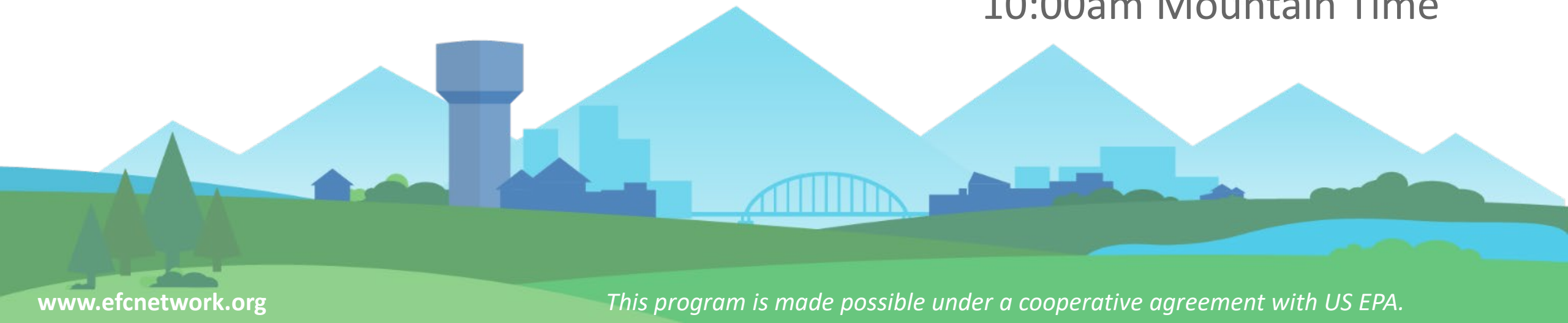
Green Infrastructure Webinar Series

Webinar 4: Asset Management for Green Infrastructure

Thursday, 23 January 2025

10:00am Mountain Time



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Logistics

Opening the control panel

Show your control panel

All phones/microphones are muted for the duration of the webinar

Toggle between full screen/window screen view

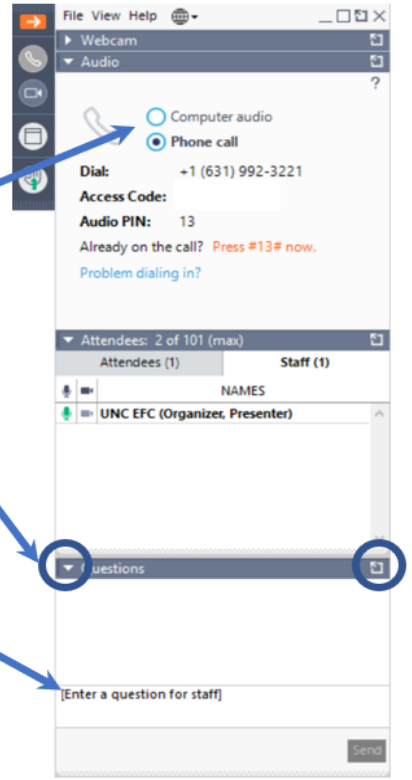
Using the control panel

Audio: please choose between computer audio or phone call

If you do not hear audio right now, please check your speaker volume or enter #[your Audio PIN]# if using phone

Click to open in Control Panel

Submit **questions** in the Questions box at any time, and press [Send]



Click to open in separate box and resize

Certificate of Completion

This session has **NOT** been submitted for pre-approval of Continuing Education Credits, but eligible attendees will receive a certificate of attendance for their personal record.

To receive a certificate:

- You must attend the entire session
- You must register and attend using your real name and unique email address - group viewing credit will not be acceptable
- You must participate in polls
- Certificates will be sent via email within 30 days

If you have questions or need assistance, please contact smallsystems@syr.edu.

EFCN
environmental finance center network

About Us

The **Environmental Finance Center Network (EFCN)** is a university- and non-profit-based organization creating innovative solutions to the difficult how-to-pay issues of environmental protection and water infrastructure.

The EFCN works collectively and as individual centers to address these issues across the entire U.S, including the 5 territories and the Navajo Nation. The EFCN aims to assist public and private sectors through training, direct professional assistance, production of durable resources, and innovative policy ideas.

Webinar Series Overview

Title	Date
Green Infrastructure 101	18 April 2024
Equitable Green Infrastructure in a Changing Climate	25 July 2024
Navigating the Green Infrastructure Policy Landscape	10 October 2024
Asset Management for Green Infrastructure	**23 January 2025**
Funding Green Infrastructure	24 April 2025
Partnerships are Critical to Successful Green Infrastructure	17 July 2025
Building a Green Infrastructure Workforce	16 October 2025
Green Infrastructure Frameworks for Environmental Justice	22 January 2026
Source Water Protection and Watershed Planning for Wildfire	16 April 2026
Bridging the Gap: Integrating Land and Water Planning for Sustainable Futures	16 July 2026

Overview of Today's Webinar

1. Overview of Integrated Green/Gray Asset Management for wastewater and stormwater systems
2. Nature as Infrastructure – City of Tucson GSI Enterprise Asset Management
3. Resources
4. Question & Answer session with speakers

Today's Speakers

Shannon Sloane Pepper
Water Utility Trainer and Specialist

SOUTHWEST ENVIRONMENTAL FINANCE CENTER

Brooke Bushman
Green Stormwater Infrastructure Maintenance Manager

Storm to Shade
City of Tucson Green Stormwater Infrastructure Program

About You!

Please complete the poll that pops up on your screen.

Your familiarity with Asset Management

Please complete the poll that pops up on your screen.

Asset Management: Blending Green and Gray for Holistic Decision-Making

What asset management is and how it helps systems make good management decisions about their green and gray assets together

EFCN
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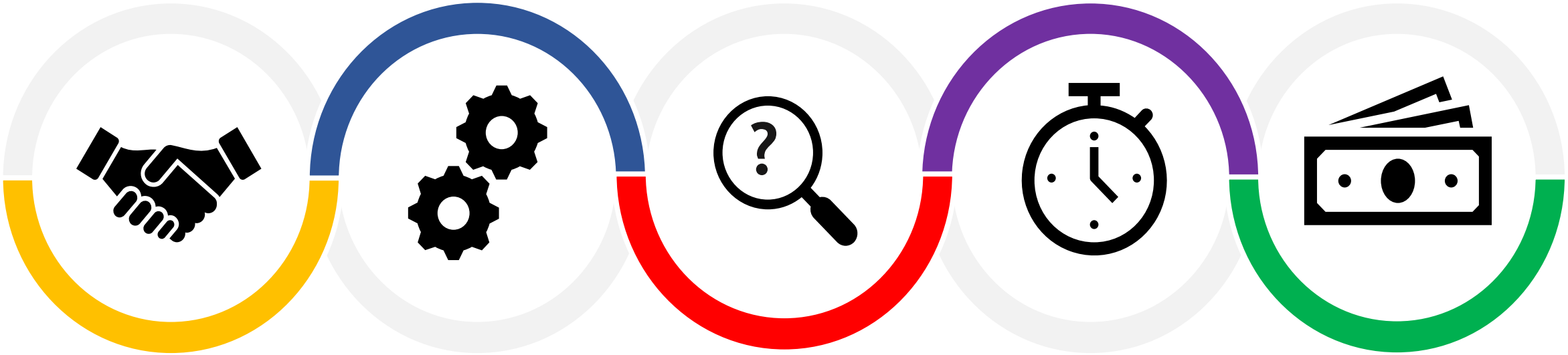
Asset Management is a **framework** designed **to help you** decide **how**, **when** and **where** to spend **limited funds** to achieve the **best results**.

Five Major Components

What service Level of Service want to provide?

Which ones are most critical to you Criticality that service?

Do you have the money to get it all done? Long-term Funding



Current State of the Assets

How do you ensure the assets do their job over their life spans? Life Cycle Costing

Core Component:

Level of Service

Goals

Level of Service Goals provide strategic direction for managerial, operational, and financial decisions.

- What service levels do your customers/community members want?
- What service levels can you provide?
- How will you measure performance?

Customer Service	System Maintenance	Response Time	Drought/Demand Management
Fewer than 2 complaints received regarding vegetation overgrowth, trash, and/or flooding of green infrastructure per month	The system will inspect and perform routine maintenance on all infiltration planters and rain gardens once a month. Routine maintenance includes weeding, mowing, unclogging, litter removal, and pruning.	System staff will inspect all green infrastructure installations within two weeks after a large storm event to assess damage.	The utility will develop a management plan for stormwater runoff entering streams and other source water to minimize pollutants within 3 years.

Core Component:

Current State of the Assets

Asset Inventory

What is the asset?

Is it managed as a whole or by individual component?

Is it replaced as a whole or by components?

What data do you collect about an asset?

What do we mean by “Green Infrastructure”?

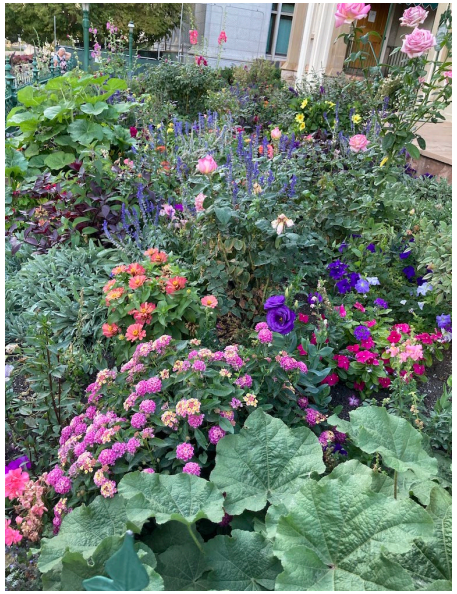
A **Natural Asset** (Already exists, just being used to serve a purpose)



Rivers, lakes, streams, forests, land around well heads

What do we mean by “Green Infrastructure”?

A **Green Asset** (Use of natural materials, engineered to serve a purpose)



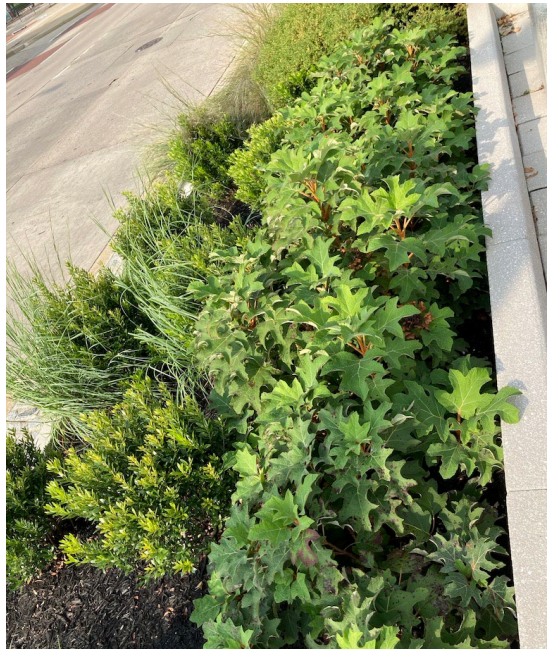

Revegetation, constructed wetlands, buffer zones

What do we mean by “Green Infrastructure”?

Engineered Green Asset (Use of gray materials or mixtures of green and gray asset components to mimic natural processes)

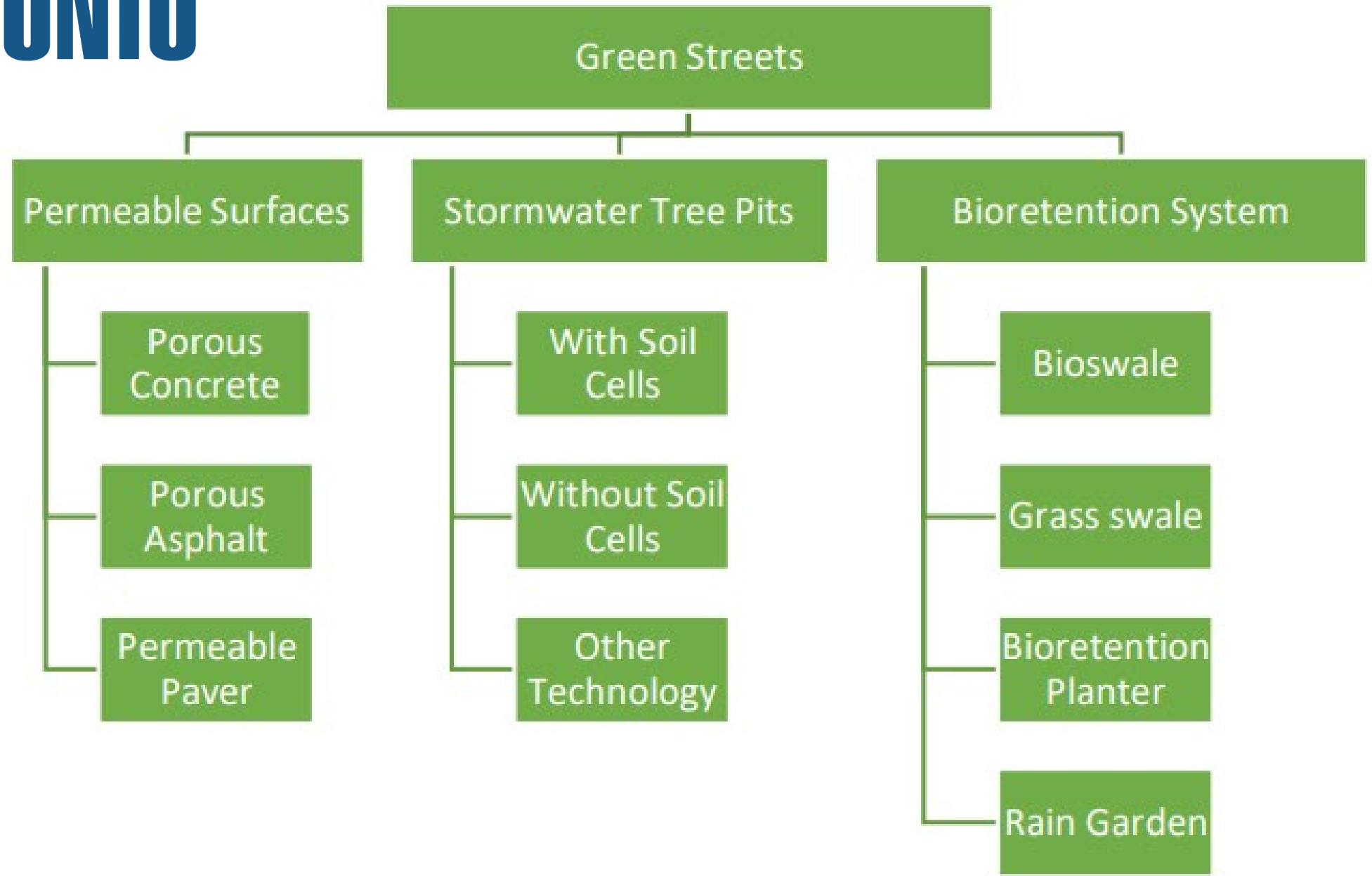
Bioretention basins, green roofs, infiltration planters

The asset can be broken into components



Or it can be just one asset

TORONTO


Green Streets
Permeable Surfaces
Stormwater Tree Pits
Bioretention System
Porous Concrete
Porous Asphalt
Permeable Paver
With Soil Cells
Without Soil Cells
Other Technology
Bioswale
Grass swale
Bioretention Planter
Rain Garden

Example:

Landing Page | Capital Projects | Constructed Projects | GI_AssetTypes | GI_Components_n_LOS

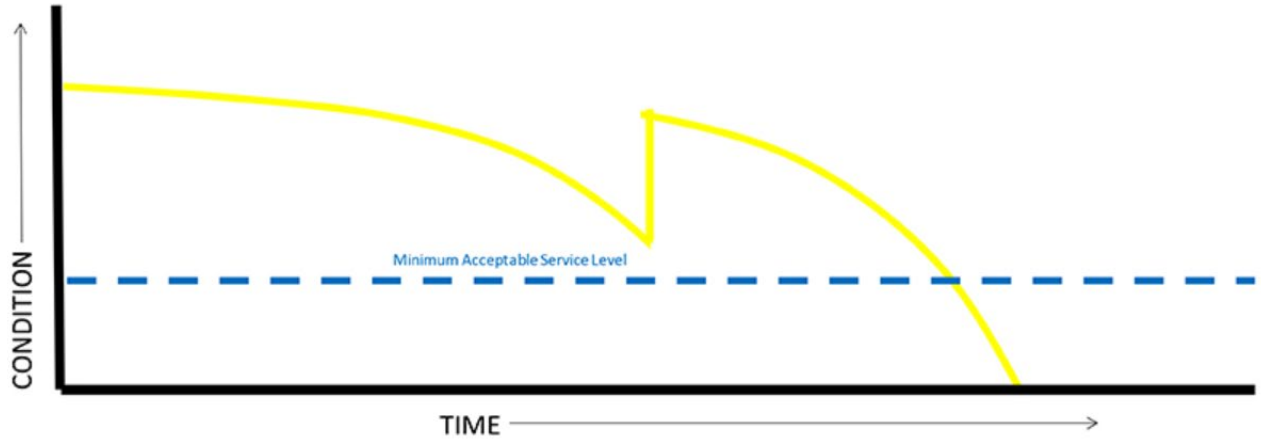
Category	Component Type	Regular Maintenan	Inspection Points	Task	Frequency/Schedule
Inlet	Concrete Curb Cut	☑	Sedimentation	Clear Debris	6mo or as required
Inlet	Catchbasin	☑	Sedimentation	Hydrovac	12mo or as required.
Inlet	Trench Drain (Narrow)	☑	Sedimentation, struct	Power wash or manual cleanc	6mo or as required
Inlet	Trench Drain (Wide)	☑	Sedimentation, struct	Power wash	12mo or as required.
Inlet	Sheet Flow	☐	Sedimentation, erosio	Clear debris	12mo or as required.
Inlet	-none-	☐			
Pretreatment	Concrete Forebay	☑			
Pretreatment	River Rock/Rift Raft	☑			
Pretreatment	Wood Disperser	☑			
Pretreatment	Catchbasin - Jellyfish	☑			
Pretreatment	Catchbasin - CB Shield	☑			
Pretreatment	Oil Grid Separator (OGS)	☑			
Pretreatment	-none-	☐			
Surface Treatment	Trees	☑			
Surface Treatment	Shrubs	☑			
Surface Treatment	Horticulture	☑			
Surface Treatment	Sod/Grass	☑			
Surface Treatment	Mulch	☑			
Surface Treatment	Base Soil	☑	Erosion	Inspect for erosion	

Condition

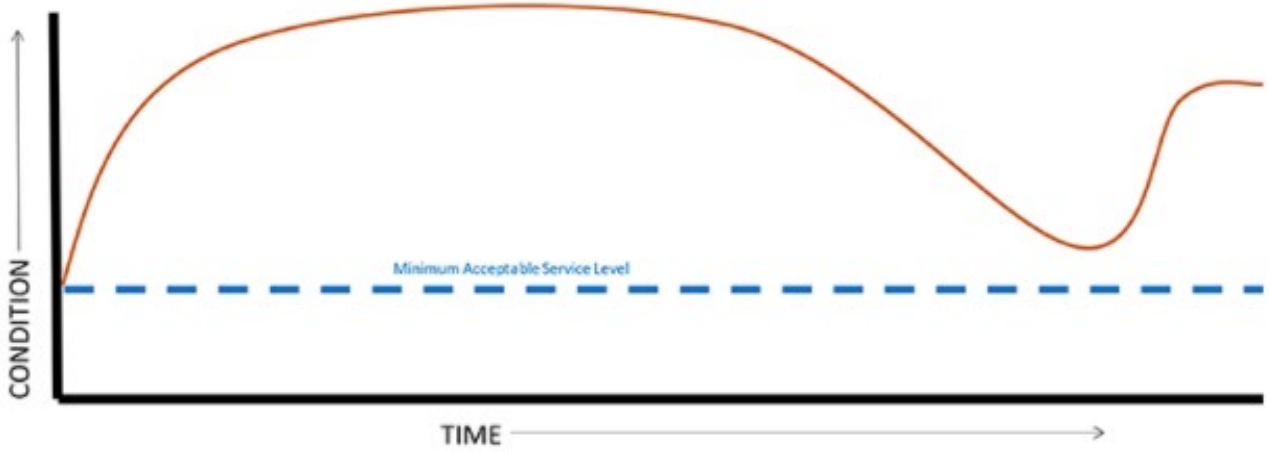
Defines the physical state of the asset at a moment in time

Will help inform useful life remaining, maintenance, interventions, replacement and other asset decisions.

Condition Curve – Typical *Gray Asset*



Condition Curve – Typical *Green Asset*



Source: SW EFC Green Gray Framework

5 Step Condition Scale: A good starting place for monitoring asset condition over time

1
2
3
4
5

OR

Excellent
Good
Average
Fair
Poor

OR

A
B
C
D
E

Example Condition Scale for Bioretention Swales and Planters (Vegetation Components):

1. **Vegetation and trees are in very good condition:** excellent vigor in trees with no pests/disease/damage, symmetrical tree growth; desirable vegetation makes up >90% of soil area; excellent vigor in vegetation; weeds cover <25% of soil area.

2. **Vegetation and trees can wait for routine maintenance and/or pruning**: average vigor in trees with no pests/disease/damage, minor asymmetry in tree form; desirable vegetation covers 75%-89% of soil area; average vigor in vegetation; weeds cover 25%-49% of soil area.

3. **Vegetation and trees require priority maintenance, pruning, irrigation and/or weeding**: fair vigor in trees with minor pests/disease/damage, minor defects in tree form; desirable vegetation covers 50%-74% of soil area; fair vigor in vegetation; weeds cover 50%-74% of soil area.

4. **Vegetation and trees require high priority weeding, irrigation and lower priority replanting**: poor vigor in trees with significant pests/disease/damage and significant growth defects; desirable vegetation covers 25%-49% of soil area; poor vigor in vegetation; weeds cover 75%-89% of soil area.

5. **Vegetation and/or tree require replacement with high priority**: Trees are dead or nearly dead and not able to be saved; desirable vegetation covers <25% of soil area; vegetation is dead or nearly dead and not able to be saved; weeds cover >90% of soil area.

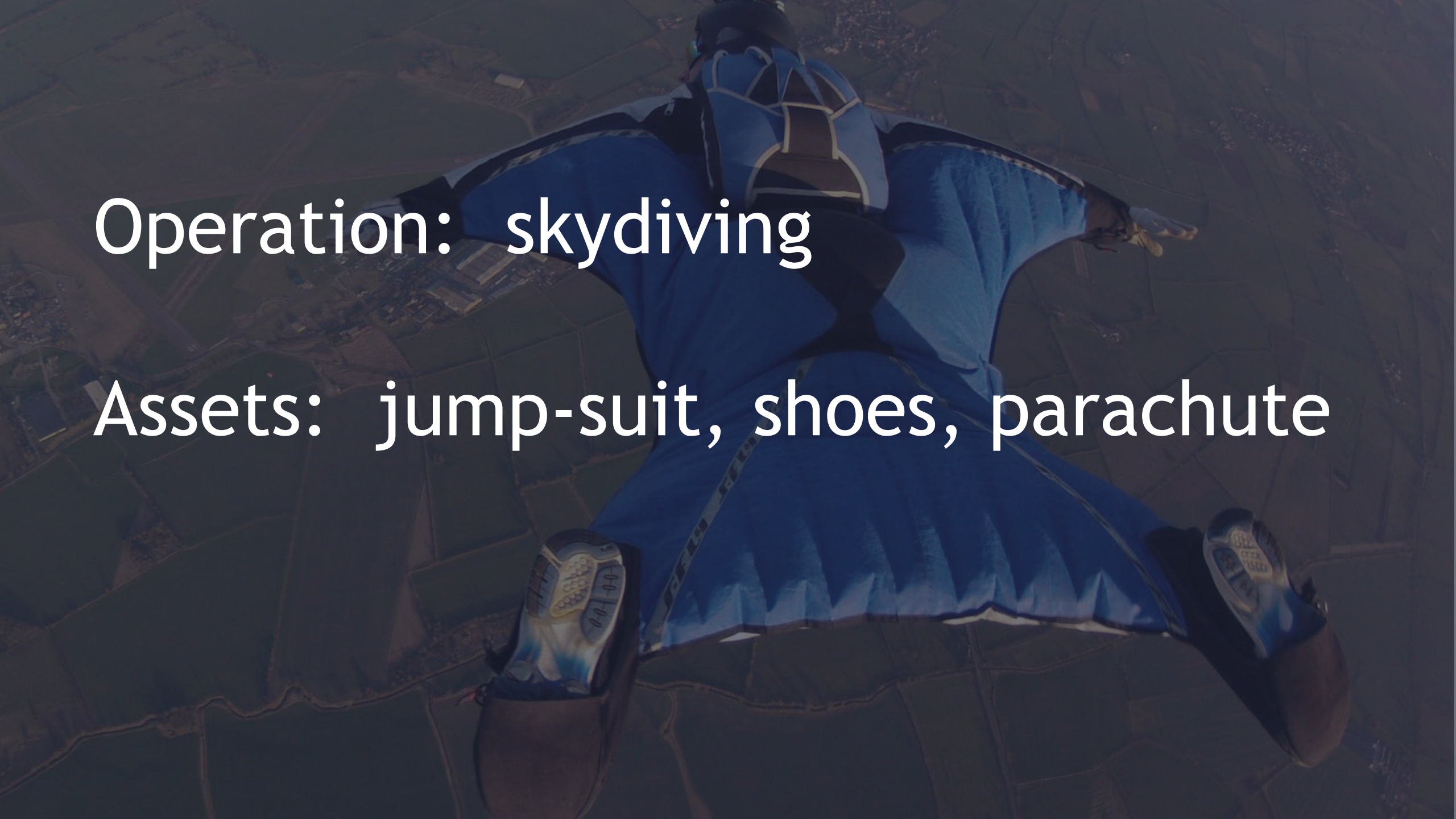
Core Component:

Criticality

Risk

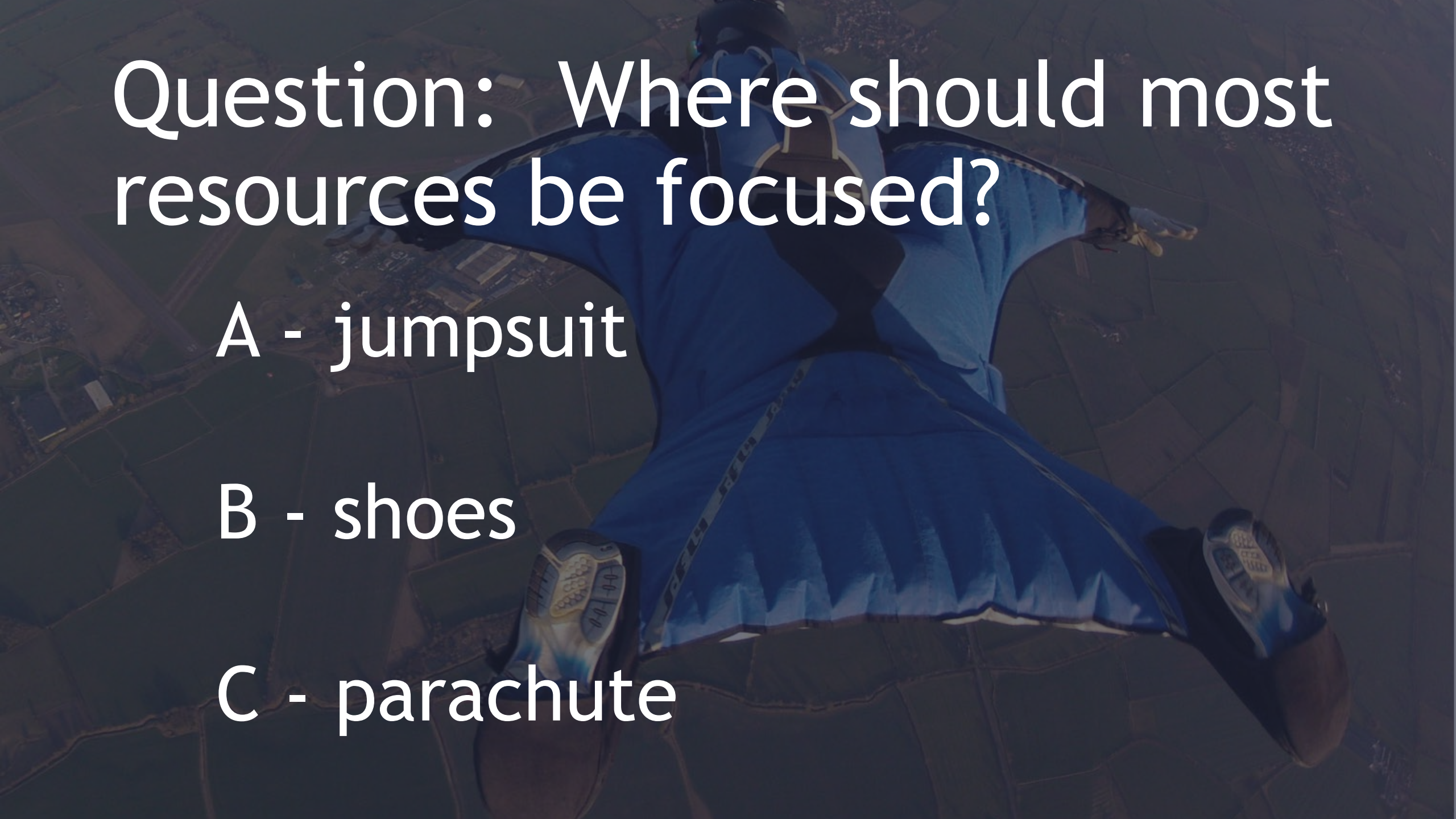
Understanding and determining the risk for each of your assets in order to prioritize activities that are most critical to your system.


Let’s
look at a
simple
example



Operation: skydiving

Assets: jump-suit, shoes, parachute



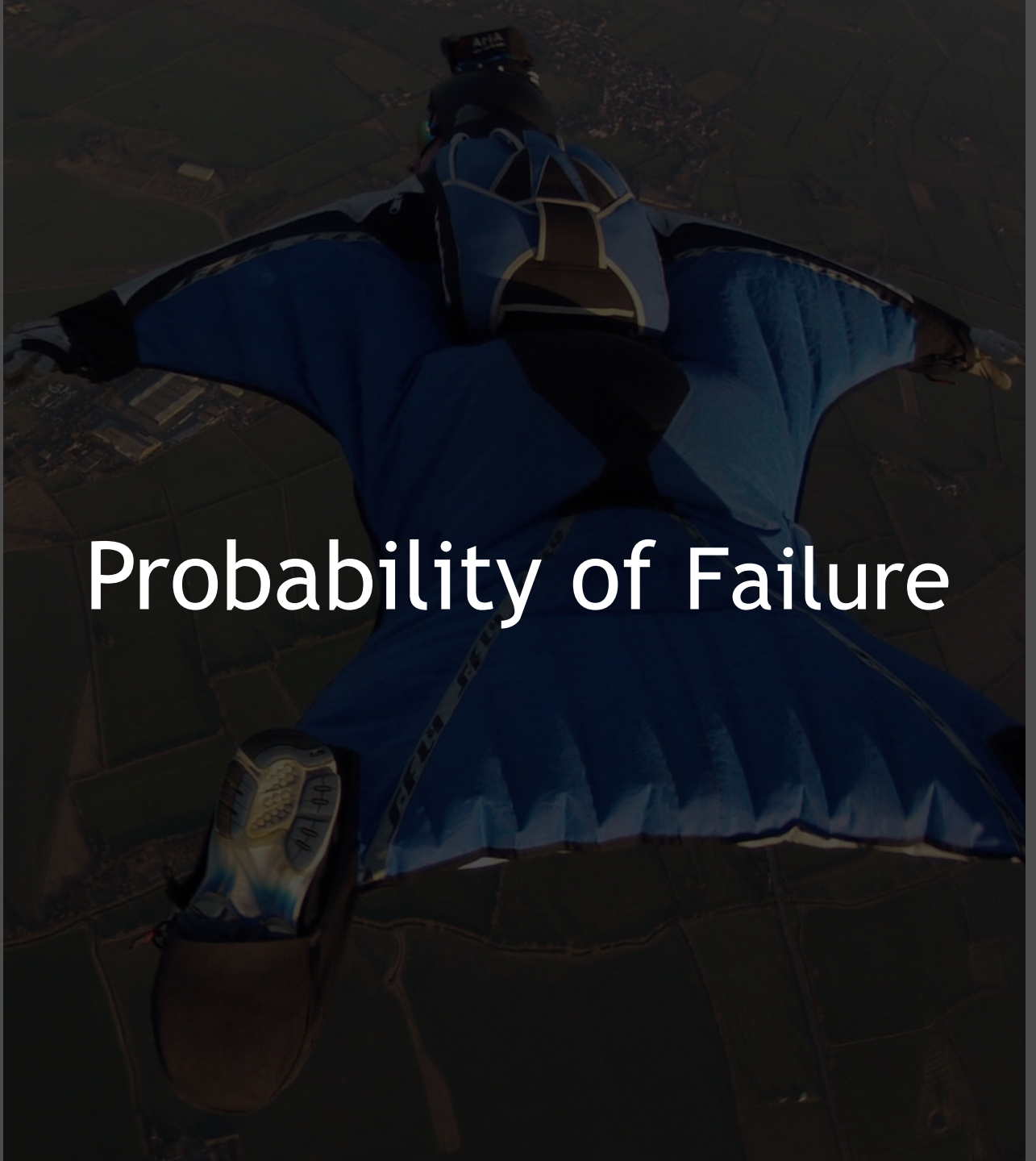
Question: Where should most resources be focused?

A - jumpsuit

B - shoes

C - parachute

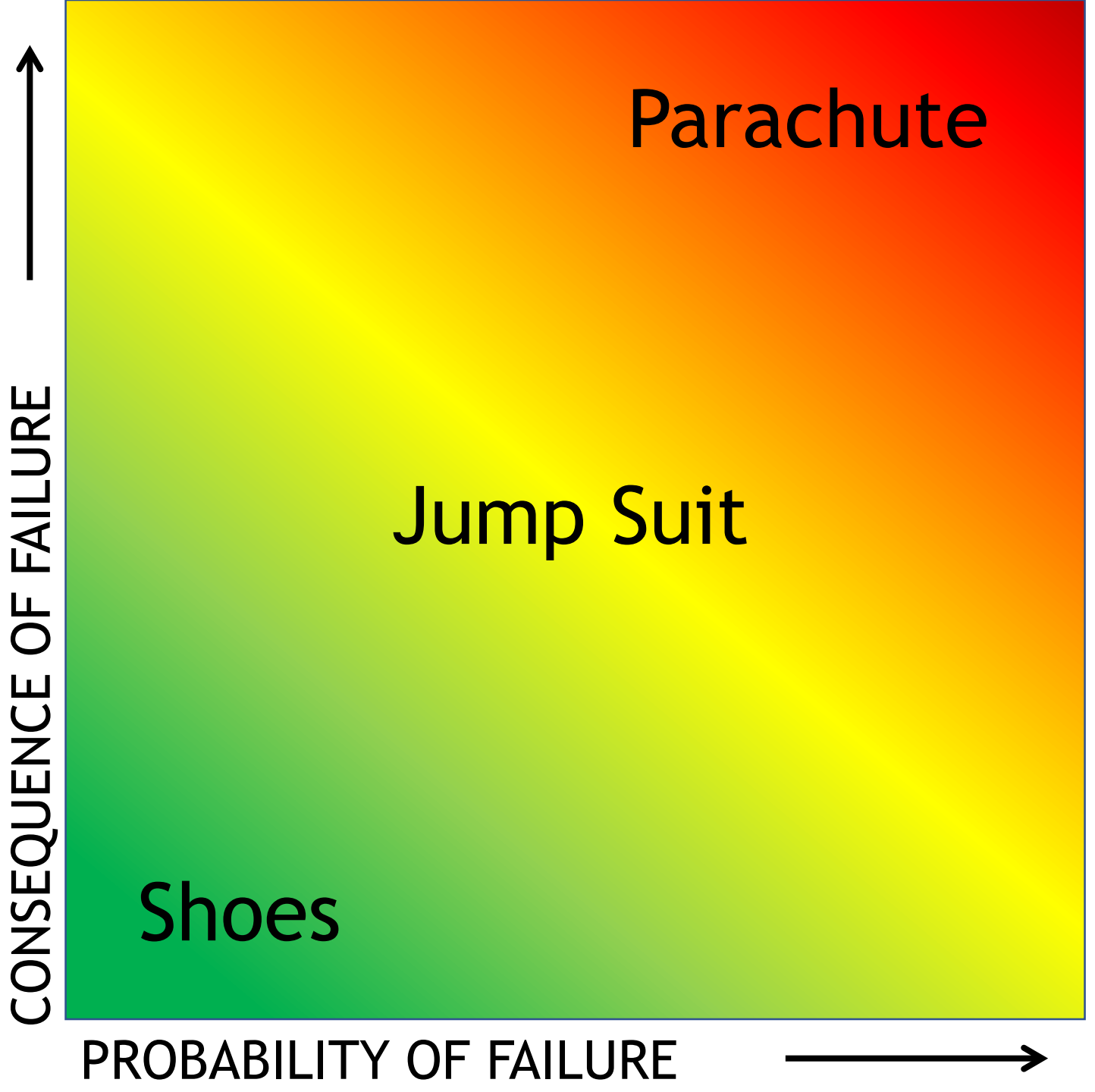
Answer:



Probability of Failure

Consequence of Failure

How we would handle these assets based on the risk



Mortality/Degradation of Green Assets can look like…

Infiltration Trench: vegetation death, invasive species infiltration, inlet blocked, debris clogging drain, broken curbs, compacted soils

Permeable Pavement: clogged joints or pores, ponding, underdrain deteriorated

Factors influencing the probability of failure of Permeable Pavement

- ❑ Low levels of preventative maintenance
- ❑ Construction
- ❑ Weather (freeze-thaw cycle)
- ❑ Traffic load/type
- ❑ Location

Consequence of failure for Permeable Pavement

- ❑ Clogged pavements (without overflow) causing overland flow into private property, potentially causing damages
- ❑ Financial impacts for required repairs
- ❑ Closing/restricting roadways or parking lots
- ❑ Tripping hazards for users, potentially causing injuries
- ❑ Loss of public support or confidence

Core Component:

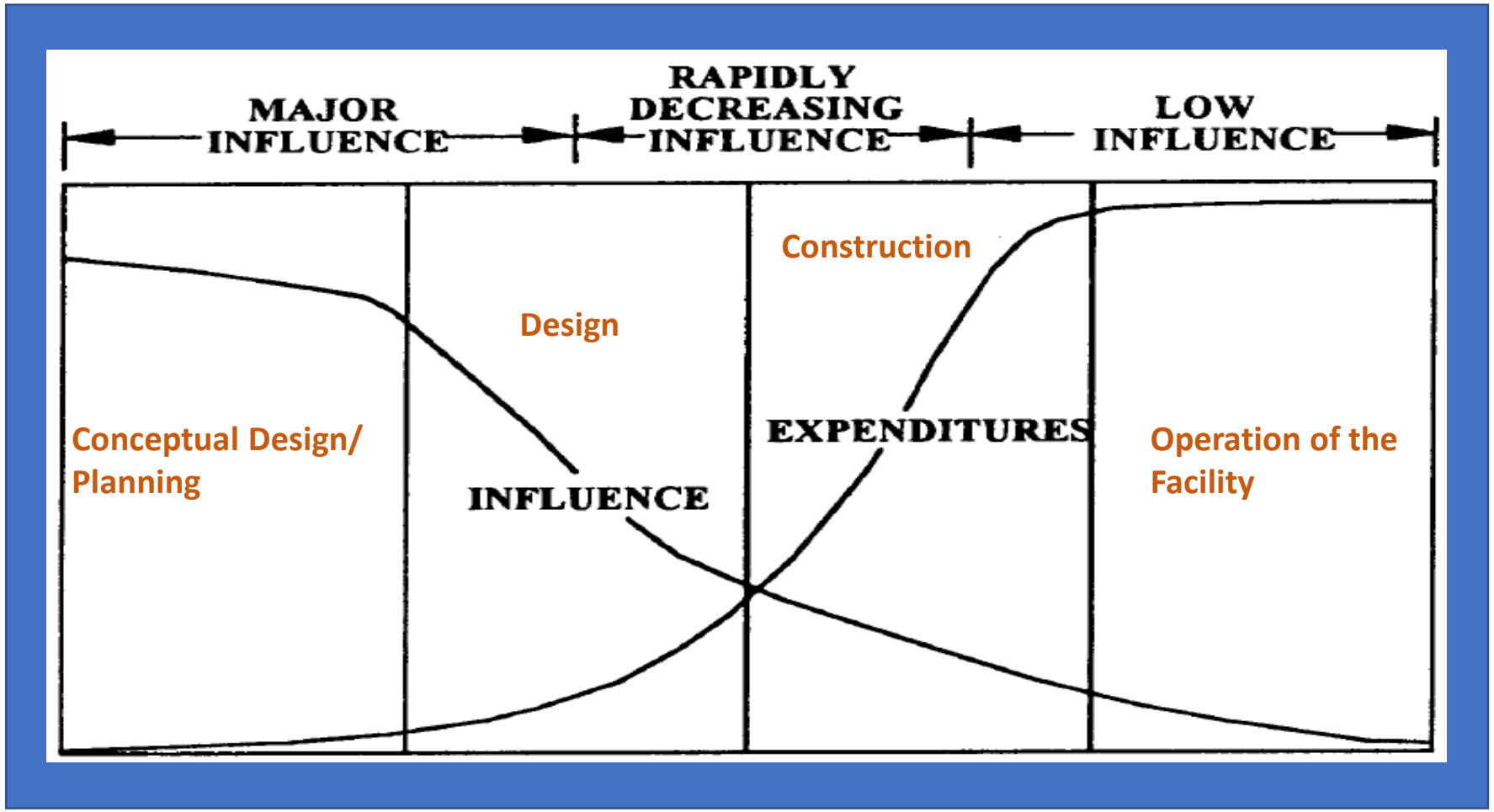
Life Cycle Costing

Costs the asset will incur over its lifespan

Costs can include: planning, design, acquisition, installation, maintenance, rehabilitation, replacement, retirement/disposal

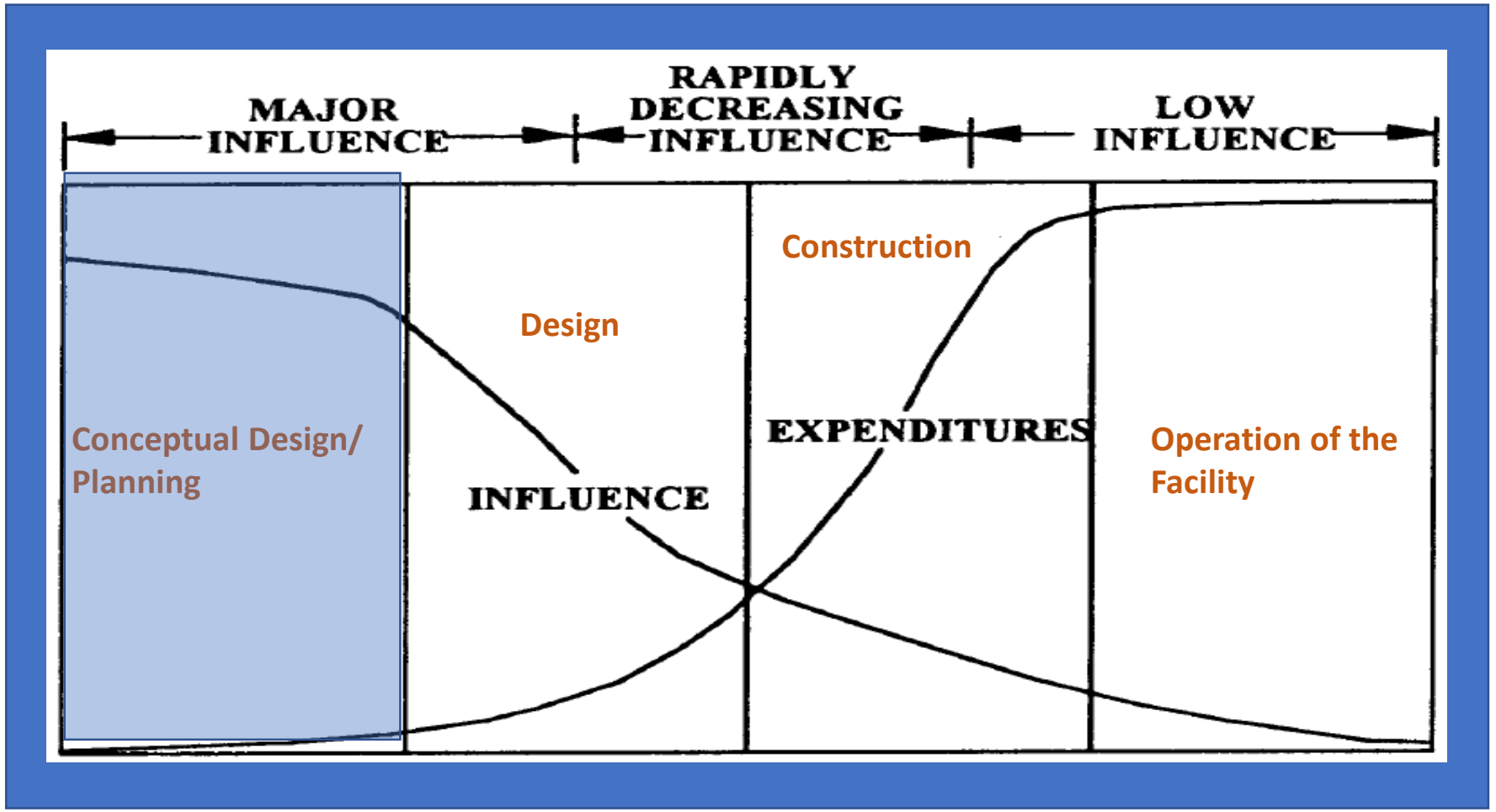
Natural assets don’t have some of these costs (won’t be replaced)

An Asset's Life Starts During the Planning Phase



Source: Gibson and Hamilton (1994) Analysis of pre-project planning effort and success variables for capital facility projects. Construction Industry Institute Source Document 105.

Initial Planning: Most Influence, Least Cost



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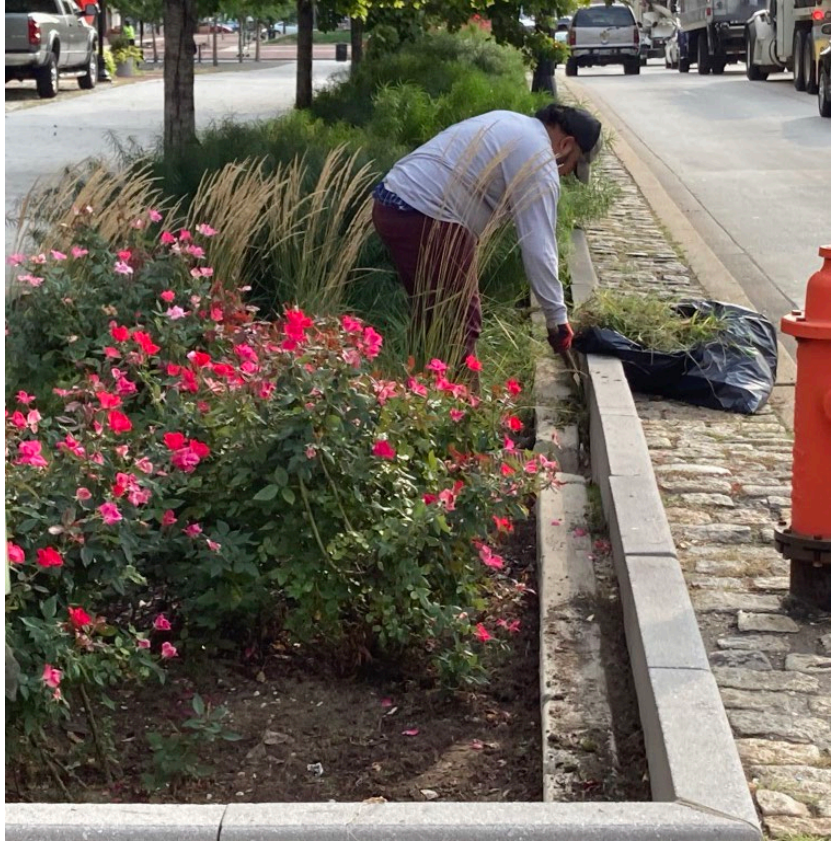
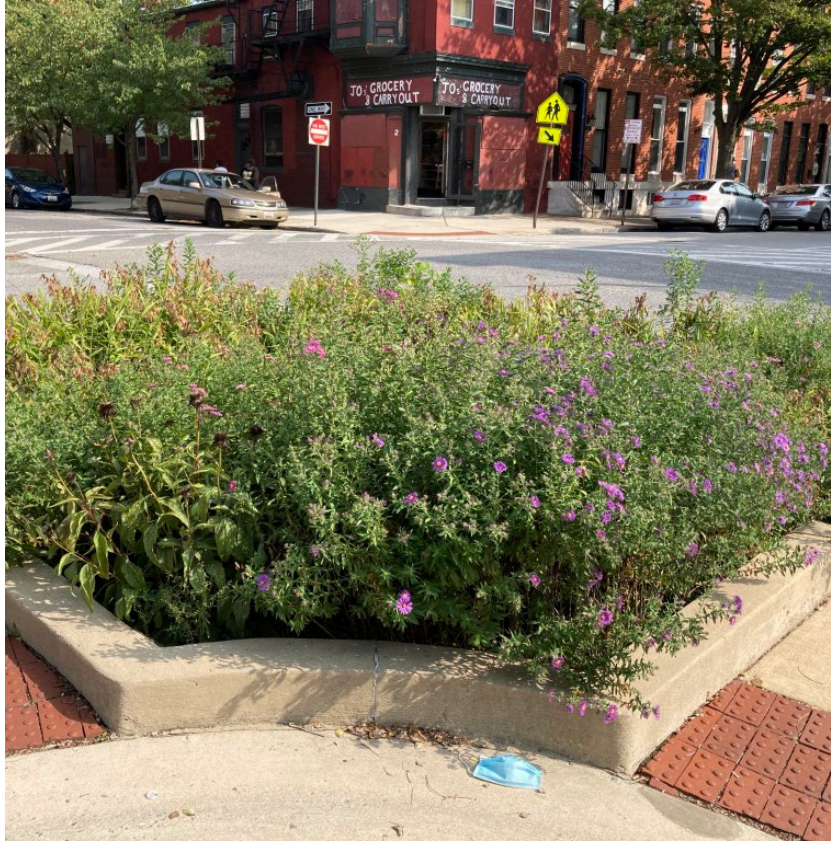




Operations and Maintenance (O&M)

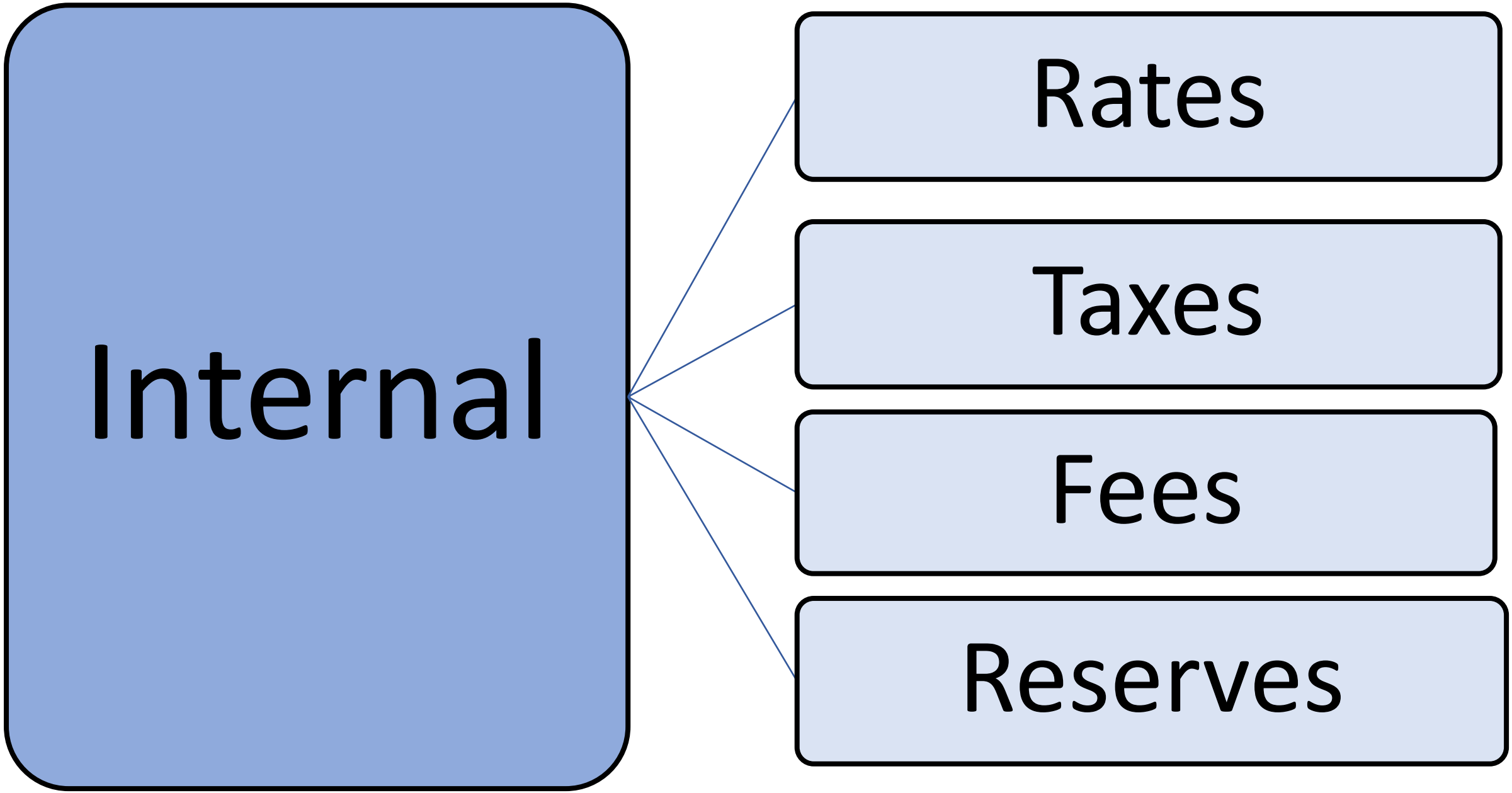
- Maintenance may take a different type of skill set, may need different staff for green vs gray assets
- The operation part of green infrastructure tends to be relatively simple. Almost all of the assets are passive operation

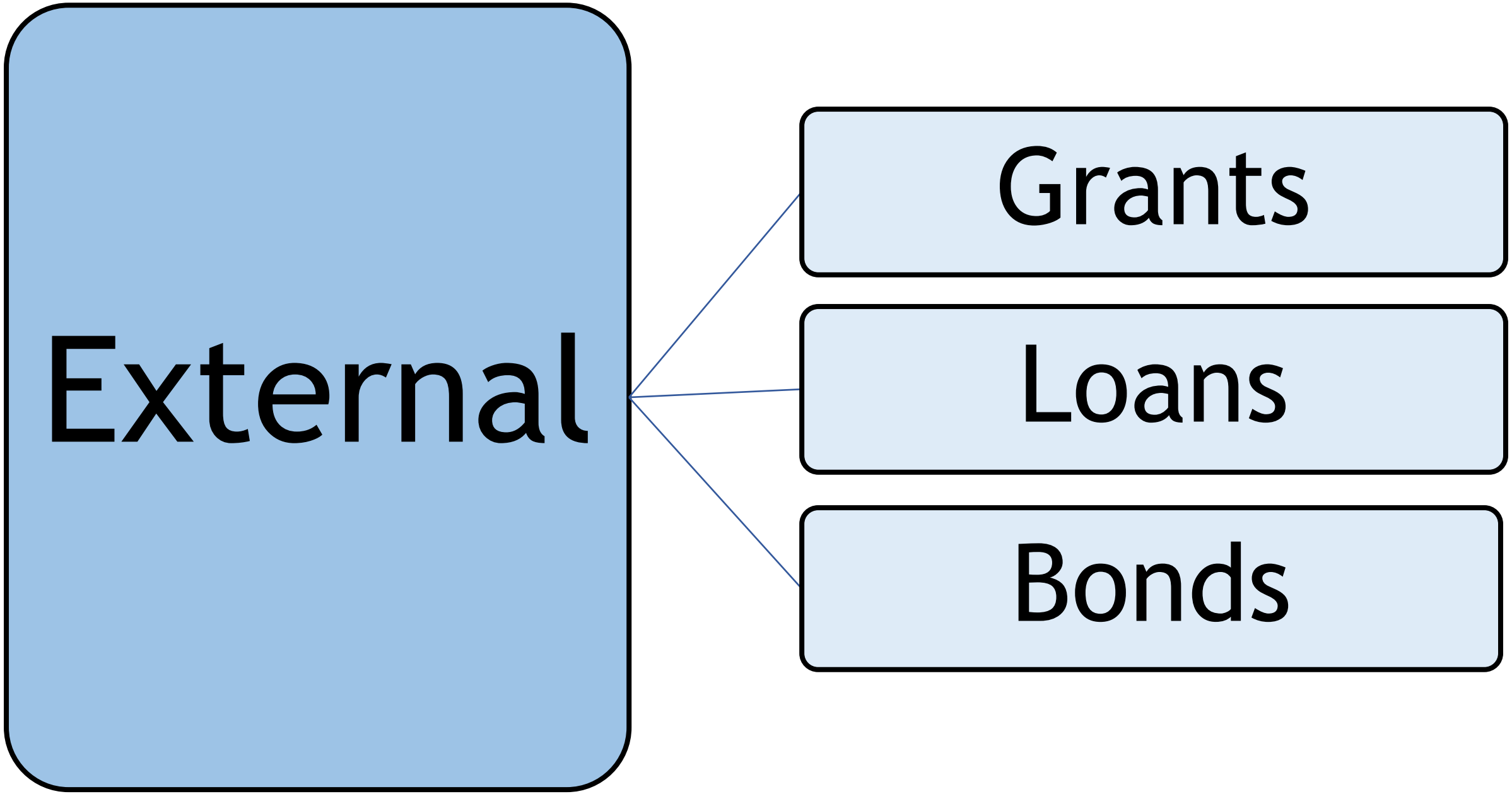
Core Component:

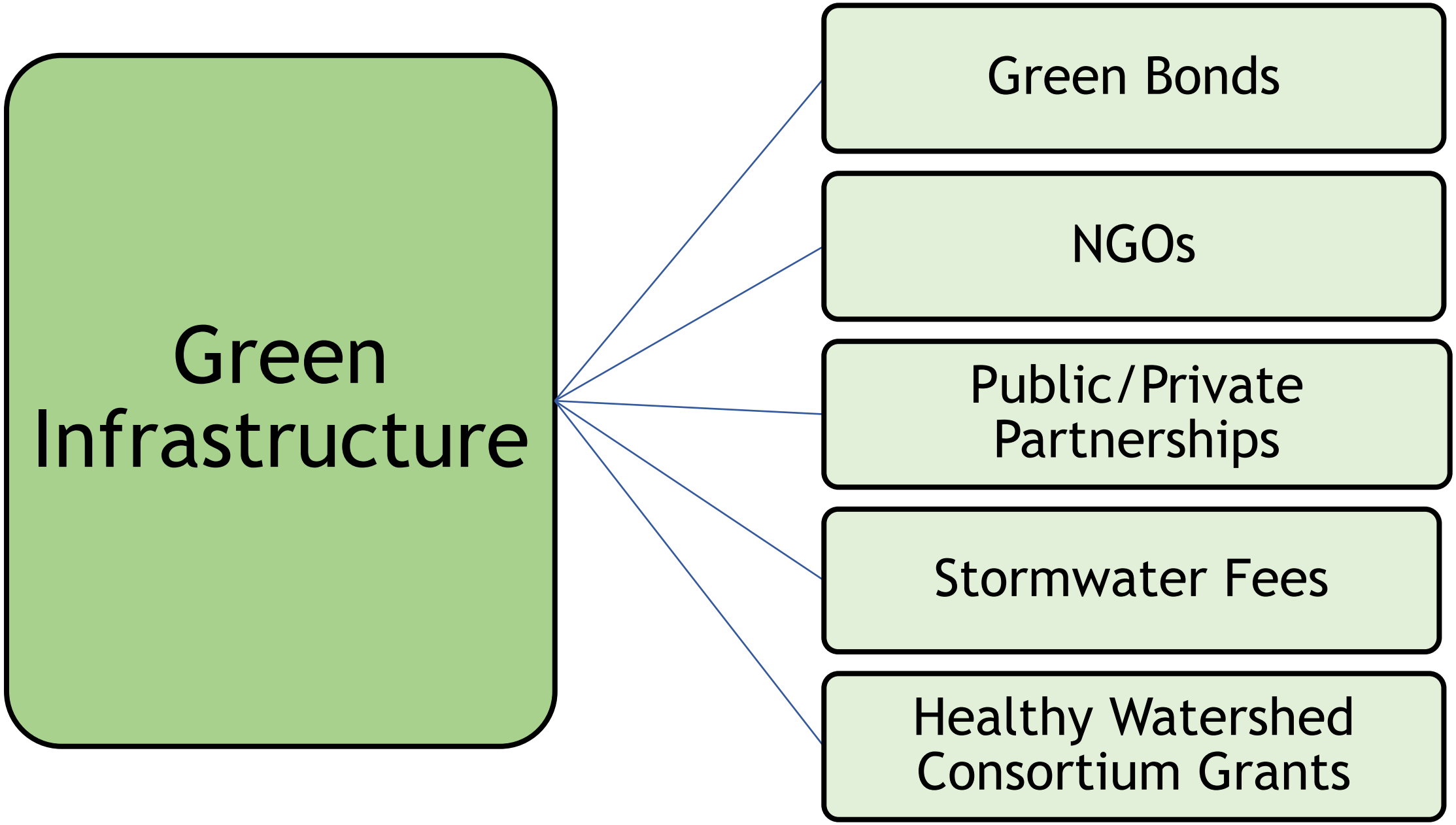
Long-Term Funding

The money you need to get it all done

In order to maintain the desired level of service for the lowest life cycle cost, a system must have a sustainable, long-term funding strategy.


Internal
Rates
Taxes
Fees
Reserves


External
Grants
Loans
Bonds

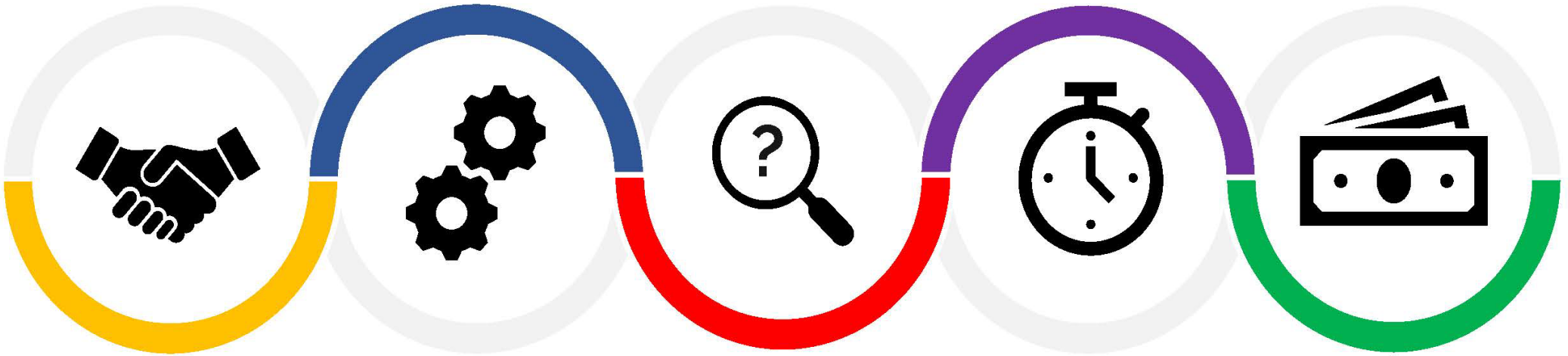

Green Infrastructure
Green Bonds
NGOs
Public/Private Partnerships
Stormwater Fees
Healthy Watershed Consortium Grants

Five Major Components

Level of Service

Criticality

Long-term Funding



Current State of the Assets

Life Cycle Costing

Want help with asset management at your system/community? Talk to us! →

https://efcnetwork.org/get-help

https://swefc.unm.edu/iamf/

Nature as Infrastructure –
City of Tucson GSI Enterprise Asset Management System

***Brooke Bushman**, Maintenance Program Manager*
Green Stormwater Infrastructure / Storm to Shade Program

January 23, 2025

CITY OF TUCSON | TUCSON WATER | Storm to Shade | HEXAGON

2020

Climate Emergency declared by Mayor Romero to address increased

- Heat
- Drought
- Flooding

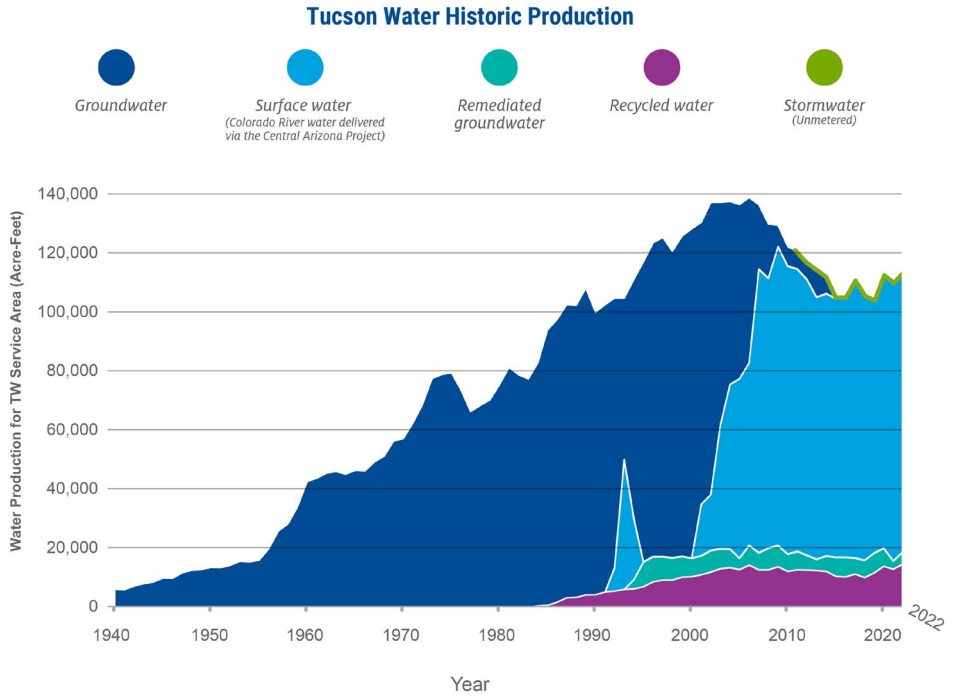
2023 – Climate Change Mitigation Plans Approved

1. Tucson Resilient Together

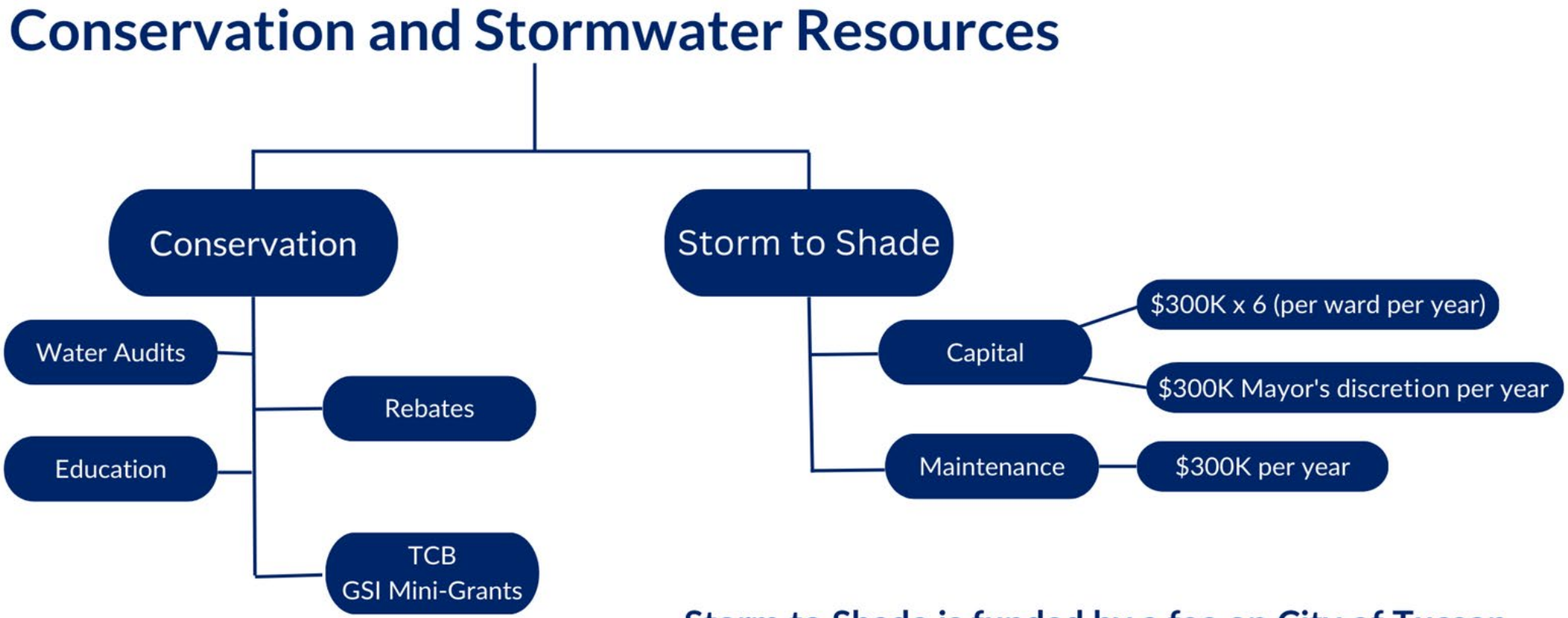
✓ GSI reflected in Extreme heat mitigation and Water resource /Drought strategies

2. One Water 2100

✓ Formally includes stormwater as a Tucson Water resource



Storm to Shade Background



Storm to Shade is funded by a fee on City of Tucson utility bill based assessed at .13 per CCF averaging $1 per month for the average household.

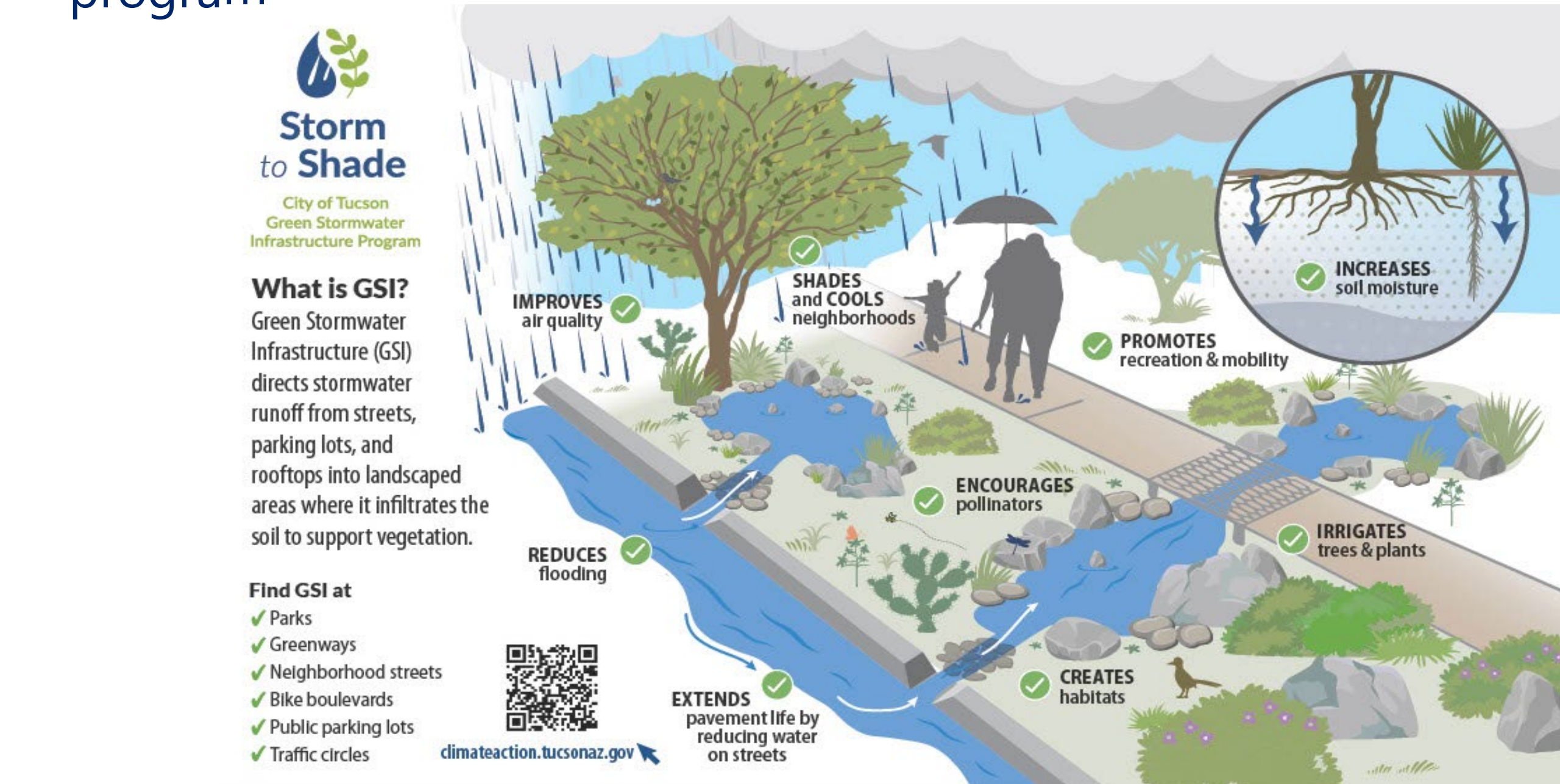
Storm to Shade

City of Tucson Green Stormwater Infrastructure Program

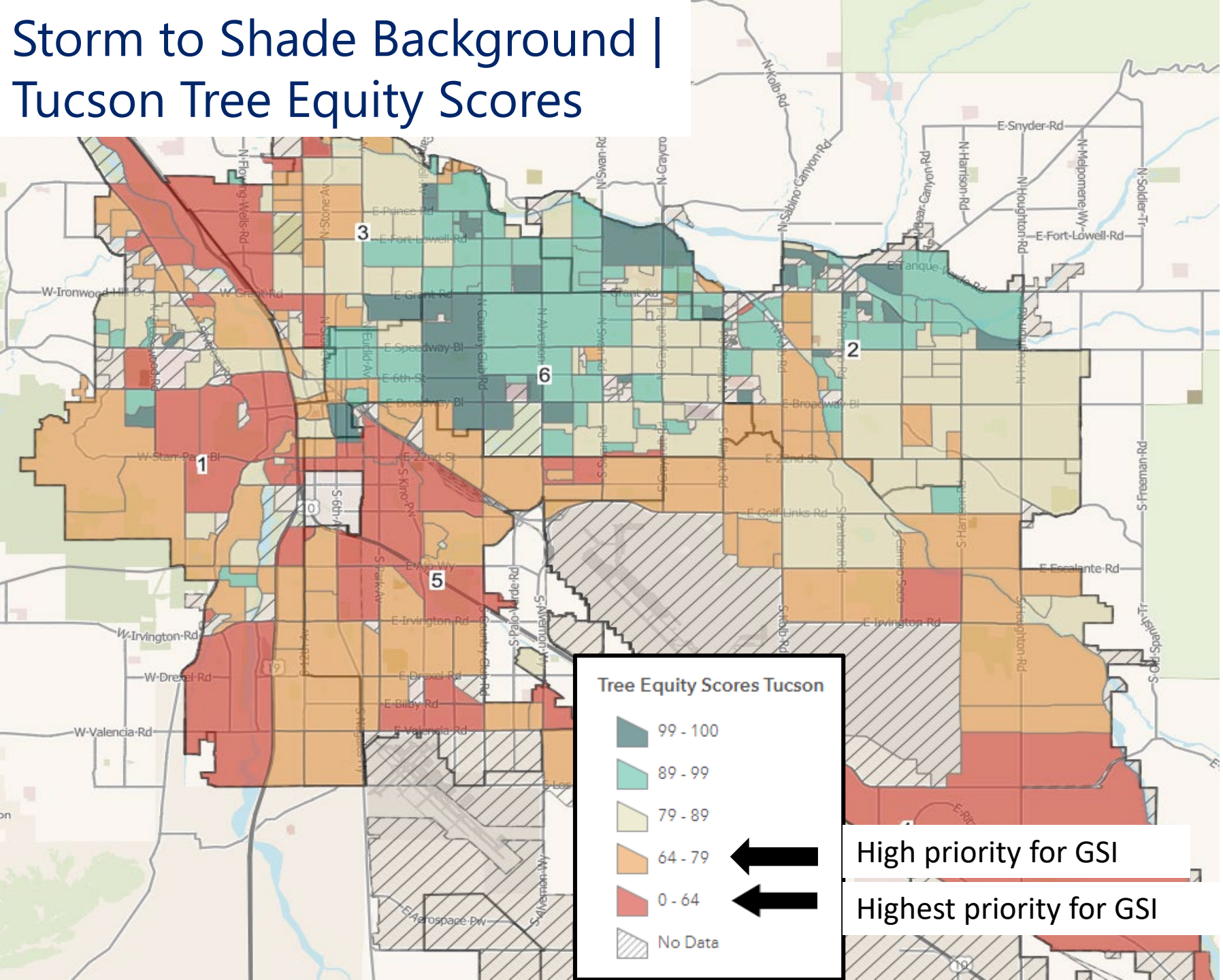
Chubasco a Sombra

Programa de Infraestructura Verde de la Ciudad de Tucson

Storm to Shade Background | Non-regulatory stormwater program



Storm to Shade Background | Tucson Tree Equity Scores



Tree Equity Score evaluates data from each neighborhood's:

- Existing tree canopy
- Population density
- Surface temperature
- Race
- Income
- Employment
- Age
- Health

City of Tucson | GSI Capital Projects

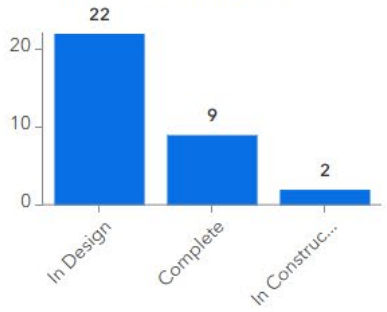
All Projects | Complete | In Construction | In Design | Identified

Storm to Shade

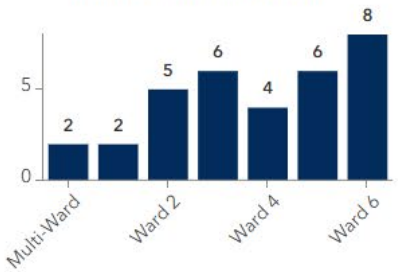
Storm to Shade has **33** new GSI projects in design, construction or completed throughout Tucson.

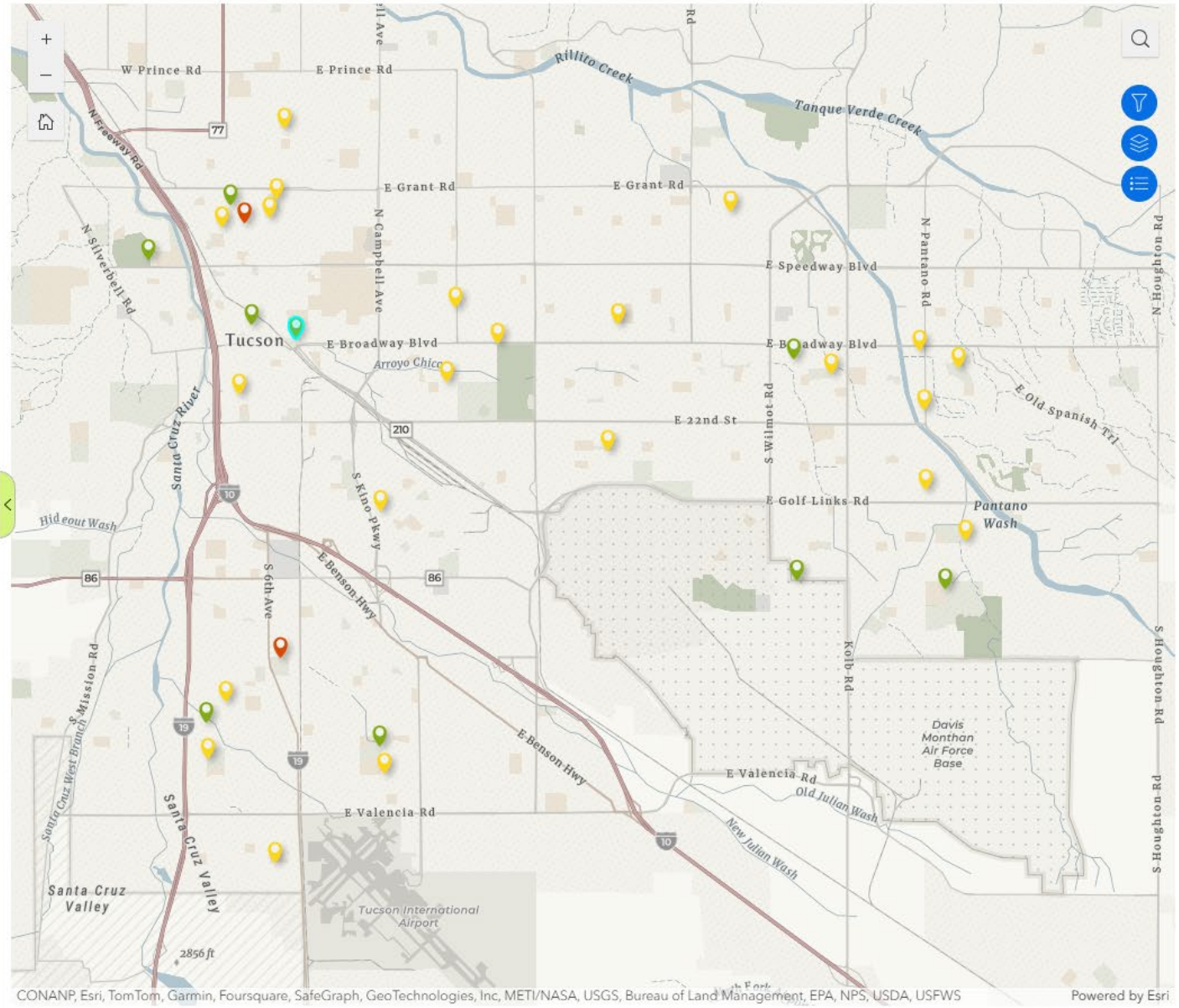
Click on the tabs at the top to see all projects by phase.

Number of Projects by Phase



Number of Projects by Ward





33 GSI Project(s)

Scroll down and click on each to learn more.

Ironhorse Park GSI

Storm to Shade has completed the construction of green stormwater infrastructure in Iron Horse Park. This green stormwater infrastructure installation includes the addition of sidewalk scuppers that allow stormwater running on 10 th Street and 1 st Avenue to enter and fill newly constructed basins irrigating 16 new native trees and dozens of native plants.

Learn More

18th St. & Main Ave.

Storm to Shade is funding the design and construction of two in-street traffic-calming green stormwater infrastructure (GSI)

S2S Maintenance Program

Development (2021 -2022)

- ✓ Publish GSI Maintenance (Mx) manual
- ✓ Hire & train 6 contractors with specialized GSI Mx skills
- ✓ Implement MOUs w/Streets & Parks Depts to coordinate between different asset management systems

Launch (2022 – 2023)

- ✓ Established **Current State of Assets** - Inventoried >700 GSI assets (ArcGIS Survey123)
- ✓ GIS (Global Info System) inventory later synched with EAM: geolocation, asset & sub asset type attributes (presence, quantity, size/capacity)
- ✓ Performed 1100 Mx visits using Survey123

Tucson Water Digital Utility Transformation Program

- **Vision** - Replace legacy systems to:
  1. Optimize business practices,
  2. Provide interconnectivity, and
  3. Allow for better data-driven decisions across Tucson Water Utility.

- **Hexagon Enterprise Asset Management (EAM) -** Identified as replacement for Tucson Water's legacy asset management software.

- **Storm to Shade (S2S) -** Joined Digital Utility Transformation Program as a new program to the City.
  - ***Fortunate to have resources committed, Hexagon process underway, and established team of TW support staff & contractors!***

TUCSON WATER
digital utility
transformation

HEXAGON

Asset Management System | Implementation Support

Tucson Water BOSS (Business and Organizational Support Services) Division

Planner/Scheduler –

- Sets up new asset routes and PM schedules
- Implements workflow unique to GSI & used by contractors (vs TW staff)
- Schedules PMs and forecasts Follow Up work orders
- Processes ad hoc work requests

System Administrators -

- Configure new assets
- New user management
- Run requested reports
- Trouble-shooting

TUCSON WATER
digital utility
transformation

Asset Management System | Hexagon EAM

First *green* infrastructure asset management framework in history of Tucson Water.

Challenges: Largest user of contracted labor in EAM and building living assets and specialized contractor training and checklists into EAM designed for grey infrastructure.

1. **Discovery** (Aug –Sept ‘22) **-** nuance for living/green assets
2. **Configuration** (Oct ‘22 - July ‘23)– hierarchies, workflows, GIS maps, Mx work checklists, routes, schedules
3. **Training** (Aug –Sept ‘23) – for contractors & BOSS
4. **Launch (**Sept ‘23) – GSI mx work begins in EAM
5. **Refine and learn** (Oct ‘24-on) – contractor workshop

TUCSON WATER
digital utility transformation

HEXAGON

Asset Management System | Discovery

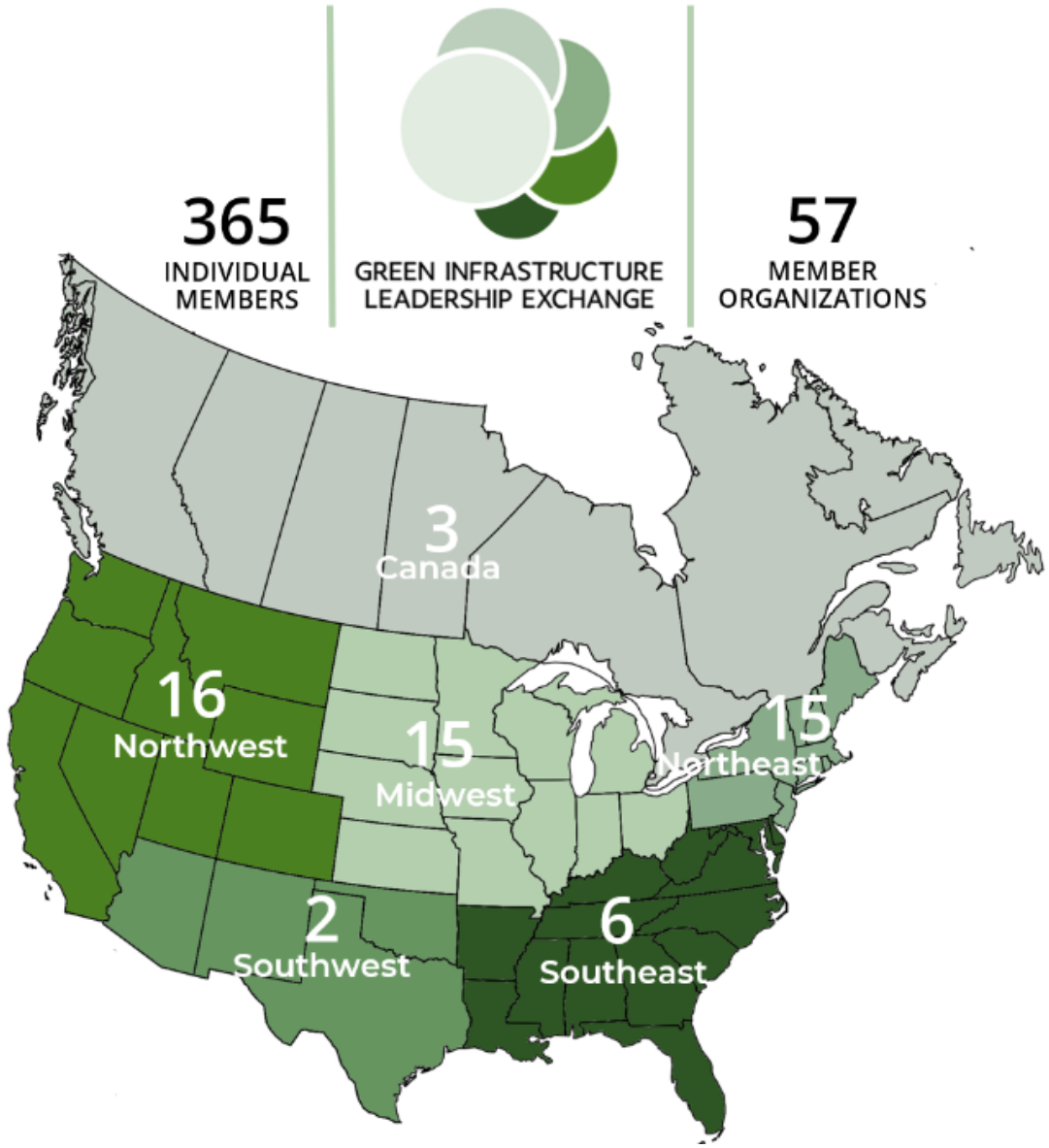
1 - Integrated Asset Management Framework: Combining Green and Grey Assets

- Southwest Environmental Finance Center (UNM)

2 - Green Infrastructure Leadership Exchange*

- ***Asset Management Peer Learning Circle***

**Practitioner network of local governments, water and stormwater utilities implementing green stormwater infrastructure equitably.*



Asset Management System Discovery | Level of Service Goals

S2S maintains GSI assets to ensure safety by:

- *Infiltrating standing water*
- *Pruning vegetation for site visibility, mobility access and hazards*
- *Preserving structural integrity*
- *Clearing trash, invasive plant species and debris*

Discovery Level of Service Goals | Glenn St Chicane Case Study

40 Chicanes, Fall 2022: *Before S2S initiated GSI Mx limited infiltration – overgrown invasive grass and volunteer trees, filled with sediment*

Cost

Preventative Mx

$43,000

Herbicide Application

$13,000

By Winter 2024: *Invasives controlled, infiltration restored after 5 rounds of seasonal Preventative Mx, herbicide treatment, & native seed dispersal. Next step – add sediment traps*

Asset Management System Configuration | Position

- **Physical location where GSI assets sit within others' jurisdictions**
- **Report on costs for assets located within other departments', divisions', and partner entities' land.**

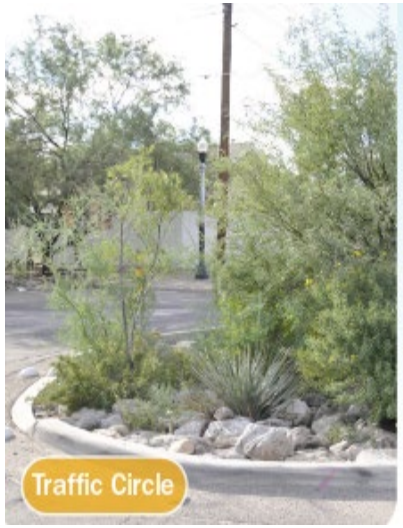
Storm to Shade Program GSI EAM Positions	
Street, GSI	Police, GSI
Parks, GSI	Fire Station, GSI
Ward Office, GSI	Housing (HCD), GSI
Well Site, GSI	TUSD Facility, GSI
Pima County FCD, GSI	Misc. COT Facility, GSI

Ward	FY2024
1	$57,965
2	$0
3	$114,732
4	$24,191
5	$50,588
6	$140,565
Total	**$388,041**

	EAM POSITION	
	Street, Parks, Ward Office	Pima County RFCD
FY23	$231,405	$8,951
FY24	$379,499	$48,018

Asset Management System Configuration | Assets & Sub Assets

Defines parts of GSI so able to maintain assets and track costs



← Parent, Asset

Entire GSI - 7 types

- 4x/year Preventative Mx work orders written to parent

Child, Sub-asset →

Parts of the GSI

Can be multiple children of same type located at same asset, e.g. 5 trees, 2 inlets, 8 basins

- Not configured individually = No serial # for living/green asset
- Follow-up & ad hoc work orders can be written to children

INLETS/OUTLETS

Conveyance allowing stormwater to flow into or out of a GSI feature

CURB CUT

Removed section of curbing that serves as an inlet or outlet

CURB CORE

Circular core drilled through curbing that serves as an inlet or outlet

SEDIMENT TRAP

Rough area at inlet that allows sediment to settle before water enters a basin

INFILTRATION BASIN

PLANTING SHELF

Asset Management System | Asset Intake

1. **ArcGIS Survey123 (*GSI Asset Inventory*)**

   ✓S2S staff geolocates and collects attribute data at new GSI assets

2. **GIS Synch (*Planned Assets created monthly*)**

   ✓TW GIS Analyst maps Inventory to EAM and asset identification autogenerated

3. **EAM Asset Creation in EAM (*Installed Asset finalized for maintenance*)**

   ✓S2S reviews Planned Asset and submits “Asset Update Request”

   ✓System Administrator configures assets based on attribute data & other info:

   - ➢Commission date
   - ➢Route
   - ➢PM schedule

Storm to Shade
TUCSON WATER
digital utility transformation

Asset Management System | Training

S2S business context

Review Learning Library simulation

Perform simulation in the live environment

Students to perform simulation in live EAM TRN environment

Course #	Course Name	Course Description
NA01	Navigating EAM	This course shows users how to navigate within the EAM system.
WO02	Work Order Execution	This course will enable users to review assigned jobs, generate pick tickets and update Work orders in mobile version of EAM

Asset Management System |
Work Order Execution (810 GSI assets)

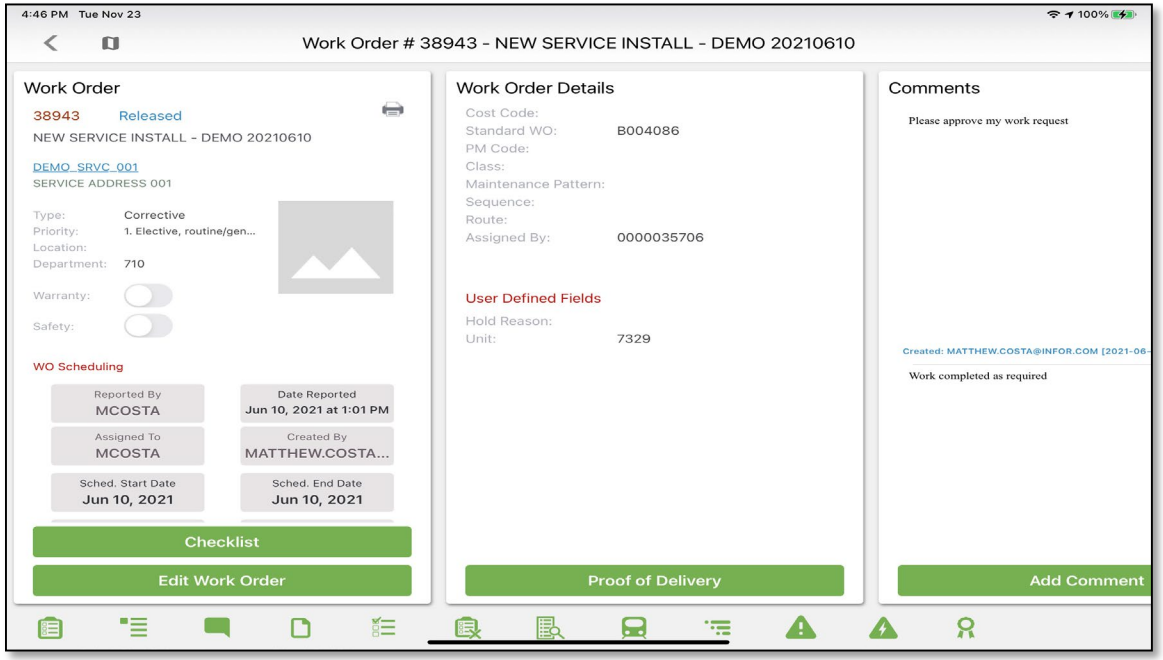
Contractors access Work Orders using Desktop and/or Mobile apps

Work Orders created through:

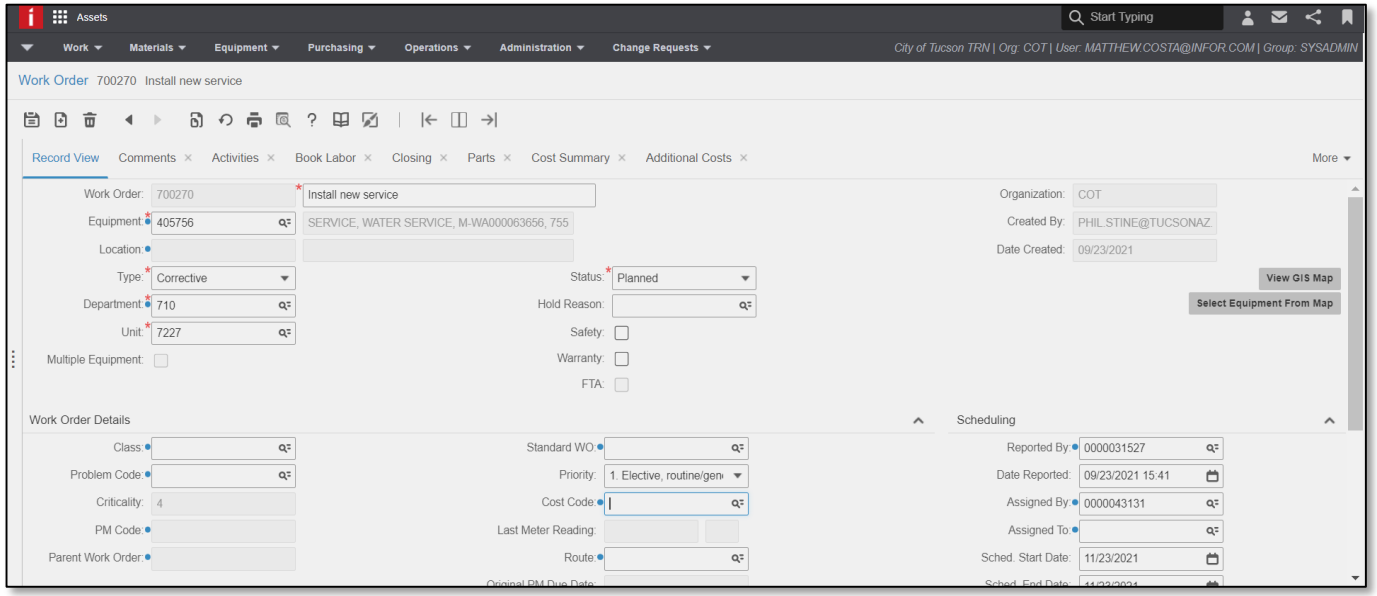
- 4 scheduled Preventative Mx
- Work Request - Ad hoc work
- Contractor checklist initiated Follow-ups

Workflow driven by the Work Order Status field: *Scheduled, Open, Field Work Complete. Awaiting Invoice, Closed*

Mobile application



Desktop application



Asset Management System | Launch

Successes:

- Automated many steps required to deploy mx work orders
- Generate reports to track performance and forecast long-term funding needs
- Contractors growing their businesses

Challenges:

- Configuring multiple green/living sub assets in GSI - No serial # (unlike grey)
- Hexagon App (login, checklist) cumbersome for contractors in the field
- Training entry level contractor staff on EAM technology and GSI skills
- **Refinements/Next Steps:**
- Checklist shortened to follow up work & data collection (invasive species, trees
- Criticality (mx priority) & Life Cycle Costing
- Sync City of Tucson Urban Tree Inventory with EAM

Storm to Shade

Storm to Shade Maintenance | Take Away

An effective Asset Management System will support S2S in ensuring that equitably distributed GSI assets FUNCTION and PROVIDE the multitude of benefits that Tucsonans need to buffer our experience of climate change- increased drought and heat, and more variable precipitation and flooding.

Website ~

climateaction.tucsonaz.gov/pages/gsi

Storm to Shade

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GSI Maintenance Program Manager

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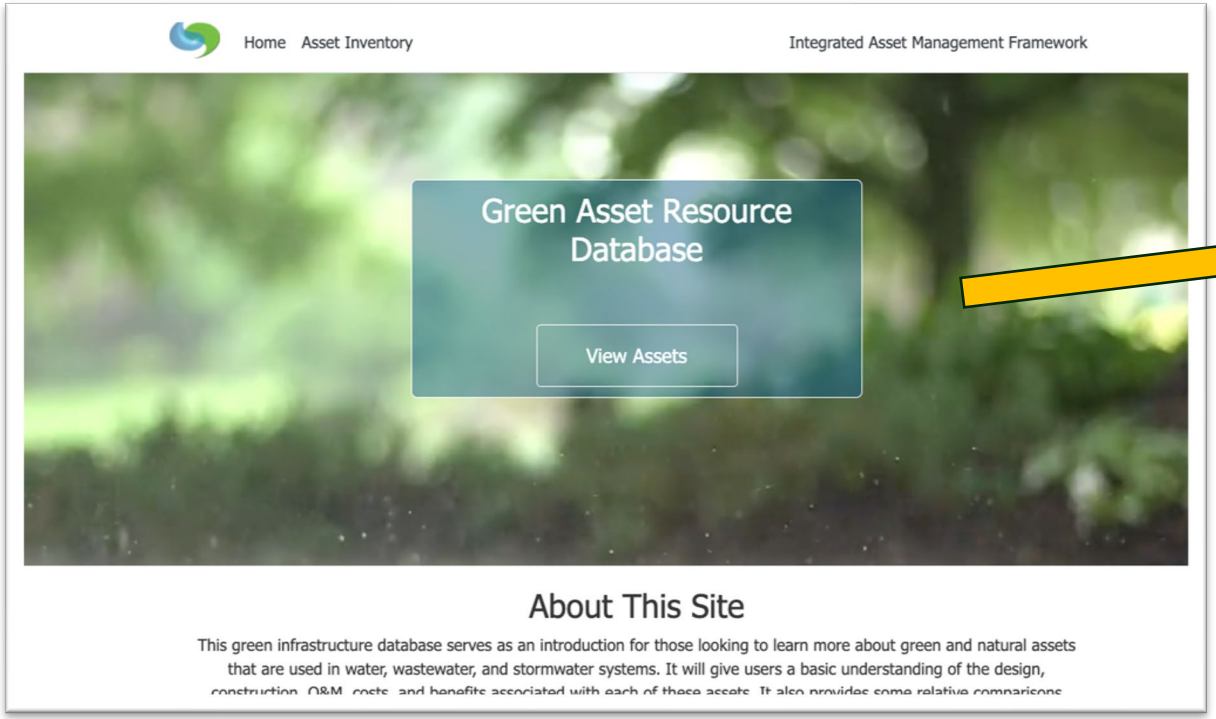
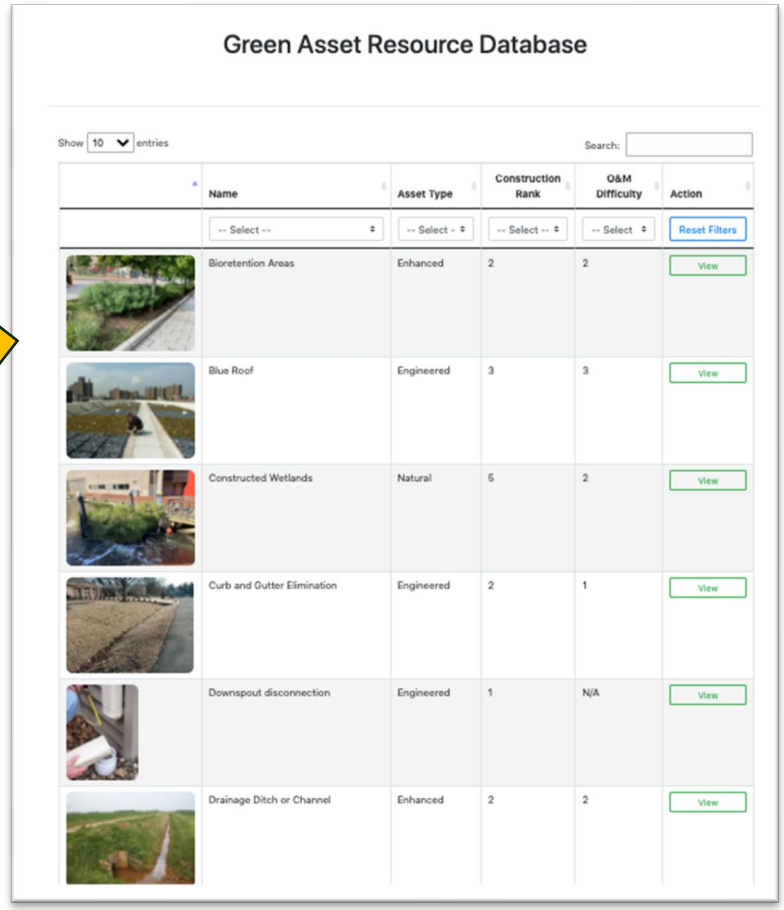
CITY OF TUCSON | TUCSON WATER

Thank You

Additional Resources

Integrated Asset Management Framework & Green Asset Resource Database

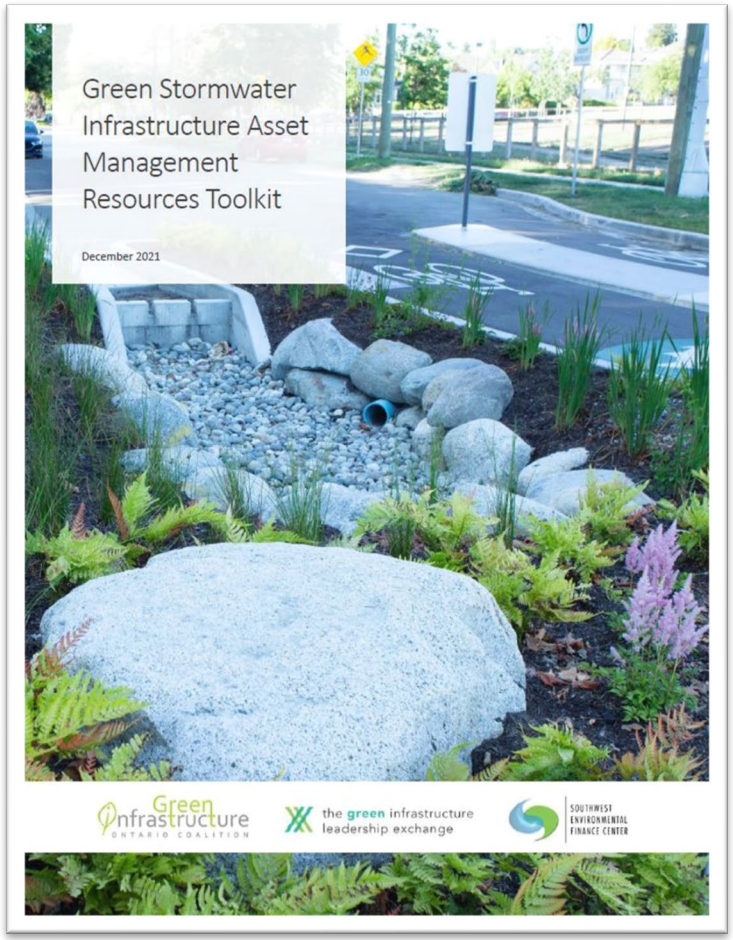




https://swefcapps.unm.edu/gardb

EFCN
environmental finance center network

Green Stormwater Infrastructure Asset Management Resources Toolkit



https://greeninfrastructureontario.org/app/uploads/2022/01/GSI-AM-Resources-Toolkit-Final-Dec-17.pdf

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GSI Operations & Maintenance Manual & Video Series

https://aridlidcoalition.org/index.php/gsi-maintenance

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Next webinar in our Green Infrastructure Series:

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April 24th, 2025

Registration is open!

Shannon Sloane Pepper
Webinar Series Host
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