecified	http://transformgov.org/en/Article/100607/Phoenix_AZ_Offers_FirstEver_Reduced_Permit_Fees_for_Green_Building	X	X	X	
Capital Improvement Program (CIP)	Financial	All	City	Developers, contractors or property owners	Any	Unspecified		X	X	X	X

4.6. Synthesis – 5-year Action Plan for Sustainable Green Systems in Solano

The following plan details the aforementioned intervention actions that government, non-profits, businesses, residents, and members of the Steering Committee can take to implement the sustainable green systems strategy. Actions are not sequential, but the sub-actions (a, b, c, etc.) are sequential. Actions are designated short-term (year 1), mid-term (1—3 years), or long-term (3—5 years).

Work with local schools and their districts on green systems pilot projects and educational outreach

1. Complete a Camelback green street pilot project with street trees, bioswales, and engineered shade. (1—3 years)

2. Create educational programming about the evidence for multiple benefits of green systems at Phoenix College with Arizona State University, businesses, and non-profits. (1—3 years)

    a. Partner the Global Institute of Sustainability with local school Districts and Gateway Community College to create a green systems educational working group (GIOS)

    b. Gather data from local pilot projects

    c. Create initial round of testing materials and test with students

3. Create pilot open space projects at Solano Elementary School and Westwood Primary School with silva cells, orchards, rain gardens, and other water harvesting and retention mechanisms. (3—5 years)

Streets and Transportation Department, Planning Department, and Downtown Phoenix Partnership work on large-scale green streets and civic space projects

1. Seek city, state, and philanthropic funding for Camelback Road improvement and create a long-term maintenance and street conversion fund with adjacent property owners. (year 1)

2. Make major green streets investments on 17th Avenue to connect connect residents to the light rail. (3—5 years)

3. Design, finance, and construct a civic space pilot project using silva cells that tests capacity for structured water management in a dense area of the District, such as Christown. (3—5 years)

Incentivize and market to developers to create open space and building and sites green systems investments

1. Pass code updates that create density dependent guidelines for water harvesting and reuse, and natural and engineered shade and cooling that is dependent on the density of the area. Form-based codes designate transect zones densities from 1 (least dense) to 6 (most dense). (Planning Department) (year 1)

2. Renegotiate MS4 permit to allow for next-generation stormwater solutions. (Public Works Department) (year 1)

3. Create an awards program that honors the most successful uses of the new code, including new technologies (Planning Department) (1—3 years)

4. Develop, Design, and building buildings with state of the art green systems technologies (3—5 years)

    a. Create clear urban examples of onsite retention and cooling in transect zones 3—6.

    b. Market building and sites green systems success stories.

    c. Deliver education and capacity building programming that uses pilot projects to teach the benefits of water harvesting and reuse, and natural and engineered shade and cooling.

Chapter 5 – Discussion and Conclusions

5.1. Strengths of the Current Transition Strategy

This sustainable green systems strategy has been developed based on a community-informed sustainability vision, a detailed sustainability assessment, and a theory of change. These inputs were then processed into evidence-supported interventions and investments to transition green systems in the District from its current state to a sustainable state of fully functional stormwater, biodiversity, and resource management practices, as well as sustainable levels of thermal comfort, energy efficiency, and access to green space. The strategy adopts a long-term perspective that needs to be coordinated with short-term actions and clear roles and responsibilities to be successful.

5.2. Testing Strategy, Interventions, Investments

More work needs to be done to further understand the drivers of the green systems challenges, and to specify the vision for sustainable green systems in order to further enhance the effectiveness and efficiency of interventions and investment options. Further research needs to scrutinize barriers to implementation and potential coping strategies, such as less expensive ways to improve the grade of properties for water retention or how to overcome common maintenance challenges with street trees. This strategy report is intended to provide a basis for use-inspired research that will lead to a culture of evidence-supported policy making as it pertains to sustainable green systems in Phoenix.

Testing interventions and investments is critical to the success of the strategy. The Steering Committee and supporting staff needs to monitor which interventions are the most effective and efficient. Pilot projects can help determining the sustainability impacts of each investment. For example, an early pilot project in the investment of green streets near District schools can help develop an understanding of the ability of that investment to achieve the specific targets, including shade and porosity. If financing, design or construction of those pilot projects proves to be difficult, then investment in green systems on buildings and property may be a better investment to reach those targets. A culture of experimenting with and testing of investment options can lead to effective and efficient policy making that demonstrates the highest impact with limited resources.

5.3. Coordination Across Strategies

There is the need for a broader transition strategy across all sectorial strategies (six planning elements), as the green systems strategy depends on other strategies. For example, strong economic development strategies will allow for more resources to be used to improve the green system of the District. If the economy of the District is strong, then businesses and property owners may be willing to pay in-lieu fees for water retention or street trees, but if economic development is weak then it is much less likely that adequate resources will be available to achieve the goals of this strategy. If these strategies are not pursued in concert, it is possible that these targets will not be reached.

5.4. Anticipating the Next Set of Interventions, Investments, and Implementation Tools

Interventions, and investments are not static. It is most likely that over the course of the next several decades that different interventions, investments, and implementation tools need to be used to achieve the green systems targets set forth. The Steering Committee and supporting city staff should attempt to anticipate possible future interventions, investments, and implementation tools that are not yet utilized in the current strategy. It is also likely that new financing mechanisms such as crowdsourcing or TIFs become viable options, and could be essential implementation tools to reach targets of green systems. While this strategy provides a solid set of intervention and investment options, it is important that these options are continual tested and monitored, while emerging options are explored.

5.5. Crafting the Next 5-year Plan

It is also important to understand that there is a lot of uncertainty about what will occur in the future that might make aspects of this strategy obsolete. Therefore, it is important that the strategy is regularly revisited and revised. Every 5-year cycle should give the Steering Committee, City of Phoenix Departments, and other stakeholders the opportunity to revisit progress towards the goals and targets, and craft a new five year plan. This will give stakeholders an opportunity to decide on critical actions that include what roles and responsibilities need to be fulfilled in the next five years. Lessons from the previous five years should inform the creation of the next five years, so that realistic expectations are set for what the group can accomplish in this timeframe. While the long-term view of this strategy is important in terms of ‘keeping the eyes on the prize’, it is critical that the Steering Committee and other stakeholders in the District organize their efforts around short-term action plans.

References

Benedict, M.A. & E.T. McMahon. (2006). Green infrastructure: Linking Landscapes and Communities. Island Press: Washington, DC.

City of Phoenix (2010). Tree and shade master plan. Phoenix, AZ: City of Phoenix. Retrieved from http://phoenix.gov/webcms/groups/internet/@inter/@dept/@parks/documents/web_content/071957.pdf

Cook, E.A. (2007). Green site design: Strategies for storm water management. Journal of Green Building, 2(4), 46-56.

(EPA) U.S. Environmental Protection Agency. (2013). "Green Infrastructure". United States Environmental Protection Agency. Retrieved from: http://water.epa.gov/infrastructure/greeninfrastructure/index.cfm

Gibson, R.B. (2006). Sustainability assessment: basic components of a practical approach. Impact Assessment and Project Appraisal: 24, 170–182.

Giguere, M. (2009). Urban Heat Island Mitigation Strategies . Quebec : Institut national de sante publique du Quebec .

Golub, A., Wiek, A., Kay, B., Connell, T., Soffel, M., Harlow, J., Pankiewicz, M. & Ramirez, N. (2013). Sustainable Green Systems Assessment for the Eastlake-Garfield District, Phoenix Evidence-based Strategies for Sustainable Green infrastructure in the Eastlake-Garfield District, Phoenix. Project Report to the Reinvent Phoenix Project, City of Phoenix.

Golub, A., Wiek, A., Pfeiffer, D., Schmidt, J., Harlow, J., Connell, T., Stranieri, A., Kay, B. (2013).. Project Report to the Reinvent Phoenix Project, City of Phoenix.

Hager, C. J. et al. (2014). Existing Health Conditions for the Eastlake-Garfield District, Phoenix.

Project Report to the Reinvent Phoenix Project, City of Phoenix.

(HUD) U.S. Department of Green systems and Urban Development, U.S. Department of Transportation (DOT), and the U.S. Environmental Protection Agency (EPA) (2009). Partnership for Sustainable Communities: Livability Principles. Washington D.C.: HUD/DOT/EPA.

Johnson, C., Upton, C., Wiek, A., Golub, A. (2011). Reinvent Phoenix: Cultivating Equity, Engagement, Economic Development and Design Excellence with Transit-Oriented Development. Project Proposal. City of Phoenix and Arizona State University.

Kay, B, Wiek, A. & Loorbach, D. (2013). The Concept of Transition Strategies. Working Paper. Sustainability Transition and Intervention Research Lab, School of Sustainability, Arizona State University.

Machler, L., Golub, A., & Wiek, A. (2012). Using a "sustainable solution space" approach to develop a vision of sustainable accessibility in a low-income community in Phoenix, Arizona. International Journal of Sustainable Transportation, vol. 6, no. 5, 298-319.

Office of Sustainable Housing and Communities. (2012). Guidance on Performance Measurement and Flagship Sustainability Indicator Fact Sheets. Retrieved May 28, 2013, from the Department of Green systems and Urban Development website: http://portal.hud.gov/hudportal/documents/huddoc?id=OSHCPerfMeasFlagSustInd.pdf

Rouse, D.C. & I.F. Buster-Ossa. (2013). Green infrastructure: A landscape approach. American Planning Association, Planning Advisory Service Report, Number 571. Chicago.

Wiek, A. (2009). Transformational Planning for Sustainability. Working Paper. Sustainability Transition and Intervention Research Lab, School of Sustainability, Arizona State University.

Wiek, A., Golub, A., Kay, B., Harlow, J., Cohen, M., Minowitz, A., Soffel, M. (eds) (2012). Sustainable Vision for the Eastlake-Garfield District, Phoenix. Project Report to the Reinvent Phoenix Project, City of Phoenix.

Wiek, A. & Kay, B. (2013). Strategies for Intentional Change Towards Sustainability - A Review of Key Paradigms. Working Paper. Sustainability Transition and Intervention Research Lab, School of Sustainability, Arizona State University.