Transforming Gray Space into Green Space:

Integrating Green Infrastructure Into The Urban Fabric

September 28, 2021

Kevin Robert Perry, FASLA, PLA

TOOLE DESIGN

Urban Rain Design inc.
A Studio of Green Infrastructure

Why Retrofit?

with Green Infrastructure

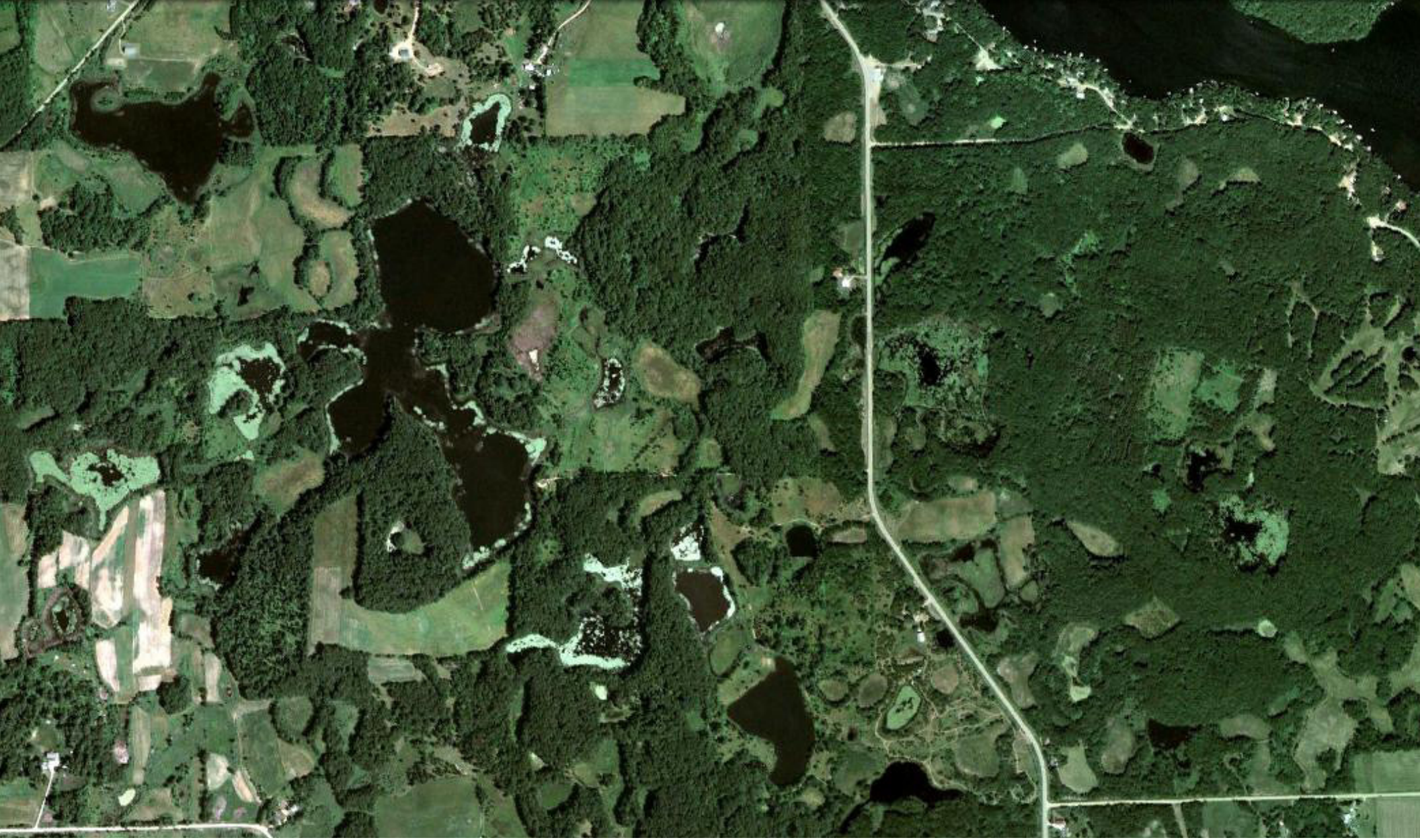

Photo: Google Earth

Natural Landscape

Photo: Google Earth

Urbanization

Minneapolis, Minnesota

Photo: Google Earth

Natural Landscape

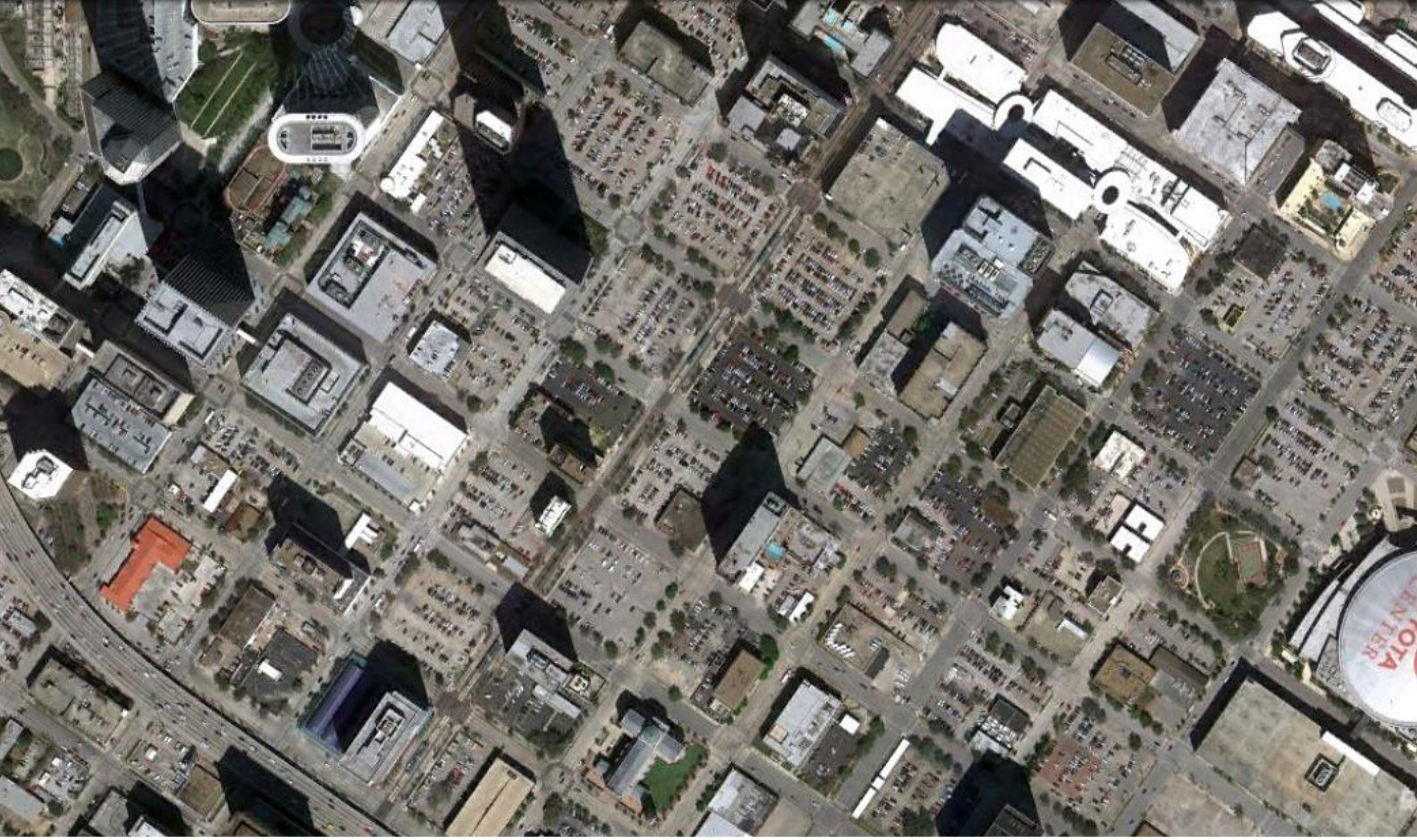

Photo: Google Earth

Urbanization

Houston, Texas

Photo: Google Earth

Natural Landscape

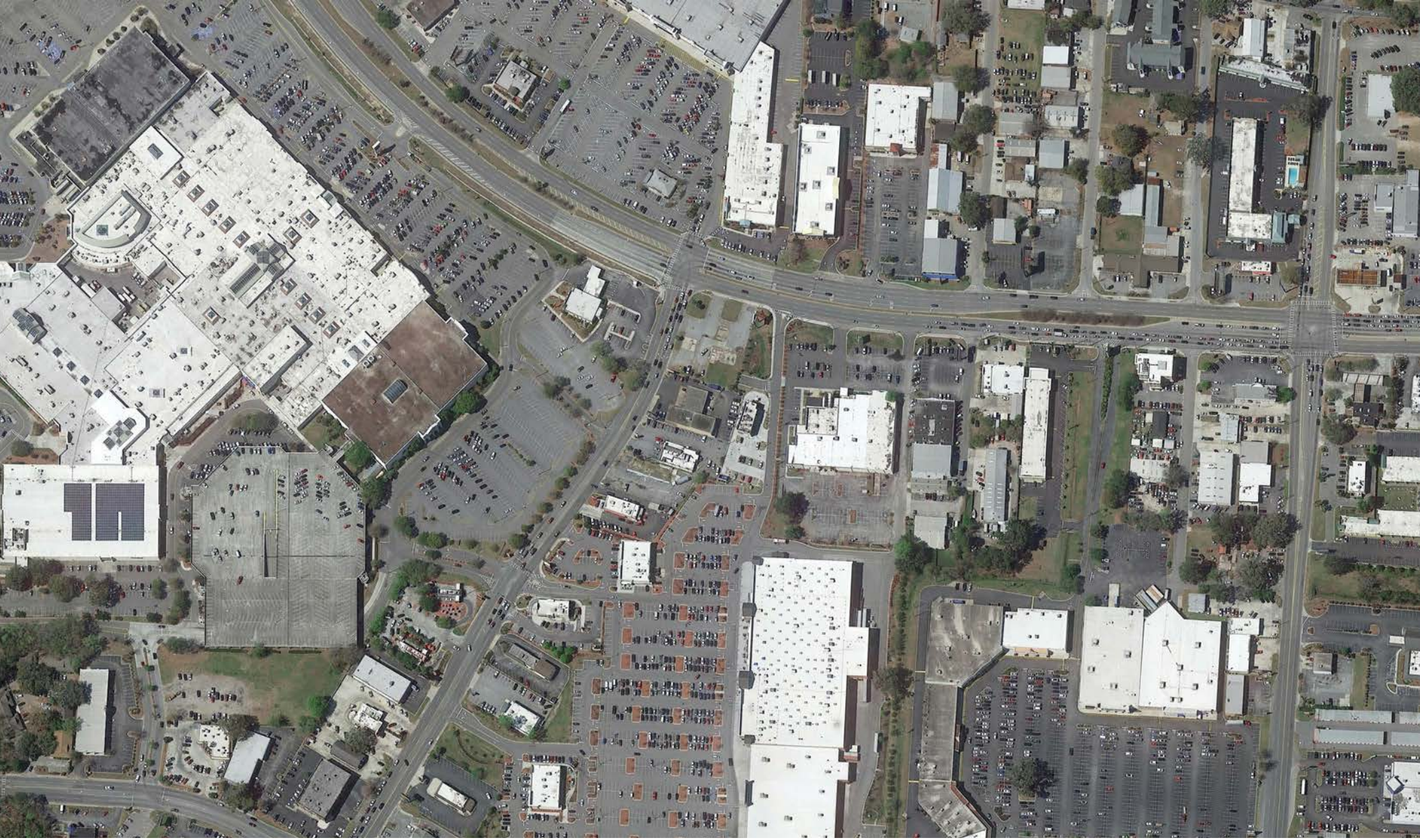

Photo: Google Earth

Suburbanization

Savannah, Georgia

Photo: Google Earth

Natural Landscape

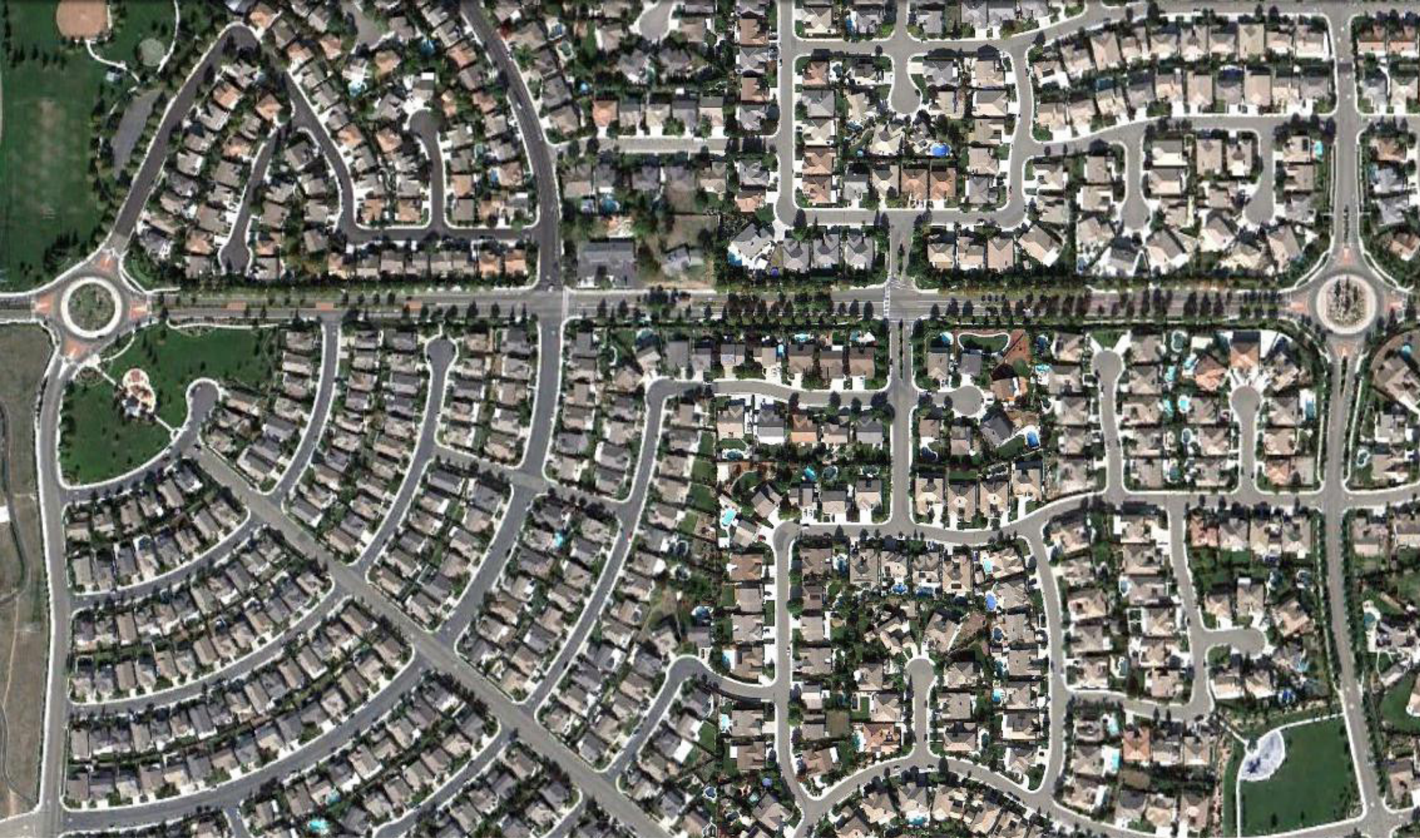

Photo: Google Earth

Sub-Urbanization

California Central Valley




Moving Towards An Unhealthy Watershed

Photo: Kevin Robert Perry

The Urban Street Stormwater System

Impervious, Little or No Landscape

Photo: Kevin Robert Perry

The Natural Stream Stormwater System

Pervious, Considerable Landscape System

Photo: Kevin Robert Perry

The "Green Infrastructure" Stormwater System

Pervious, Integrated Landscape System

The Green Infrastructure “Toolbox”

Think Big

Complete Streets + Green Streets

Photo: Nevue Ngan Associates/Kevin Robert Perry

Transforming Our Street Network

Image: Nevue Ngan Associates/Kevin Robert Perry

Transforming Our Street Network

Photo: Kevin Robert Perry

Transforming Our Street Network

Image: Ray Papa/Kevin Robert Perry

Transforming Our Street Network

Photo: Kevin Robert Perry

Transforming Our Streets into Places

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Transforming Our Streets into Places

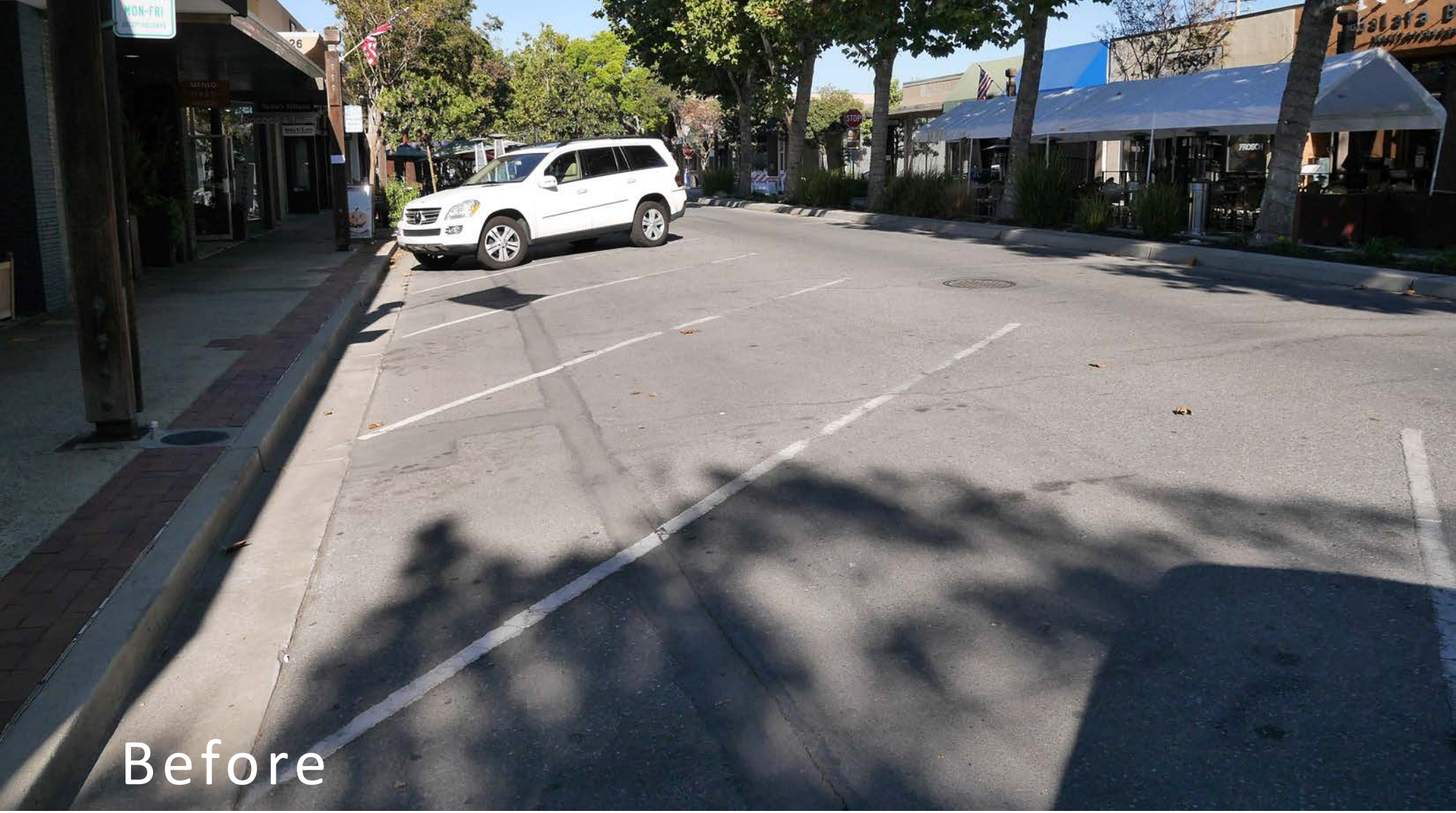
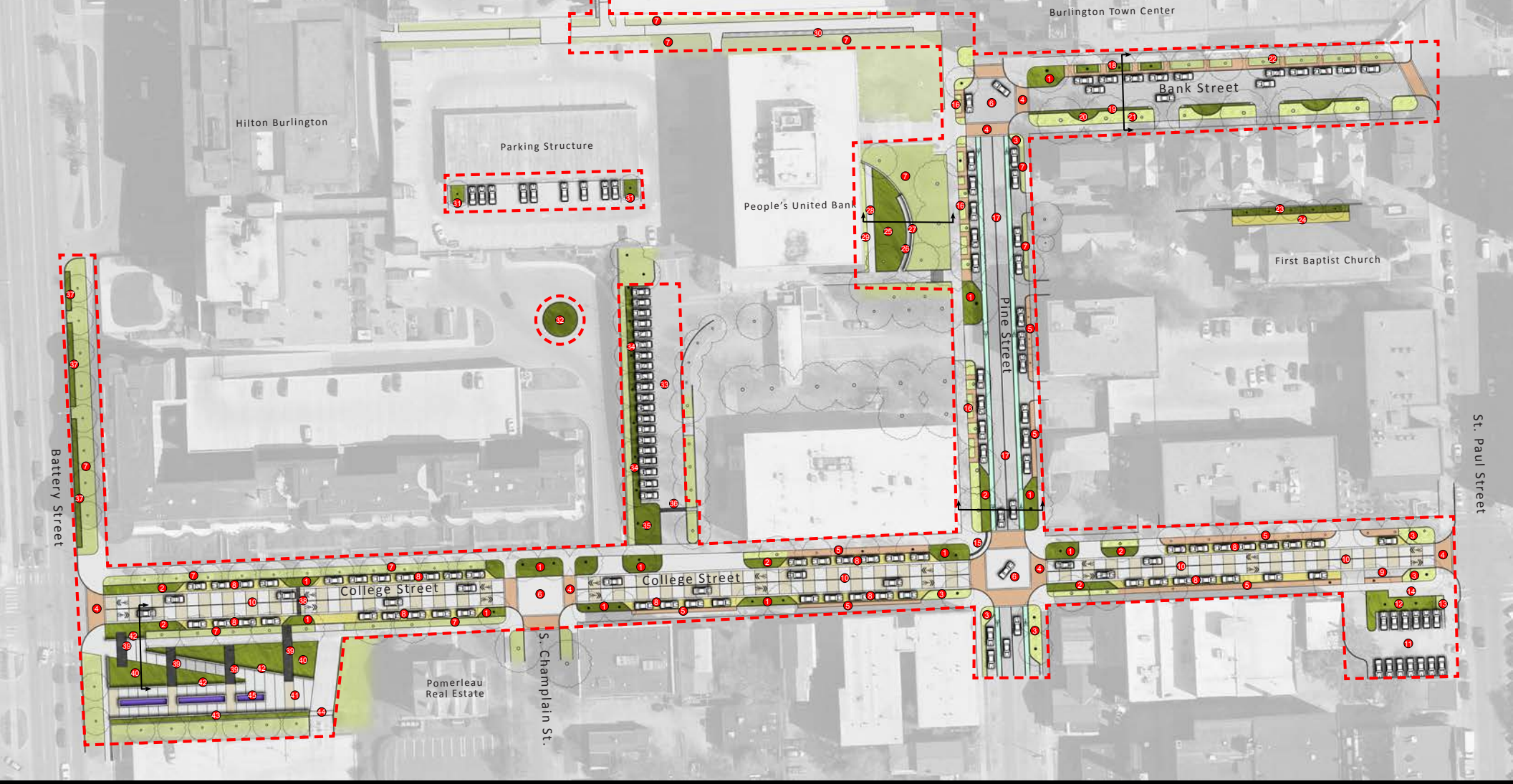


Photo: Kevin Robert Perry

Transforming Our Streets into Places

Image: Ray Papa/Kevin Robert Perry

Transforming Our Streets into Places



Phase 3 Full Build-Out Scenario: Site and Stormwater Improvements

Scale: 1"=30'
February 2014

Urban Rain | Design
The Office of Kevin Robert Perry, ASLA

1. Stormwater curb extensions with new trees, shrubs, and groundcovers captures stormwater runoff.
2. Stormwater curb extensions captures stormwater runoff but in order to protect the existing tree(s), the existing curb remains and the grade is only altered between the new curb location and existing curb. The landscape under the new tree is switched from lawn to shrubs and groundcovers.
3. New conventional curb extensions do not accept stormwater but are planted with trees, shrubs, and groundcovers.
4. Brick pavers at cross walk zones help demarcate pedestrian zones.
5. Brick pavers at sidewalk strips.
10. College Street is re-paved with colored concrete and is striped with bike sharrows.
11. Private parking lot is re-configured with 9'x16' parking stalls and a 24' wide parking aisle.
12. A new rain garden accepts stormwater runoff from parking lot and potentially adjacent building rooftops.
13. Existing private sign is preserved.
14. Sidewalk zone at intersection is expanded to allow for better pedestrian movement at bus stop location.
15. A 2' wide trench drains allows stormwater to flow from the Pine Street stormwater curb extension into the College Street stormwater curb extension.
19. A shallow, 2' wide green gutter is placed at the existing street curb to collect stormwater runoff from Bank Street.
20. Three small rain gardens placed between existing street trees help manage addition stormwater runoff from the green gutter.
21. Existing lawn areas are replaced with new shrubs and groundcovers.
22. Existing lawn areas are replaced with new shrubs and groundcovers. Brick paver walkways are installed to accommodate pedestrians traveling from the sidewalk zone to the parking zone.
25. New stormwater planter accepts runoff from private yards.
28. Walkway allows for building maintenance to occur.
29. New shrubs and groundcovers along building wall.
30. New rock energy dissipation strips are placed along alley walkways to control flow and erosion.
31. New 3' high, above-grade stormwater planters are placed on parking structure deck to accept stormwater from upper roof areas.
32. Existing landscape median is re-graded to daylight piped stormwater runoff from parking structure. Median is replanted with shrubs and groundcovers.
33. Private parking lot is re-configured with 9'x16' parking stalls and a 22' wide parking aisle.
37. New 5' wide stormwater planters planted with shrubs and groundcovers accept stormwater runoff from Battery Street.
38. A 3' wide trench drain allows for stormwater to flow from the College Street north stormwater curb extension to the south stormwater curb extension.
39. 8' wide boardwalks allow pedestrians to cross over rain garden landscape and allows water to move between landscape spaces.
40. Large rain gardens with new plaza space accepts surface runoff from College Street and also daylights piped stormwater from the upstream stormwater system.
41. Snow storage area at upper plaza section.

Widespread and Interconnected Green Spaces

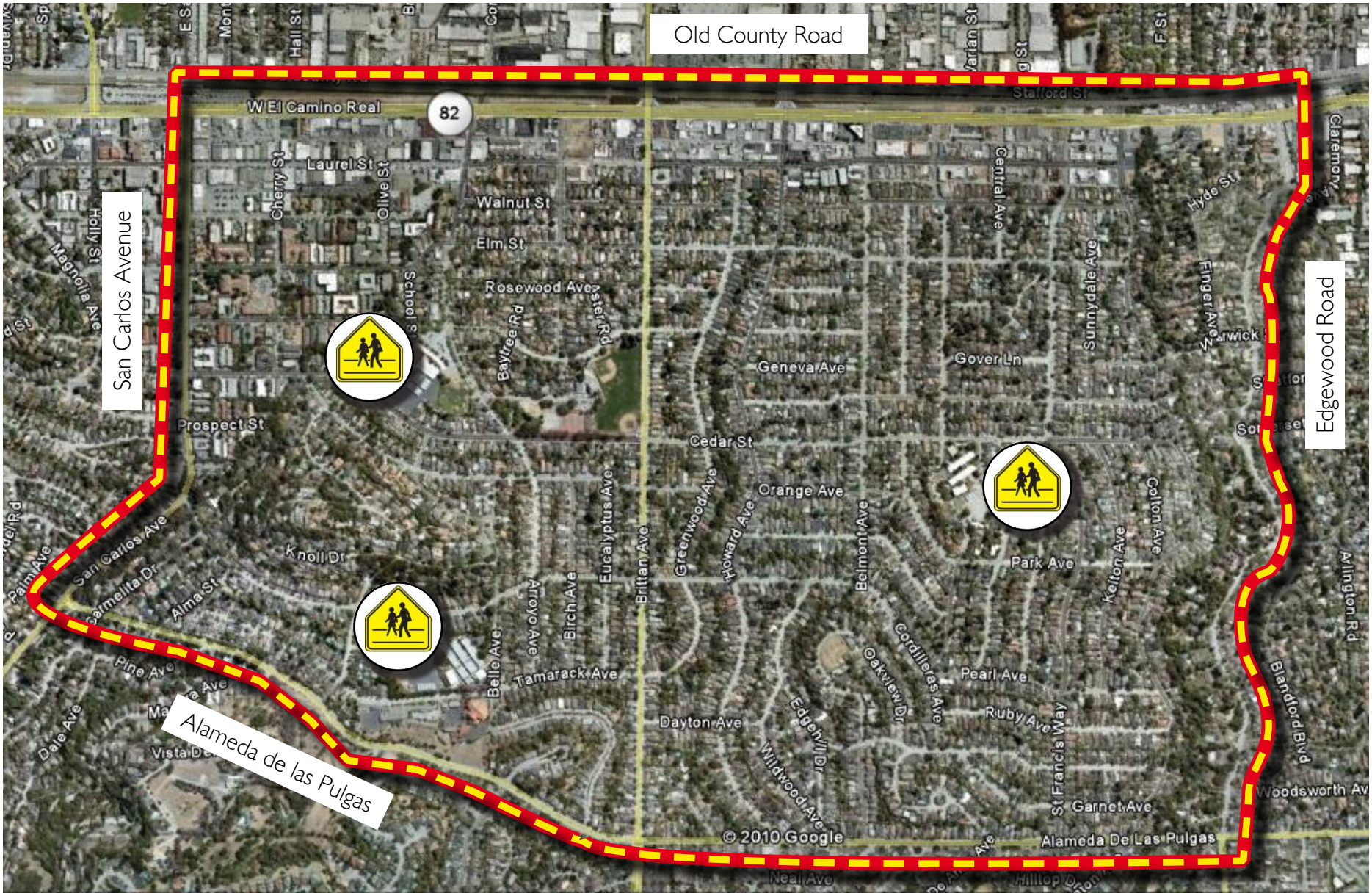


Illustration: Nevue Ngan Associates

Widespread and Interconnected Green Spaces

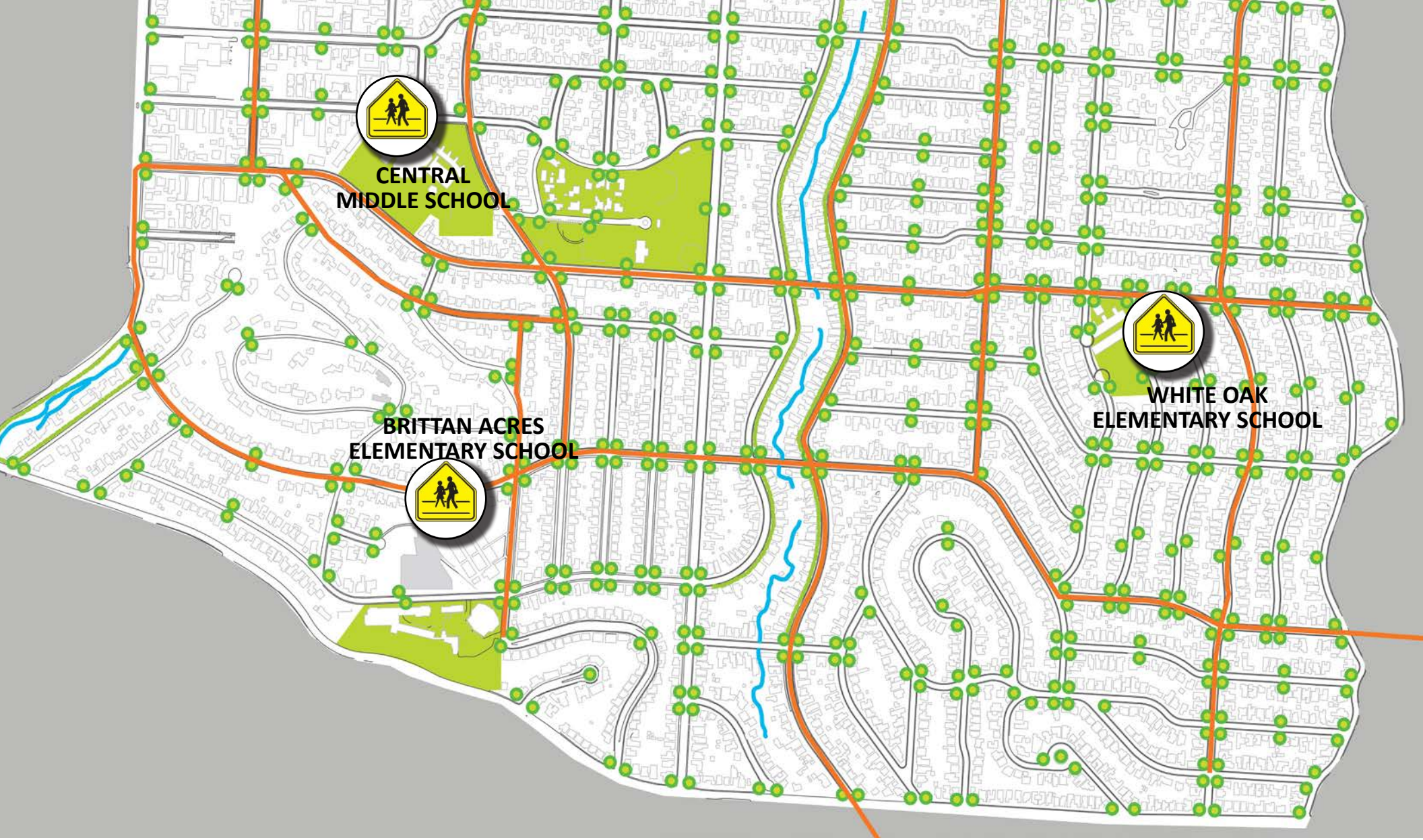


Illustration: Nevue Ngan Associates

Widespread and Interconnected Green Spaces

Start small

Tactical Green Infrastructure

Tactical Green Infrastructure is a specialized design-build methodology used to identify and implement simple, low-cost, highly visible, beautiful, inspirational, and quickly-built stormwater projects.

The 6 Principles of Tactical Green Infrastructure

1.

Simple green infrastructure relies on a landscaped-based approach to manage stormwater with little or no reliance on traditional underground piped stormwater infrastructure.

2.

Low-cost green infrastructure minimizes the use of labor-intensive construction materials, limits the amount of site grading, works with native soil conditions, and often enlists volunteers for construction.

3.

Highly-visible green infrastructure sites provide the maximum education and outreach benefit to the community.

4.

Beautiful green infrastructure showcases how the landscape can be aesthetically pleasing in both wet and dry weather with little maintenance burden.

5.

Inspirational green infrastructure gives city agencies, businesses, and the general public ideas on how to transform underperforming spaces into highly-functional stormwater gardens.

6.

Quickly-built green infrastructure projects can show how we can make a widespread impact in a short amount of time and investment.

Early Origins of Tactical Green Infrastructure

Photo: Kevin Robert Perry, ASLA

NE Siskiyou Green Street

2002

Photo: Kevin Robert Perry, ASLA

NE Siskiyou Green Street

2016

Photo: Kevin Robert Perry, ASLA

NE Siskiyou Green Street

Concept Plan

Photo: Kevin Robert Perry, ASLA

NE Siskiyou Green Street

Sawcut and Removal of Road

Photo: Kevin Robert Perry, ASLA

NE Siskiyou Green Street

Formwork and Grading

Photo: Kevin Robert Perry, ASLA

NE Siskiyou Green Street

Plant Installation

Photo: Kevin Robert Perry, ASLA

NE Siskiyou Green Street

Portland, Oregon

Photo: Kevin Robert Perry, ASLA

NE Siskiyou Green Street

Portland, Oregon

1. **Simple:** shallow grading, no manipulation of existing storm drains.

2. **Low-cost:** $18,000 to construct.

3. **Highly visible:** Located in a popular, active neighborhood.

4. **Beautiful:** Looks great year-round, blends into the existing neighborhood.

5. **Inspirational:** This project alone has inspired tens of thousands of green streets.

6. **Quickly-built:** This took three weeks to design; three weeks to build.

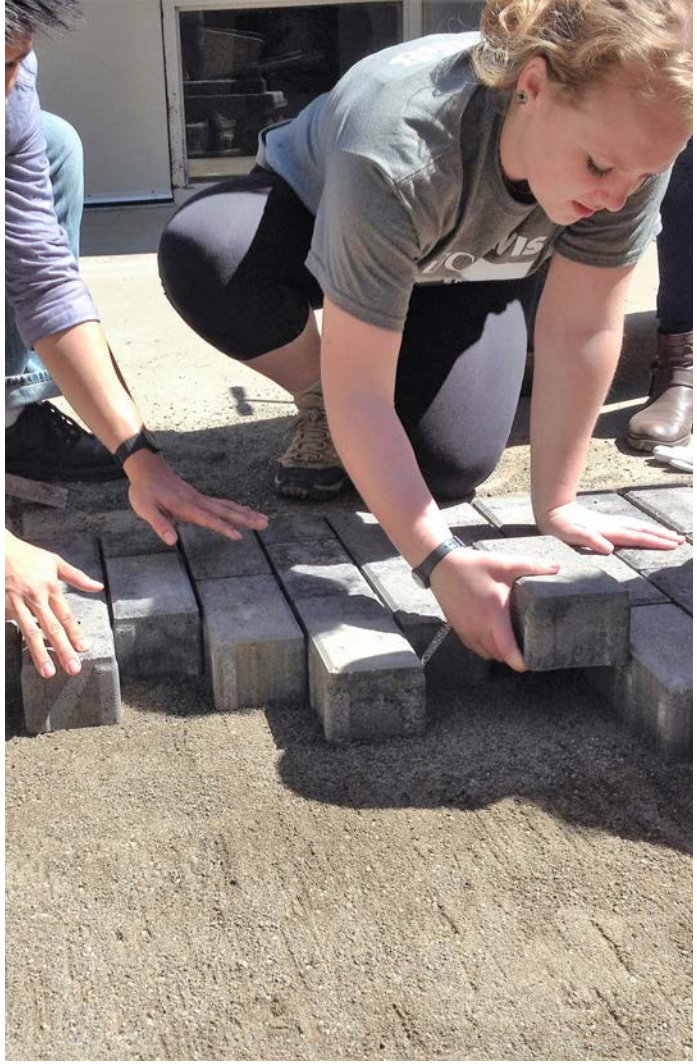
NE Siskiyou Green Street

Portland, Oregon

Fast forward...

UC Davis

Tactical Green Infrastructure



Design **Build** **Advocate**

California SLGI

STUDENT LEADERSHIP IN GREEN INFRASTRUCTURE ™

Student Leadership in Green Infrastructure

UC Davis 2015-16

2016

California Avenue Rain Garden

Photo: Kevin Robert Perry, ASLA

California Avenue Rain Garden

SLGI Campus Retrofit #1

Photo: Kevin Robert Perry, ASLA

California Avenue Rain Garden

SLGI Campus Retrofit #1

Photo: Kevin Robert Perry, ASLA

California Avenue Rain Garden

SLGI Campus Retrofit #1

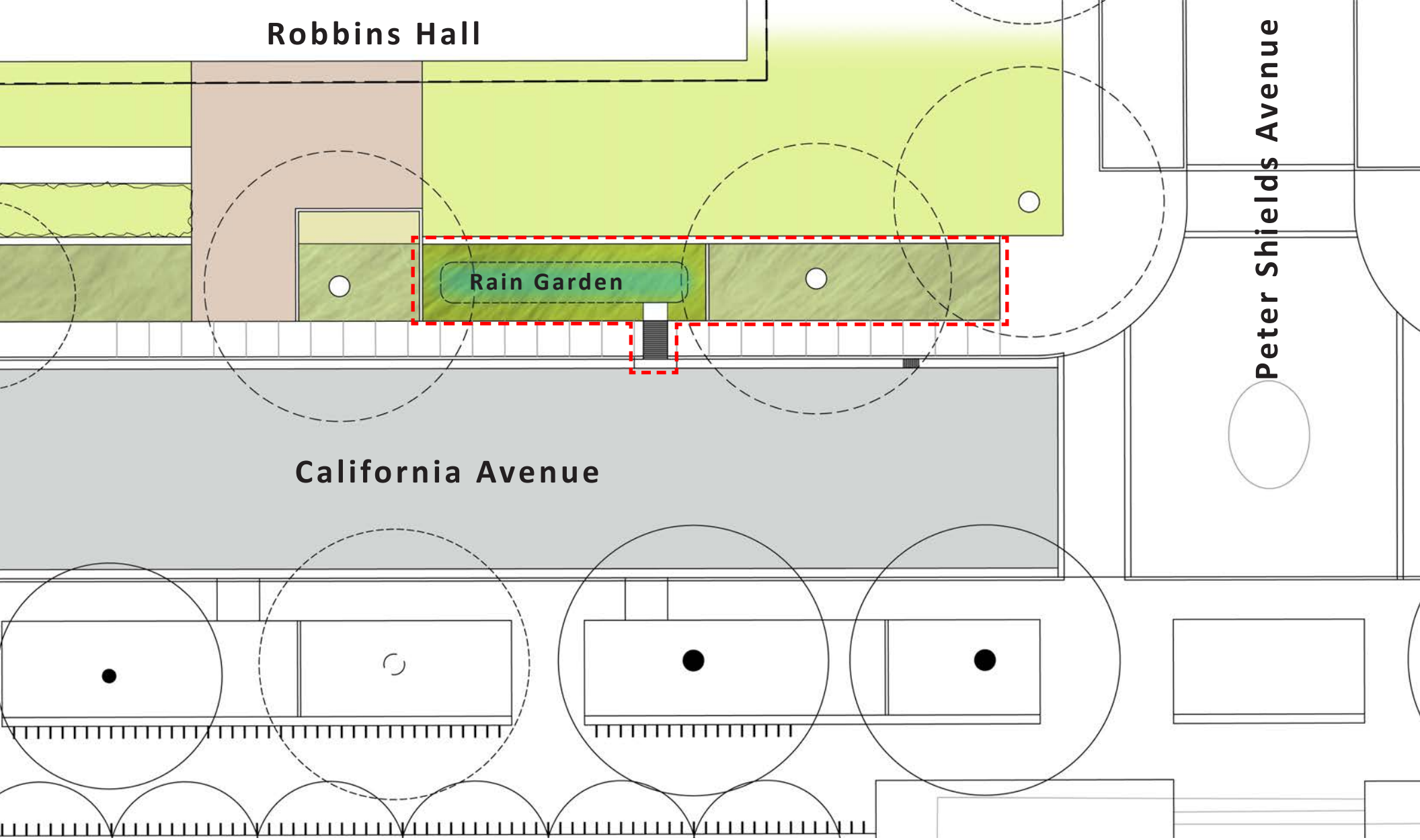


Photo: Kevin Robert Perry, ASLA

California Avenue Rain Garden

SLGI Campus Retrofit #1

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California Avenue Rain Garden

SLGI Campus Retrofit #1

2017

Social Sciences and Humanities Rain Garden

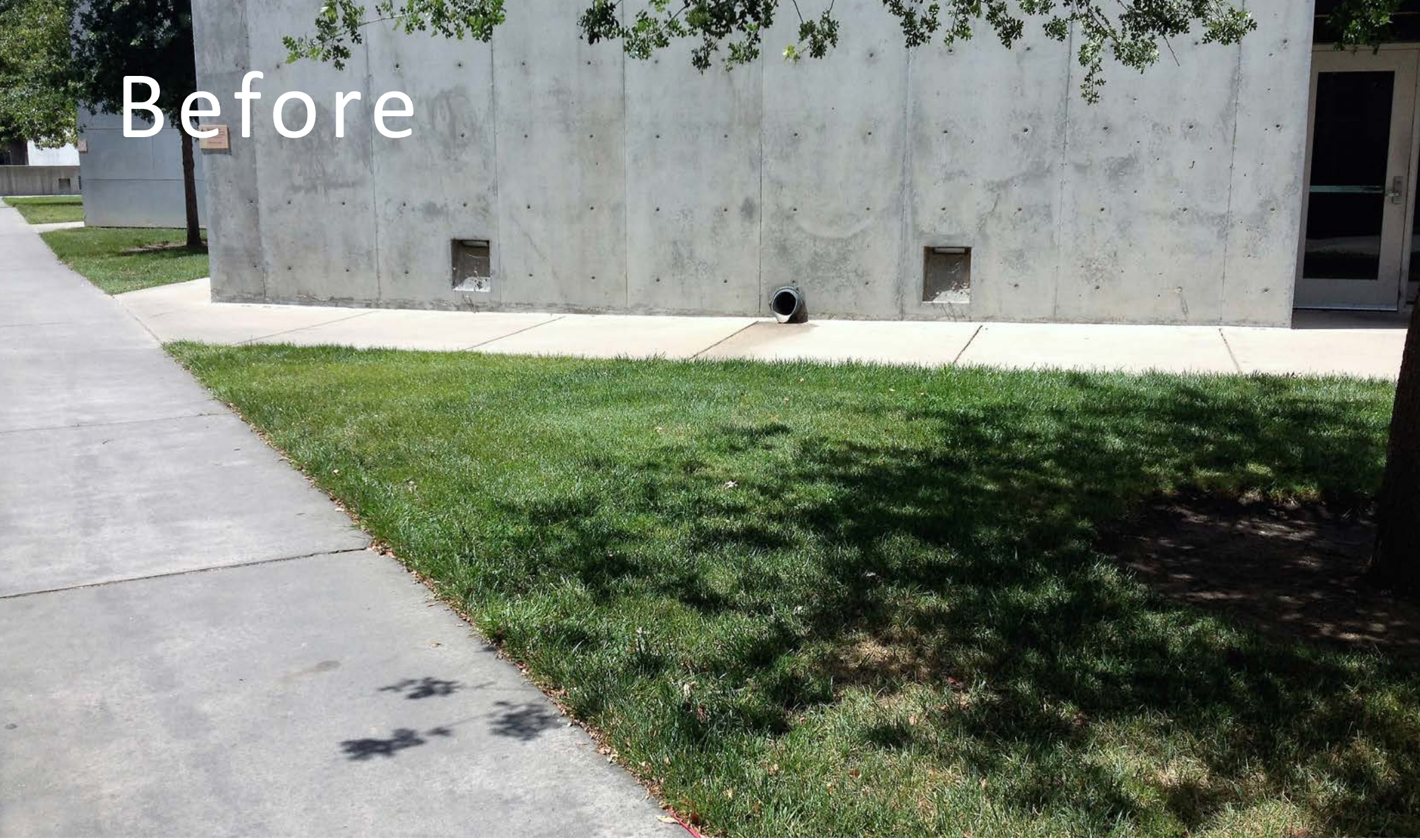


Photo: Kevin Robert Perry, ASLA

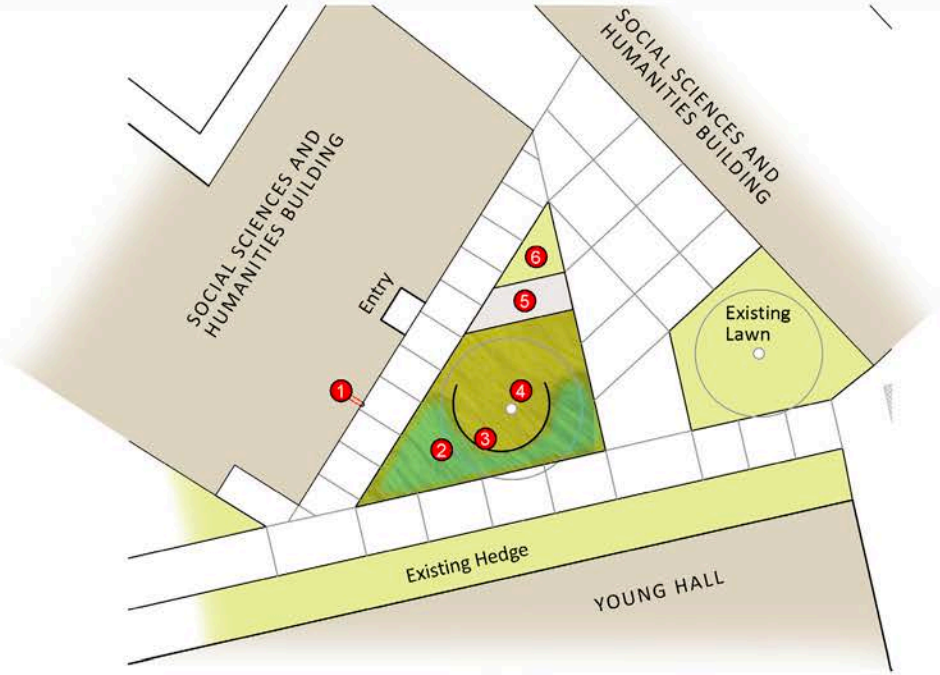
Social Sciences and Humanities Rain Garden

SLGI Campus Retrofit #2

Photo: Kevin Robert Perry, ASLA

Social Sciences and Humanities Rain Garden

SLGI Campus Retrofit #2



Rain Garden Concept Plan

0' 10' 20' 40'

1. Existing roof downspout currently allows stormwater to flow over the sidewalk and into the landscape area.
2. Existing lawn outside of the existing tree drip line is removed and is regraded to allow for 3-4" of retained stormwater runoff within a rain garden landscape.
3. A curved metal edge retains the soil at the drip line of the existing tree.
4. Lawn within the drip line of the existing tree is removed and replaced with drought-tolerant species.
5. A new paver pathway is proposed to correspond to the current desire line of pedestrians leading into on of the Social Sciences and Humanities Building entry ways.
6. Existing portion of the lawn remains unchanged due to high pedestrian traffic.

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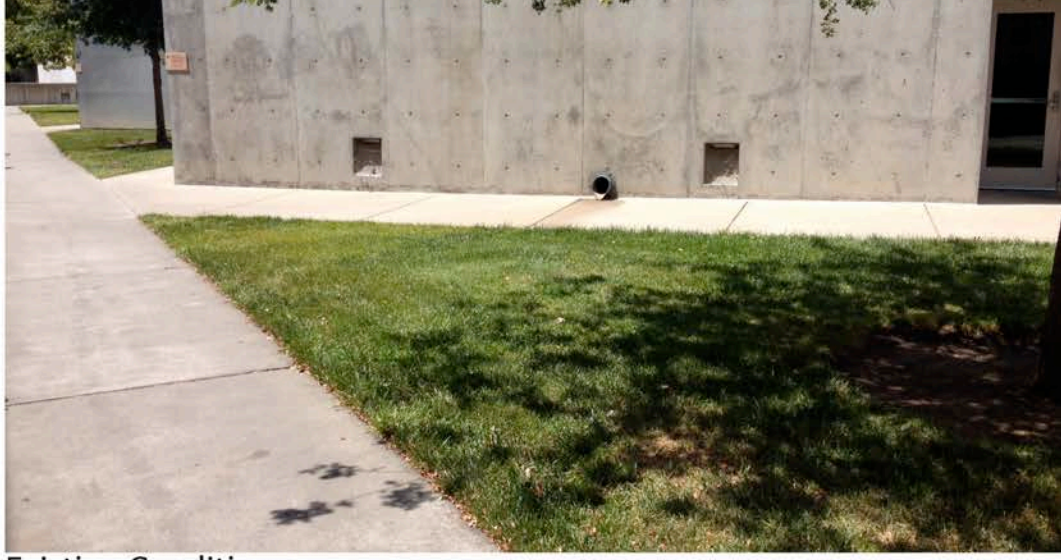

Existing Conditions

Proposed Rain Garden

Social Sciences and Humanities Rain Garden

SLGI Campus Retrofit #2

Photo: Kevin Robert Perry, ASLA

Social Sciences and Humanities Rain Garden

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Social Sciences and Humanities Rain Garden

SLGI Campus Retrofit #2

2019

Young Hall Rain Garden

Photo: Kevin Robert Perry, FASLA

Young Hall Rain Garden

SLGI Campus Retrofit #3

Photo: Kevin Robert Perry, FASLA

Young Hall Rain Garden

SLGI Campus Retrofit #3

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Young Hall Rain Garden

SLGI Campus Retrofit #3

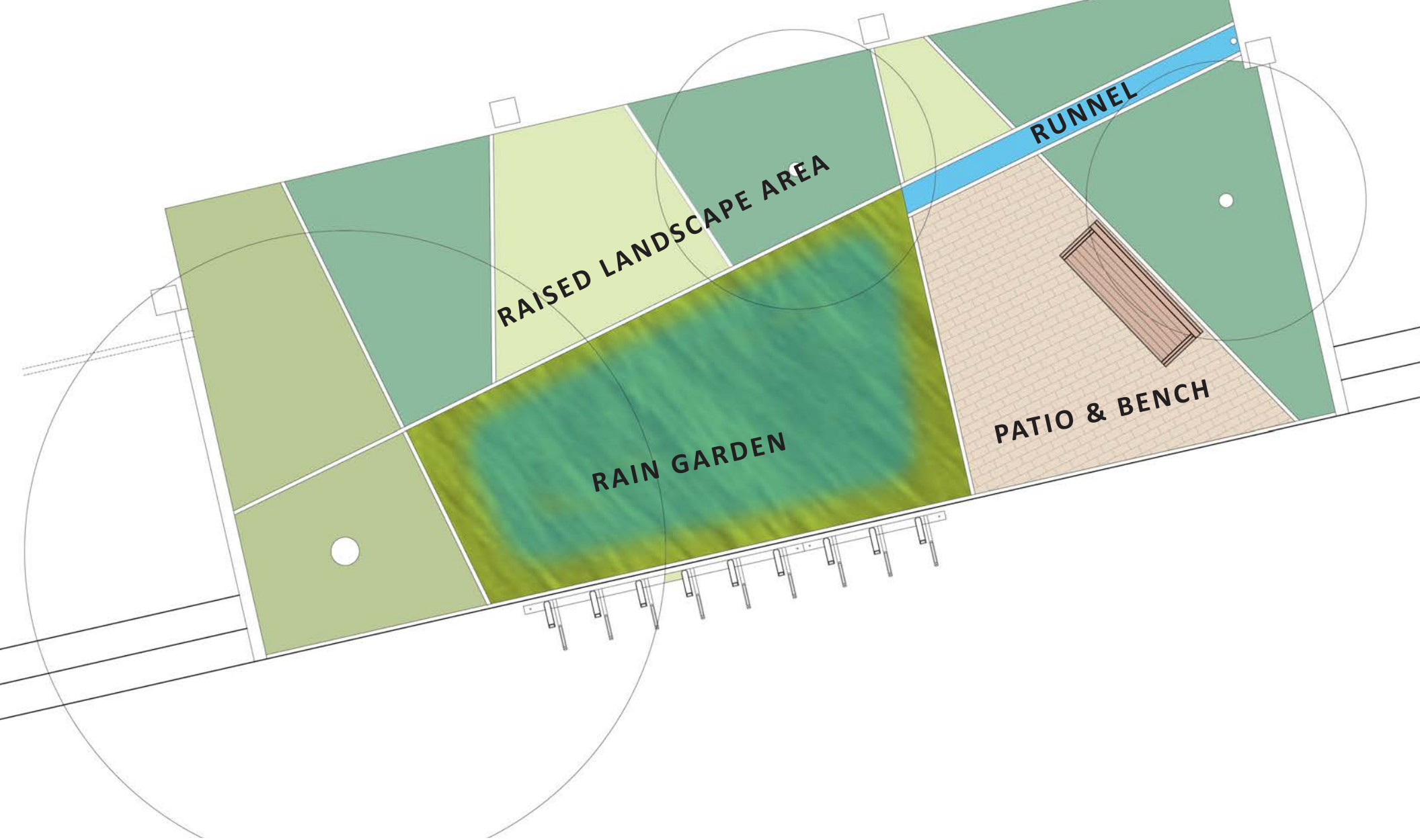

Photo: Kevin Robert Perry, FASLA

Young Hall Rain Garden

SLGI Campus Retrofit #3

Photo: Kevin Robert Perry, FASLA

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SLGI Campus Retrofit #3

Photo: Kevin Robert Perry, FASLA

Young Hall Rain Garden

SLGI Campus Retrofit #3

Opening

Photo: Kevin Robert Perry, FASLA

Young Hall Rain Garden

SLGI Campus Retrofit #3

Photo: Kevin Robert Perry, FASLA

Young Hall Rain Garden

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Young Hall Rain Garden

SLGI Campus Retrofit #3

2020

Davis Senior High School Rain Garden

Photo: Kevin Robert Perry, FASLA

Davis Senior High School Rain Garden

SLGI Campus Retrofit #4

Photo: Kevin Robert Perry, FASLA

Davis Senior High School Rain Garden

SLGI Campus Retrofit #4

Photo: Kevin Robert Perry, FASLA

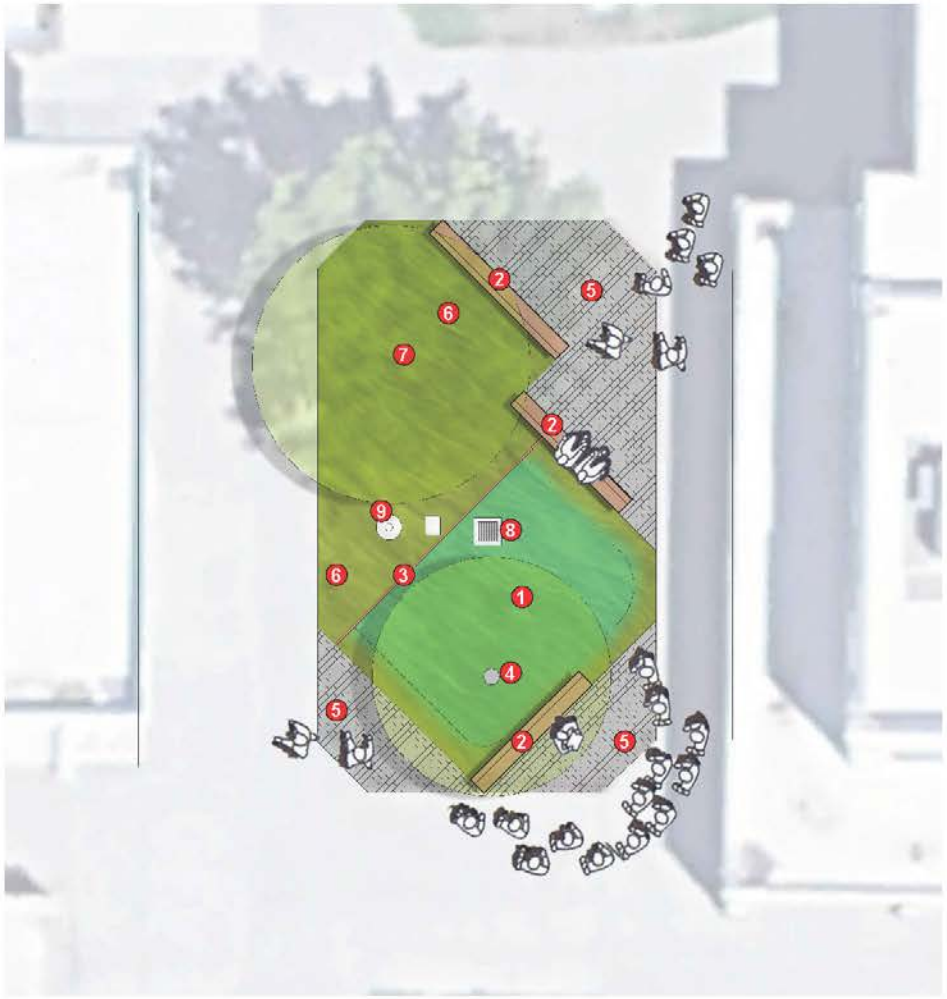
Davis Senior High School Rain Garden

SLGI Campus Retrofit #4

Photo: Kevin Robert Perry, FASLA

Davis Senior High School Rain Garden

SLGI Campus Retrofit #4



Davis High School Rain Garden (Simple)

0' 5' 10' 20'

N

1. Recessed rain garden landscape area retains up to 4" of water
2. 18" high wood benches
3. Wood or metal header vertically retains grade between existing soil and recessed rain garden elevation
4. New small to medium size tree
5. Pervious paver walkways
6. Drought-tolerant part shade to full sun plantings
7. Existing tree to remain
8. Existing storm inlet to remain
9. Existing light pole and utility box to remain

Existing site in dry conditions

Existing site in storm event conditions

California full-sun adaptable plantings

Interpretative signage

Stormwater boardwalk overlook

Pervious paver pathway

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The Office of Kevin Robert Perry, FASLA

California SLGI
STUDENT LEADERSHIP IN GREEN INFRASTRUCTURE

Davis Senior High School Rain Garden

SLGI Campus Retrofit #4

Photo: Kevin Robert Perry, FASLA

Davis Senior High School Rain Garden

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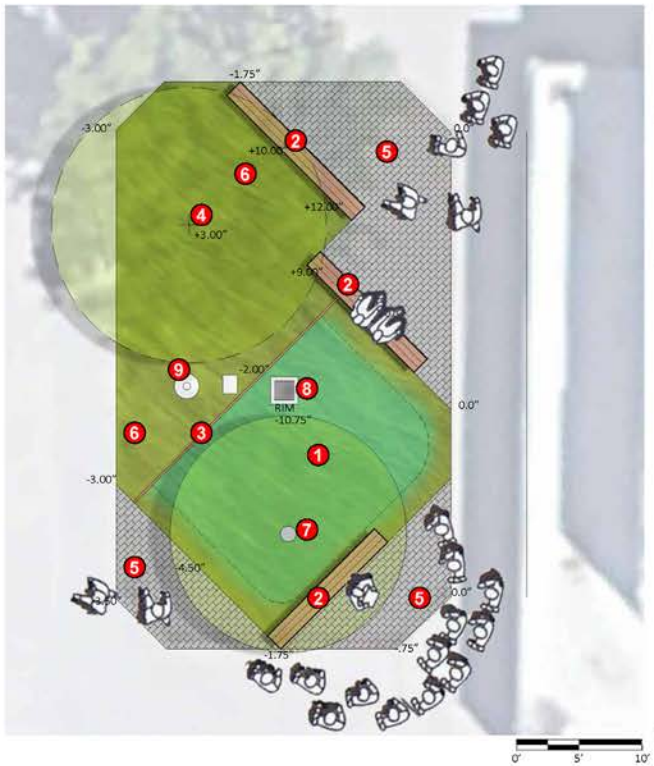
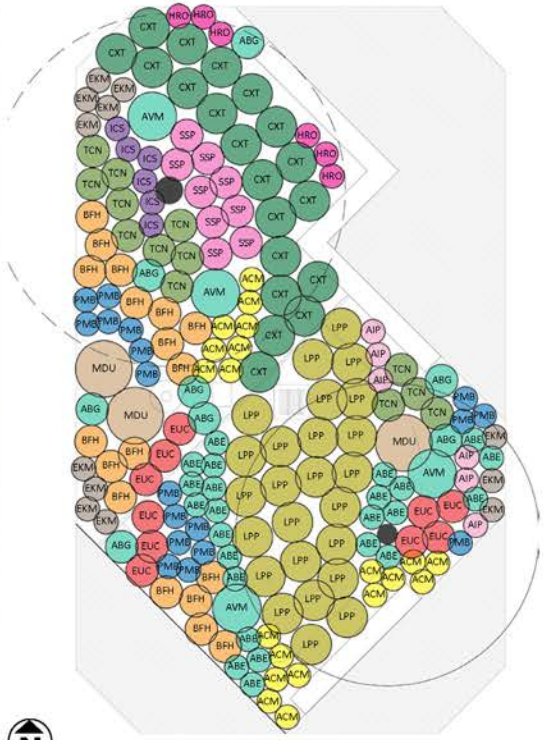
Davis Senior High School Rain Garden

SLGI Campus Retrofit #4






Moonshine Yarrow


Blue Glow Agave


Octopus Agave


Blue Elf Aloe


Berkeley's Sedge


California Fuchsia


Pink Santa Barbara Daisy


Rosada Coral Bells


Pom Pom Mat Rush


Pine Muhly


Foothill Penstemon


Hummingbird Sage


Hallmark Bulbine


Canyon Snow Iris


Dwarf Wall Germander


Island Pink Yarrow

Davis Senior High School Rain Garden

1. Recessed rain garden landscape area retains up to 4" of water
2. Wood benches also retain soil excavated rain garden
3. A metal headerboard vertically retains grade between existing soil and recessed rain garden elevation
4. Existing Chinese Pistache to remain
5. Pervious paver walkways at rain garden corners
6. Excess soil from rain garden excavation forms an upland plant community with drought-tolerant plant species
7. Plant new Chinese Pistache tree within rain garden
8. Existing storm inlet to remain
9. Existing light pole and utility box to remain

SHRUB AND PERENNIAL PLANTING LEGEND

SYMBOL	BOTANICAL NAME	COMMON NAME	SIZE	QUANTITY
AIP	*Achillea millefolium 'Island Pink'*	Island Pink Yarrow	1 gal	6
ACM	*Achillea 'Moonshine'*	Moonshine Yarrow	1 gal	20
ABG	*Agave 'Blue Glow'*	Blue Glow Agave	1 gal	8
AVM	*Agave vilmoriniana*	Octopus Agave	3 gal	4
ABE	*Aloe 'Blue Elf'*	Blue Elf Aloe	1 gal	24
BFH	*Bulbine frutescens 'Hallmark*	Hallmark Bulbine	1 gal	18
CXT	*Carex tumulicola (divulsa)*	Berkeley's Sedge	1 gal	20
EUC	*Epilobium canum 'Uvas Canyon'*	California Fuchsia	1 gal	10
EKM	*Erigeron karvinskianus 'Moerheimii'*	Pink Santa Barbara Daisy	1 gal	12
HRO	*Heuchera 'Rosada'*	Rosada Coral Bells	1 gal	6
ICS	*Iris douglasiana 'Canyon Snow'*	Canyon Snow Iris	1 gal	6
LPP	*Lomandra confertifolia ssp. pallida 'Pom Pom'*	Pom Pom Mat Rush	1 gal	25
MDU	*Muhlenbergia dubia*	Pine Muhly	3 gal	3
PMB	*Penstemon heterophyllus x 'Margarita BOP'*	Foothill Penstemon	1 gal	18
SSP	*Salvia spathacea*	Hummingbird Sage	1 gal	9
TCN	*Teucrium chamaedrys 'Nanum'*	Dwarf Wall Germander	1 gal	13

Davis Senior High School Rain Garden

SLGI Campus Retrofit #4

Photo: Kevin Robert Perry, FASLA

Davis Senior High School Rain Garden

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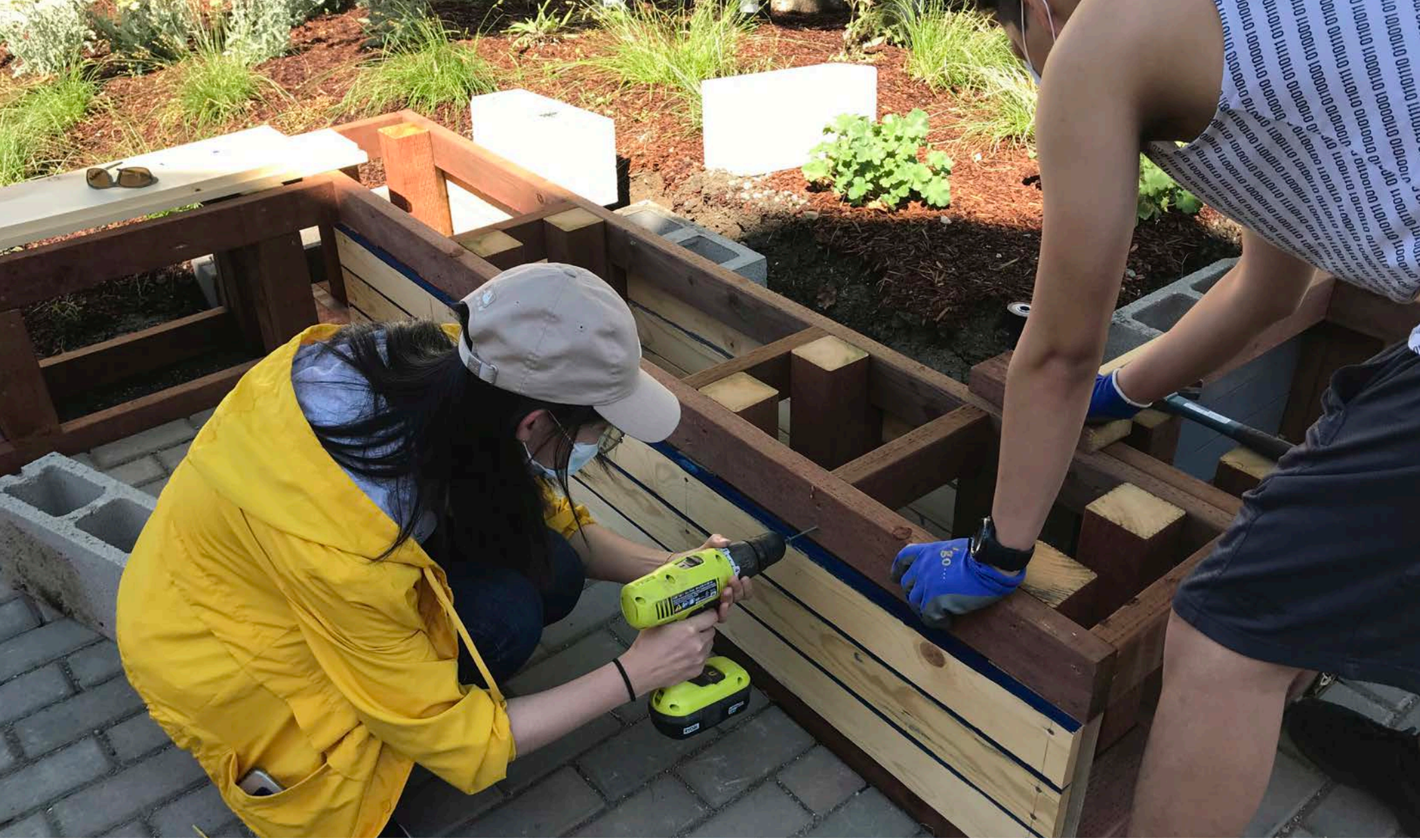

Photo: Kevin Robert Perry, FASLA

Davis Senior High School Rain Garden

SLGI Campus Retrofit #4

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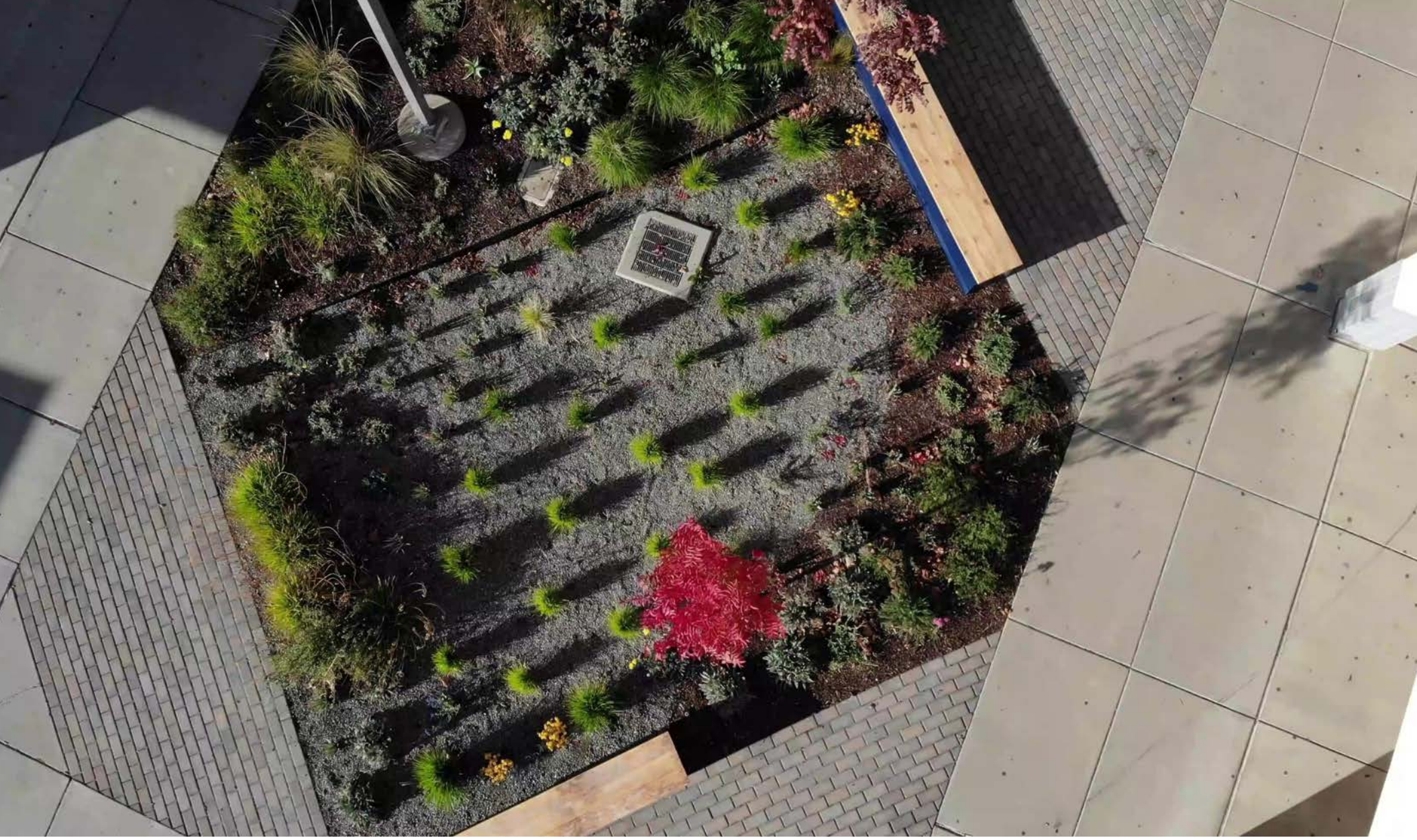

Photo: Kevin Robert Perry, FASLA

Davis Senior High School Rain Garden

SLGI Campus Retrofit #4

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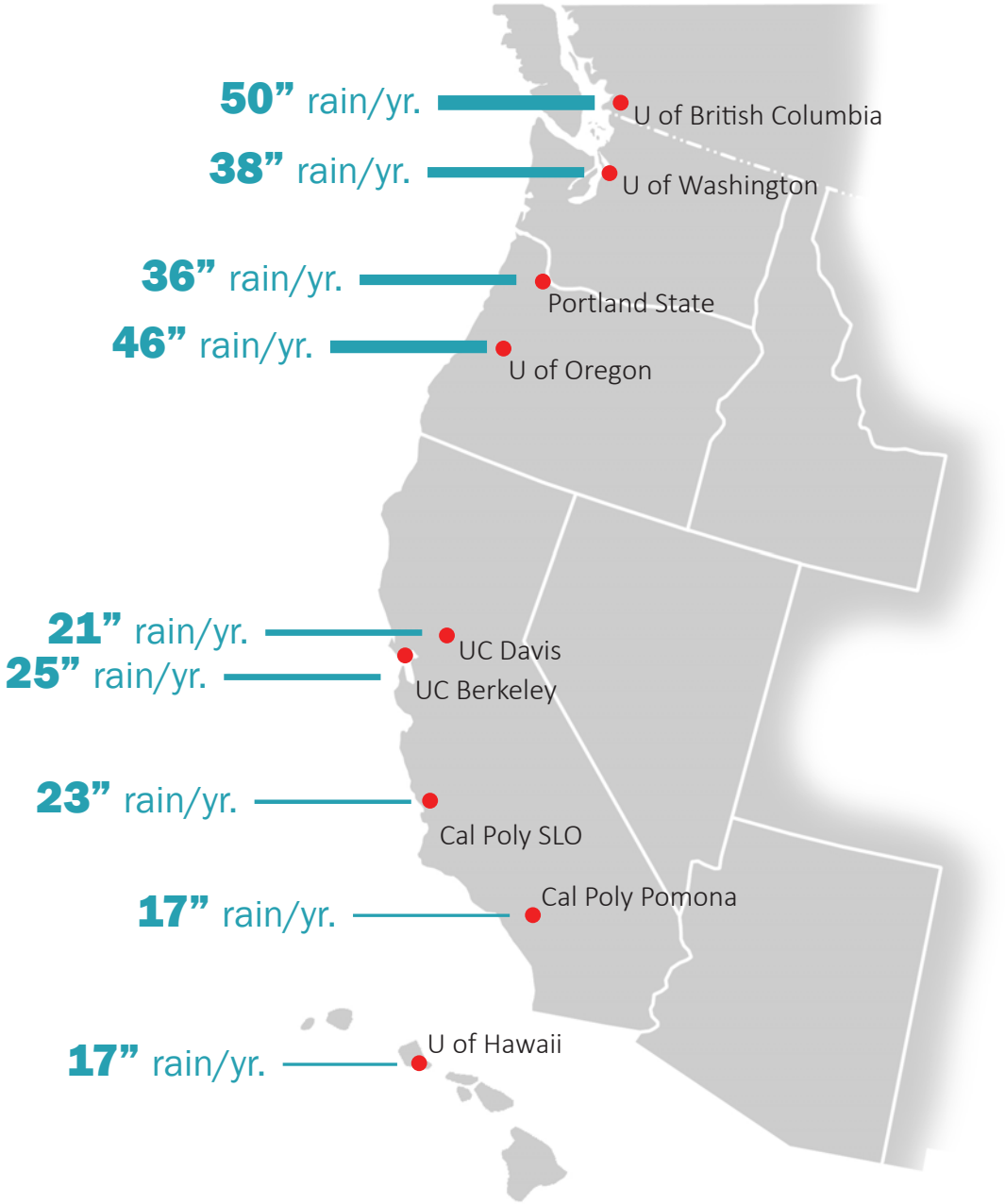
Davis Senior High School Rain Garden

SLGI Campus Retrofit #4

Expanding
Tactical Green Infrastructure

Pacific Rim

"Tactical Green Infrastructure Program"



Local Government Commission

Council for Watershed Health

RIOS

ATLAS LAB

PARTNERSHIP berger

OLaunu

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TOOLE DESIGN

Streets

Schools

Parks

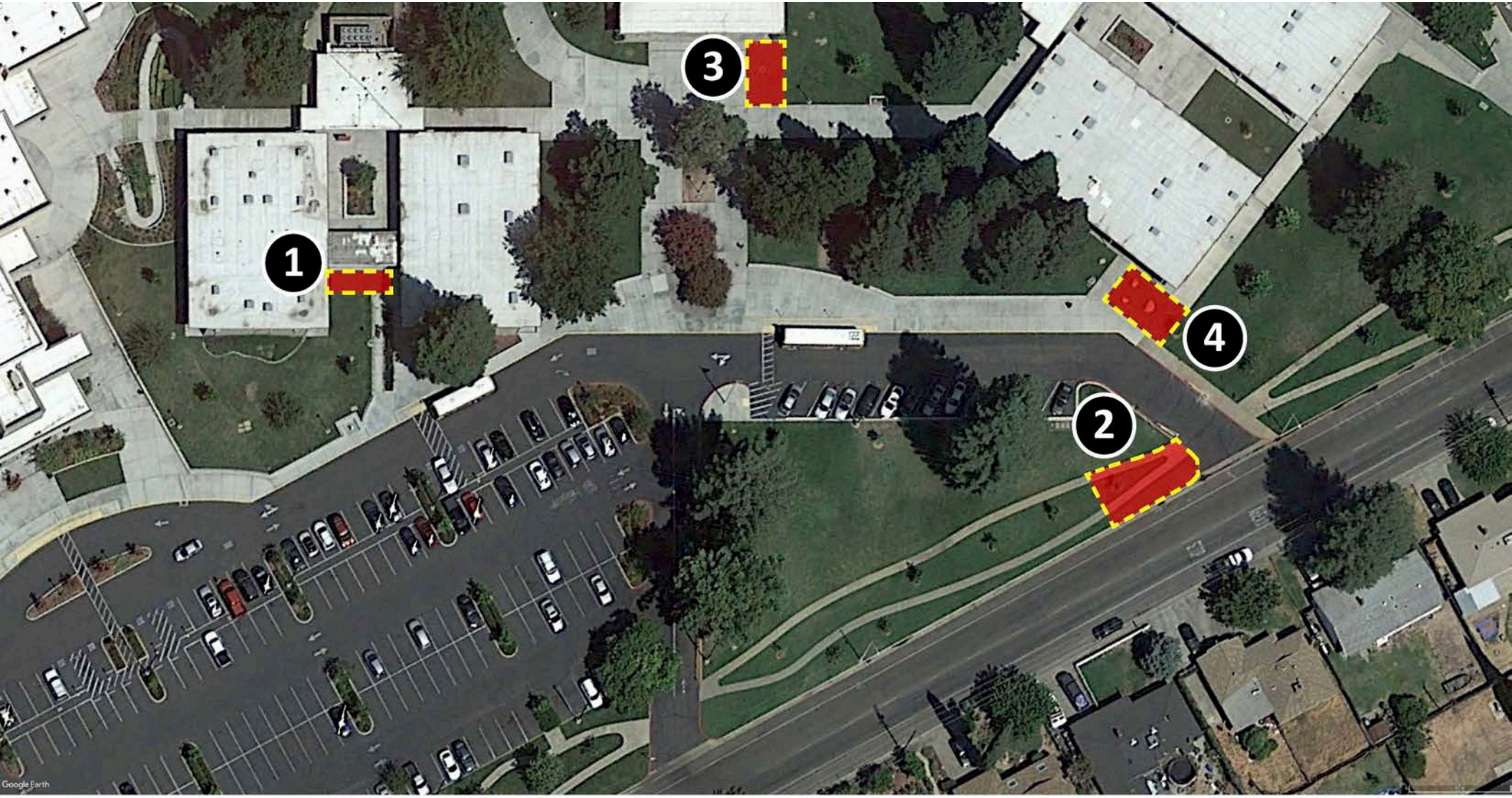
Pacific Rim Tactical Green Infrastructure Program

A Focus on Retrofitting the Public Realm

Photo: Kevin Robert Perry, FASLA

School Opportunities

A Focus on Retrofitting the Public Realm



Cordova High School Green Infrastructure Site Assessment

April 22, 2019

Photo: Kevin Robert Perry, FASLA

School Opportunities

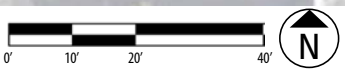
A Focus on Retrofitting the Public Realm

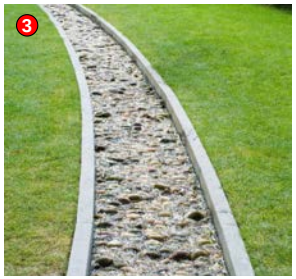
Existing conditions at Seattle University's Flagpole Plaza

KEY PROJECT IMPROVEMENTS:

1. Central rain garden is formed as a series of terraced cells allowing water to cascade over metal weirs.
2. Curved seatwalls define multiple seating zones.
3. Stormwater is routed from nearby hardscape into a curved metal runnel.
4. A small bridge allows water from the runnel to flow under pedestrians and into the rain garden.
5. Crushed stone pathways meander through Pacific Northwest understory plantings.
6. Pervious concrete pavers at central seating area.
7. Low-growing Pacific Northwest understory plantings.
8. 5' wide ADA accessible concrete pathway.
9. Existing concrete area is expanded into the rain garden plaza to create an integrated drop-off area space.
10. Two existing benches from the drop-off space are relocated near crushed stone pathways.
11. Existing flagpole area remains.

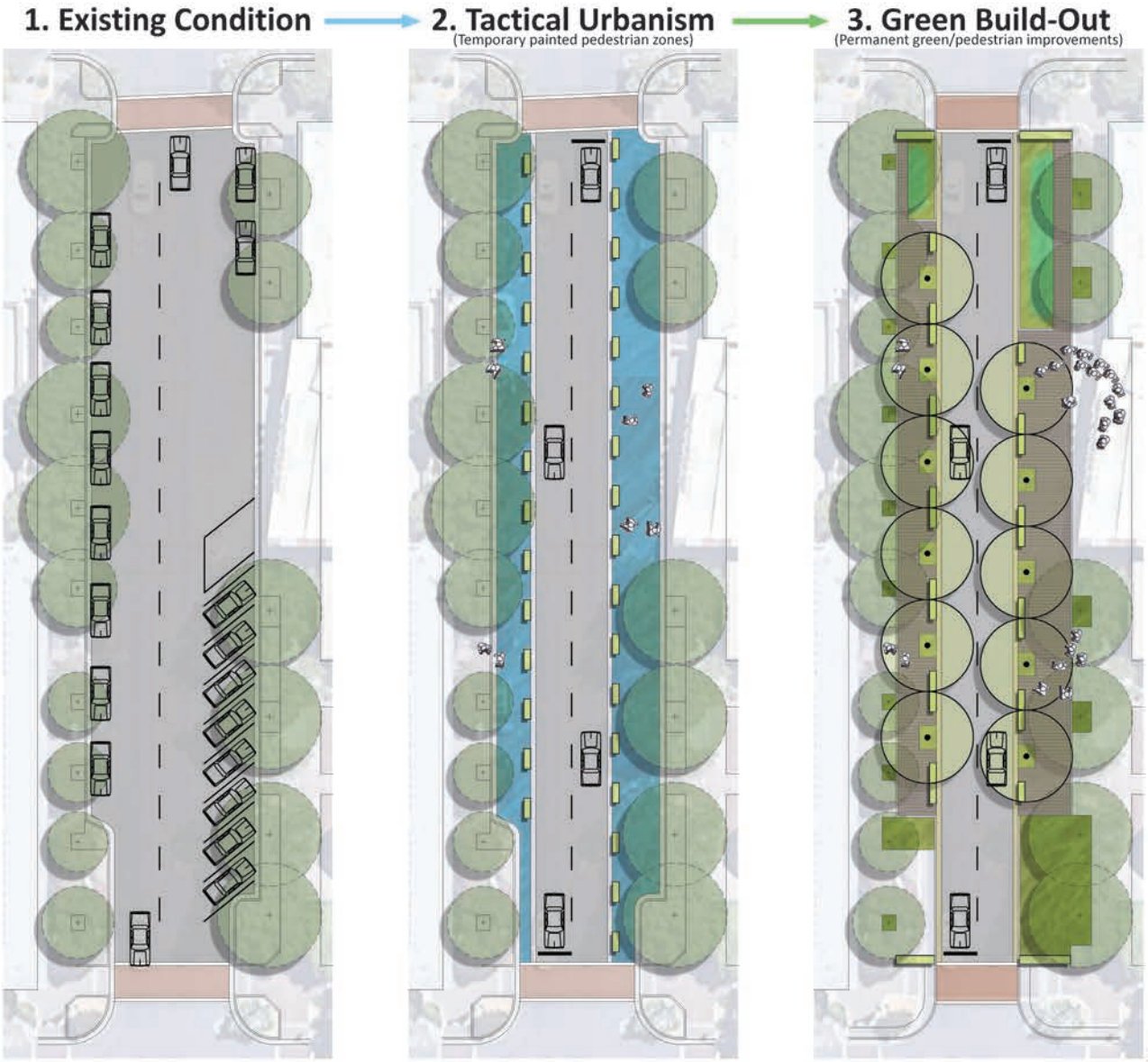
Seattle University: Flagpole Plaza Rain Garden Concept Plan

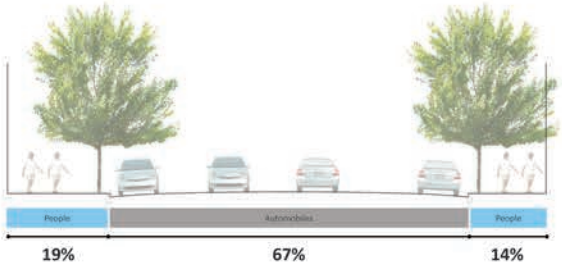




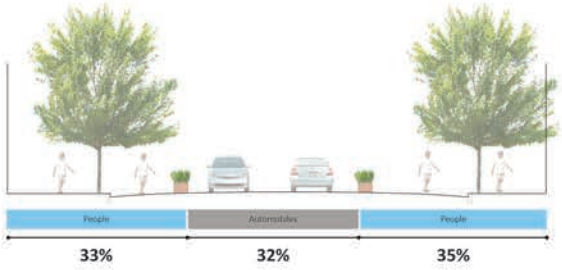
School Opportunities

A Focus on Retrofitting the Public Realm

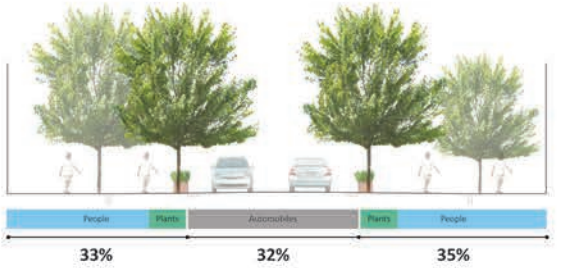




Existing Condition



Tactical Urbanism



Green Build-Out

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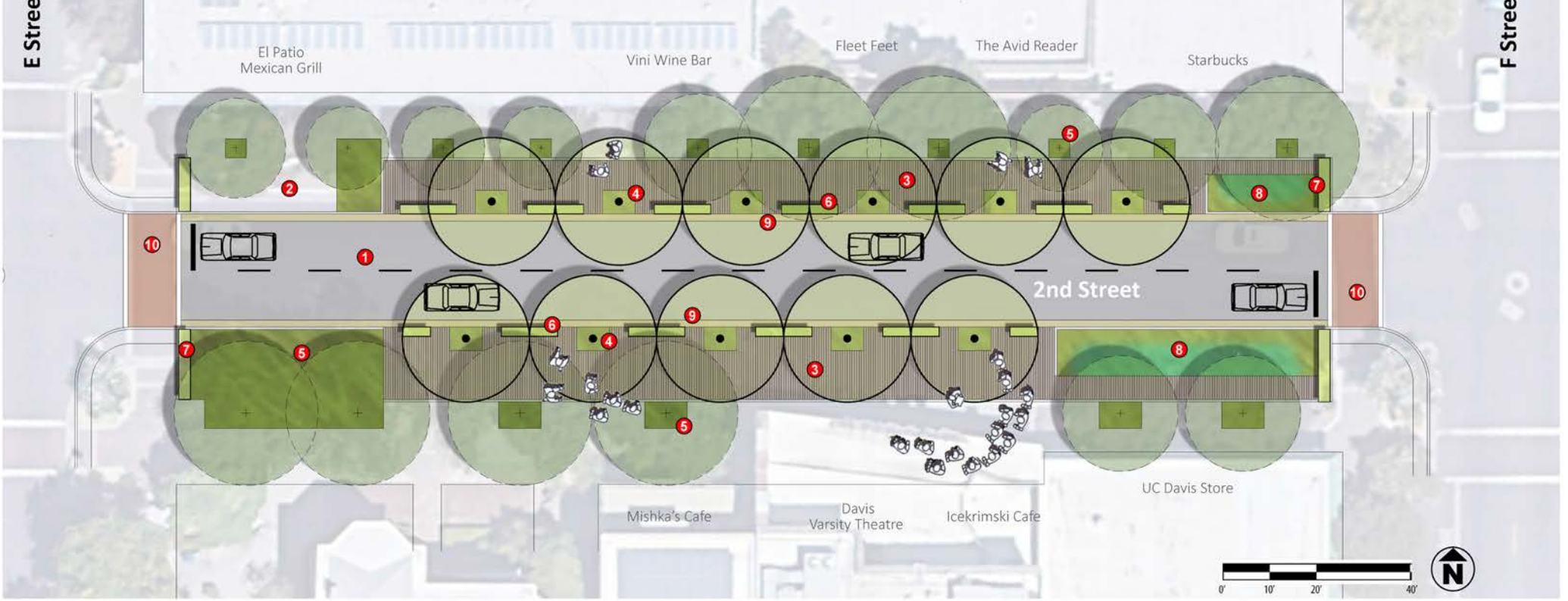
TOOLE DESIGN

Street Opportunities

A Focus on Retrofitting the Public Realm



Davis 2nd Street: Public Realm and Greening Expansion Concept Plan

*Note: This is a hypothetical street concept with no endorsement from the City of Davis or surrounding business community.

1. Auto travel remains the same with two travel lanes in each direction.
2. Existing bus location remains in place.
3. New pedestrian "patio" space and outdoor dining boardwalk zones replaces on-street parking.
4. New street trees and ground plane landscaping.
5. Existing trees remain in place. New ground plane landscaping.
6. Raised landscape planters define and protect pedestrian space.
7. Specialized raised landscape planters at street intersection locations.
8. Stormwater planters at intersection captures and treats street and building runoff.
9. Concrete band allows for a flush paving condition. This condition allows 2nd street to be closed off an be used for a public plaza for special events.
10. New crosswalk paving.

Existing conditions along 2nd Street. An auto dominated public realm.

Example of expanding pedestrian and green space into the existing parking zone.

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Street Opportunities

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Urban Tree Sponge: Phase I Demonstration Improvements

0' 10' 20' 40'

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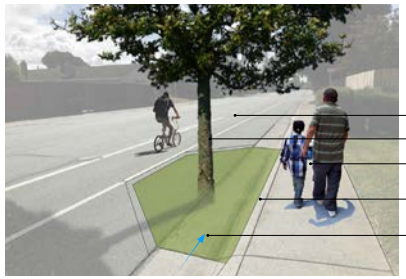
The proposed Urban Tree Sponge pilot project would showcase a new approach, design, and methodology to insert more large canopy street trees along existing suburban streets. This initial pilot project locates five Urban Tree Sponges along this suburban street.

Each Urban Tree Sponge removes 150 square feet of asphalt within the street's parking zone and converts it into both a drought and wet tolerant mini landscape that can also support a large canopy street tree. At each location, the existing curb and gutter system is modified to allow stormwater runoff from the street to filter within this landscape system. The combined effect of multiple Urban Tree Sponges helps better manage stormwater runoff, shades the overall street environment, decreases vehicle speed, and provides a more attractive and desirable streetscape condition.

Existing Conditions



Typical Urban Tree Sponge

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TOOLE DESIGN

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Elk Grove Great Nature Park: Full Build-Out Concept Plan

DRAFT 4-2-2020

Phase 1: Add improvements outside current wetland zone

Phase 2: Add CCSD parking lot stormwater infrastructure

Phase 3: Add wetland meadow circulation and main green

Phase 4: Add Nature Center and supporting parking lot

Park Opportunities

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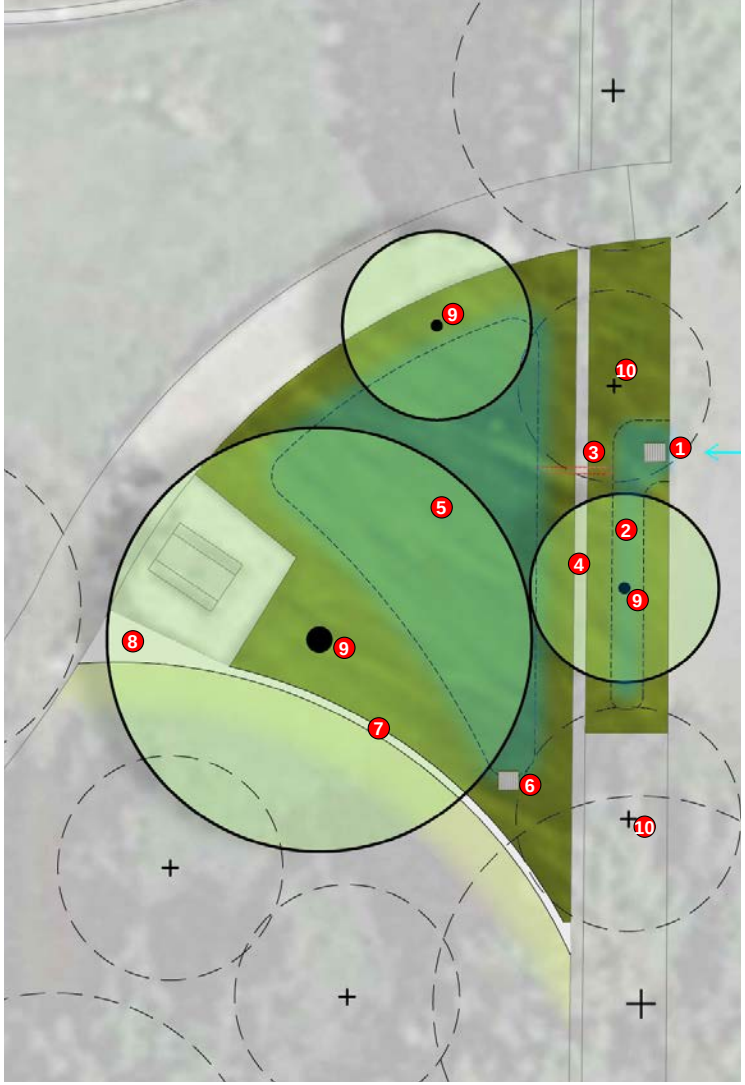


Moonshine Yarrow


Blue Glow Agave


Octopus Agave


Blue Elf Aloe


Hallmark Bulbine


Berkeley's Sedge


California Fuchsia


Pink Santa Barbara Daisy


Rosada Coral Bells


Canyon Snow Iris


Pom Pom Mat Rush


Pine Muhly


Foothill Penstemon


Hummingbird Sage


Dwarf Wall Germander

KEY GREEN INFRASTRUCTURE IMPROVEMENTS

1. Existing inlet perimeter is bermed with asphalt to prohibit stormwater entering the storm drain system.
2. 250 square feet of existing landscape is graded to capture runoff.
3. New culvert pipes routes stormwater under concrete band and fence structure.
4. Existing concrete band and fence structure to remain.
5. 950 square feet of lawn is removed and a new rain garden is graded to allow the capture and infiltration of stormwater runoff.
6. Existing inlet acts as overflow during larger storm events.
7. New concrete mowband separates lawn from rain garden plantings.
8. New concrete paving allows adjacent to existing concrete pad conforms to mowband radius.
9. New trees, varied canopy size.
10. Existing trees to remain and be protected during construction.

Elk Grove Nature Park Tactical Green Infrastructure Site Plan

10-26-2020

0' 5' 10' 20'

N

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Park Opportunities

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Urban Rain Design inc.
A Studio of Green Infrastructure
www.urbanraindesign.com

TOOLE DESIGN
www.tooledesign.com

Kevin Robert Perry, FASLA, PLA
kevin@urbanraindesign.com
kperry@tooledesign.com