WORKING WITH NATURE TRAINING SERIES

FEB. 16, 2022

Nature-based solutions in roadway projects and programs

LOUISIANA
WATERSHED
INITIATIVE

working together for sustainability and resilience

AGENDA

- Program overview
- Nature-based solutions in roadway projects and programs
- MOVEBR program case study
- Questions

NATURE-BASED SOLUTIONS PROGRAM OVERVIEW

MAXIMIZE NATURAL FUNCTIONS OF THE FLOODPLAIN

- Fund projects that harness natural features to reduce flood risk, improve water quality and provide additional co-benefits
- Provide training and technical resources to advance understanding and adoption of nature-based solutions
- Prioritize nature-based solutions throughout state programs and projects
- Use tools to quantify benefits and measure performance of nature-based projects

NATURE-BASED SOLUTIONS IN ROADWAY PROJECTS

Lolly Kunkler, PE

CIVIL ENGINEER, MIG | SvR

Lolly Kunkler is a licensed professional civil engineer with 20 years of experience in stormwater management and low-impact development. She specializes in the planning and design of large-scale infrastructure redevelopment projects, including streetscapes, nonmotorized transportation elements and green infrastructure systems.

Overview

- How we use our streets
- Integrating green infrastructure into streets, roads and rights of way with multiple co-benefits
- Jurisdiction-wide feasibility and suitability analyses
- Methods for identifying potential sites
- Context-appropriate design elements
- Moving beyond pilot projects
- Case study in brief: 21st Street, Paso Robles, California

Public infrastructure

- City streets make up more than 80% of all public space in cities (*Urban Street Design Guide*, National Association of City Transportation Officials).
- A significant percentage of all land within urban areas is public right of way.
- Stormwater impacts:
  - High percentage of impervious surface coverage
  - Primarily pollution generating
  - Major contributor to nonpoint source water pollution (second behind agricultural runoff)

Complex and competing needs

- Existing roadway uses and needs

Complex and competing needs

- Growing set of users

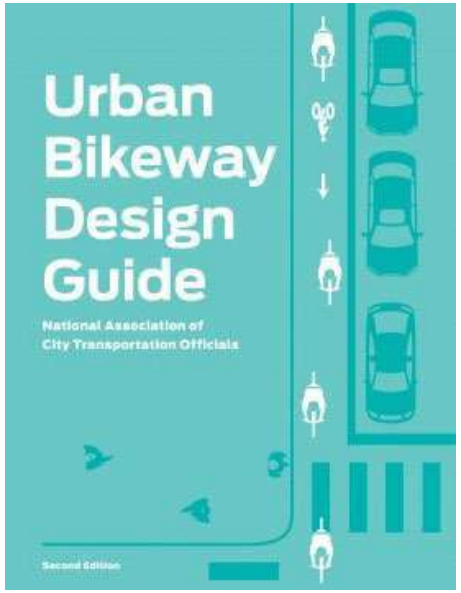


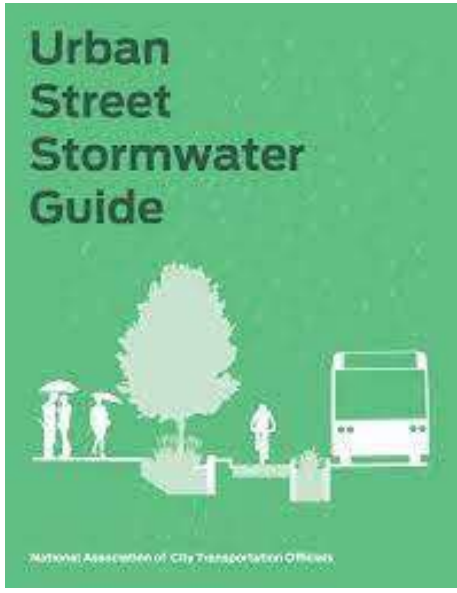

- Growing set of desires

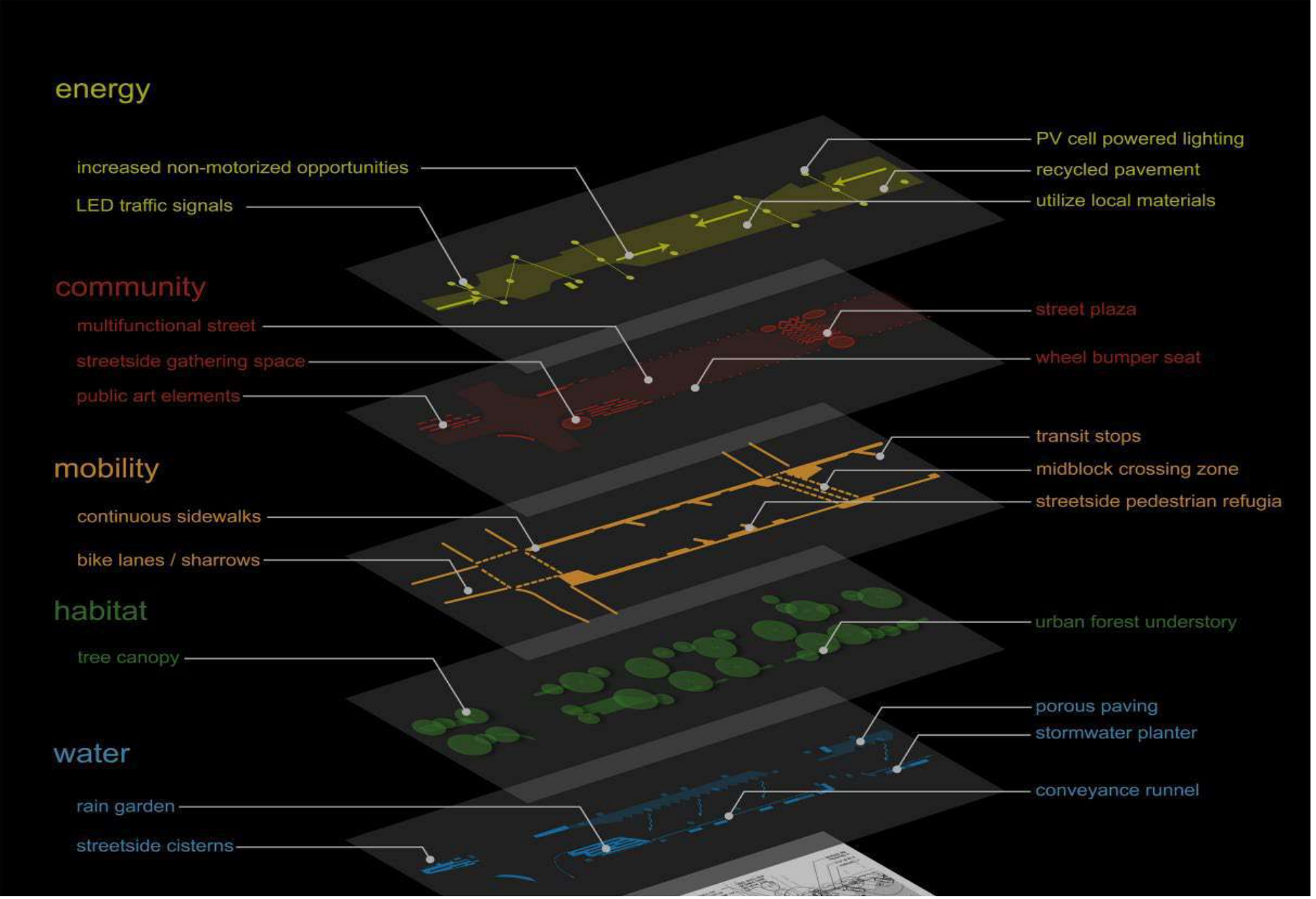


Rethinking streets

- Vehicle-centric design does not apply to nonmotorized users.
- The National Association of City Transportation Officials has changed the practice for design.
- Changing metrics
  - Transportation
  - Safety
  - Reliability
  - Economic
  - Environmental
  - Community
  - Equity







MIG

- Energy
- Community
- Mobility
- Habitat
- Water

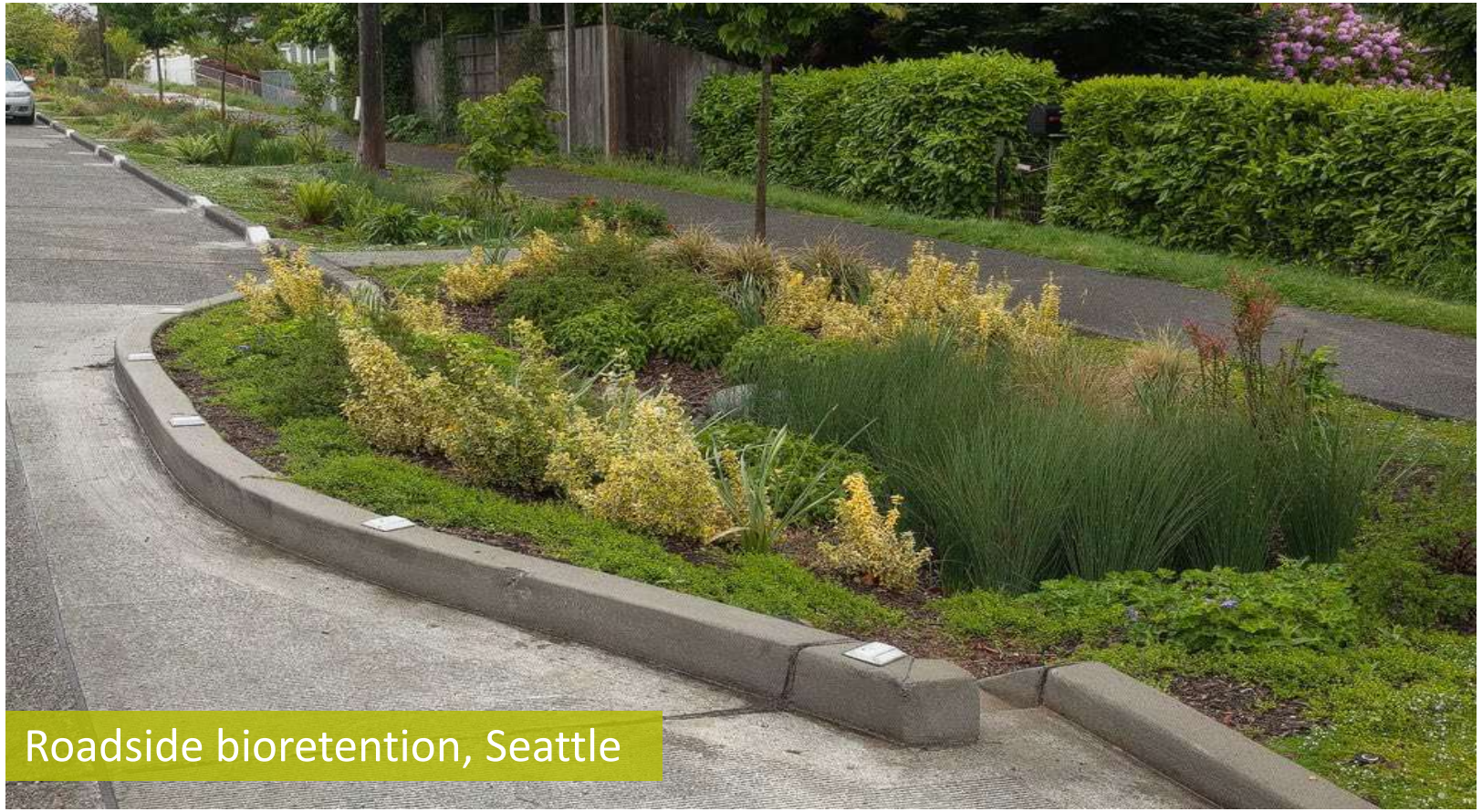
Rethinking stormwater

- Comply with recent regulations, targets and goals:
  - National Pollutant Discharge Elimination System permits
  - Combined Sewer Overflows control mandates
  - Climate change initiatives
- Integrate facilities
- Localize treatment and control
- Provide multiple benefits (aesthetics, traffic calming, user separation, etc.)

Urban stream channel, Paso Robles

Green infrastructure for transportation corridors

- Filter strip
- Bioretention
- Permeable pavement
  - Pervious concrete
  - Porous asphalt
  - Permeable pavers
- Trees
- Proprietary products
  - Filterra
  - Silva cells



Roadside bioretention, Seattle

GI for transportation corridors

Curb bulb bioretention, Portland

Curb bump, Philadelphia

Stormwater planter, Milwaukee

Enhanced tree pit, Brooklyn

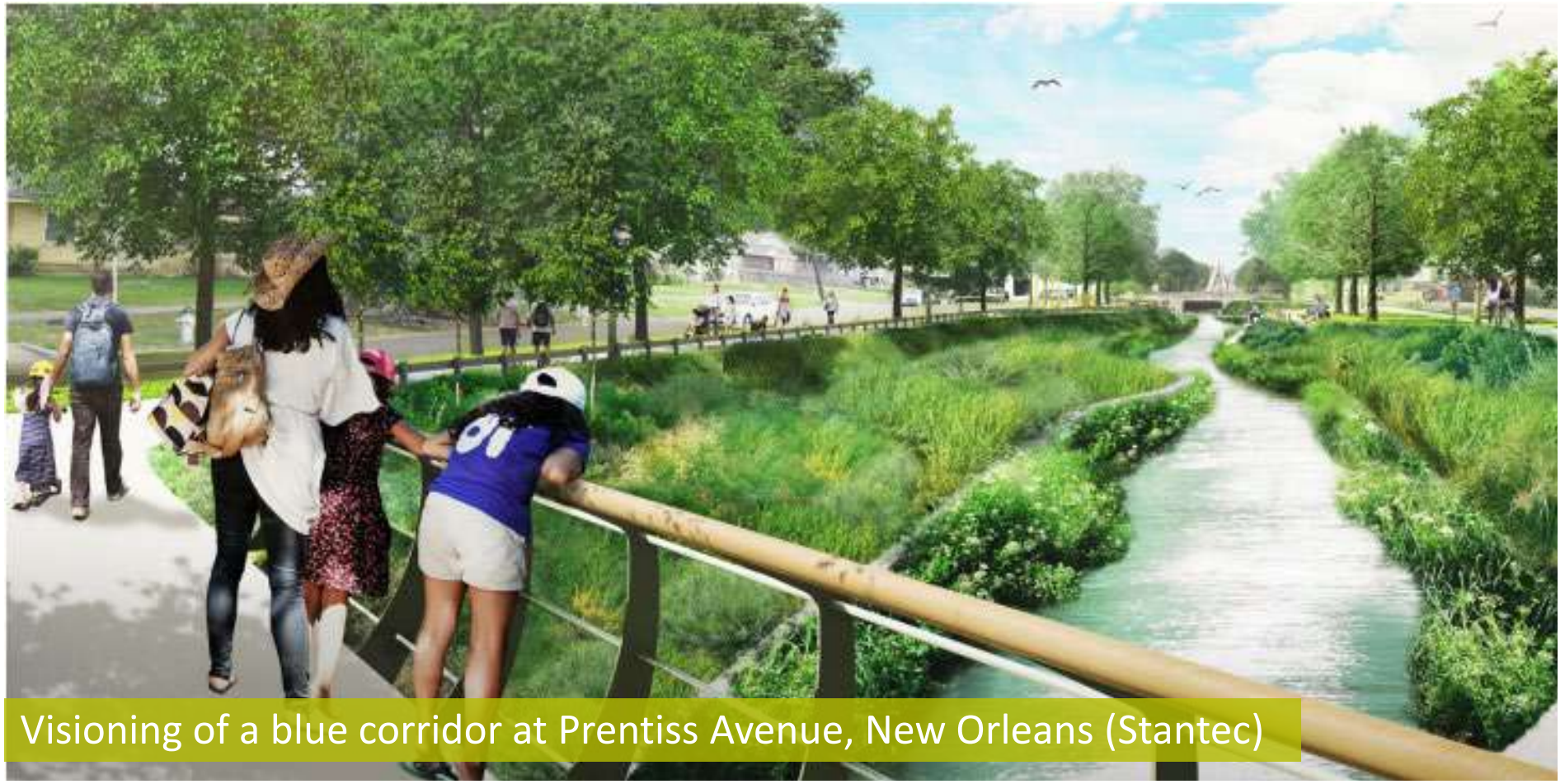
GI for transportation corridors

GI for transportation corridors

Infiltration pipes (Contech Engineered Solutions)

Treatment catch basins, Seattle

GI for transportation corridors



Visioning of a blue corridor at Prentiss Avenue, New Orleans (Stantec)

GI for transportation corridors

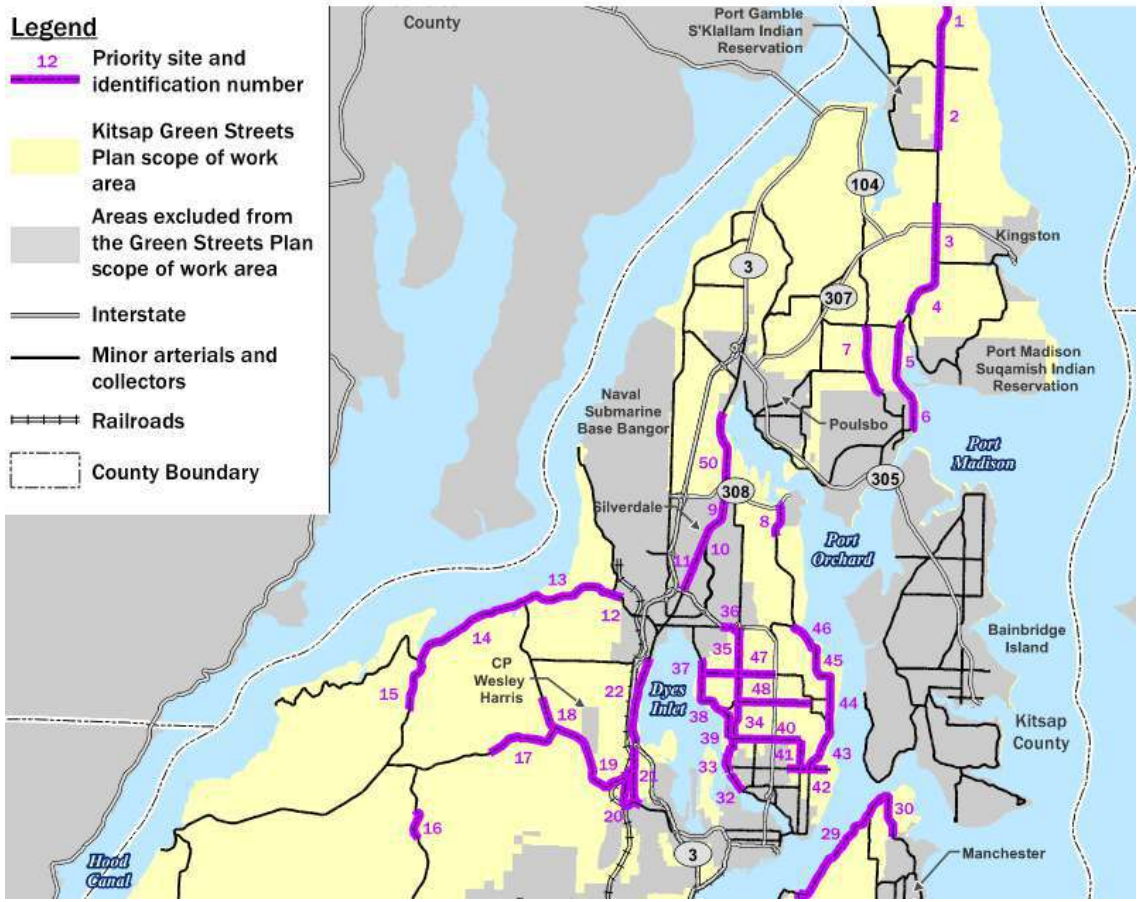
Visioning of a blue corridor, New Orleans (Stantec)

Feasibility analysis

KITSAP COUNTY WASHINGTON

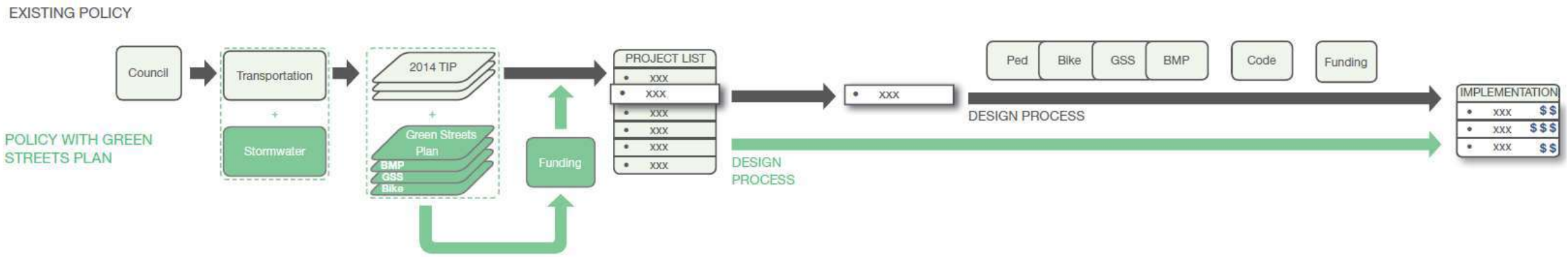
Clean Water Kitsap
Partners in Stormwater Solutions

http://www.kitsapgov.com/sswm/



Project goals

- Adhere to comprehensive plan and National Pollutant Discharge Elimination System permit
- Influence county policy, road standards and codes
- Identify suitable strategies for roads
- Create interdepartmental capital alignment
- Define operations and management responsibilities



Project goals

- Project prioritization process needed
  - Previous approach was opportunistic and funding-driven
- Maintenance clarification between roads and stormwater crews
- Additional facility design training
- Additional considerations:
  - Integrate comprehensive plan and code updates
  - Update road standards to support green street program

Introduce basic principles

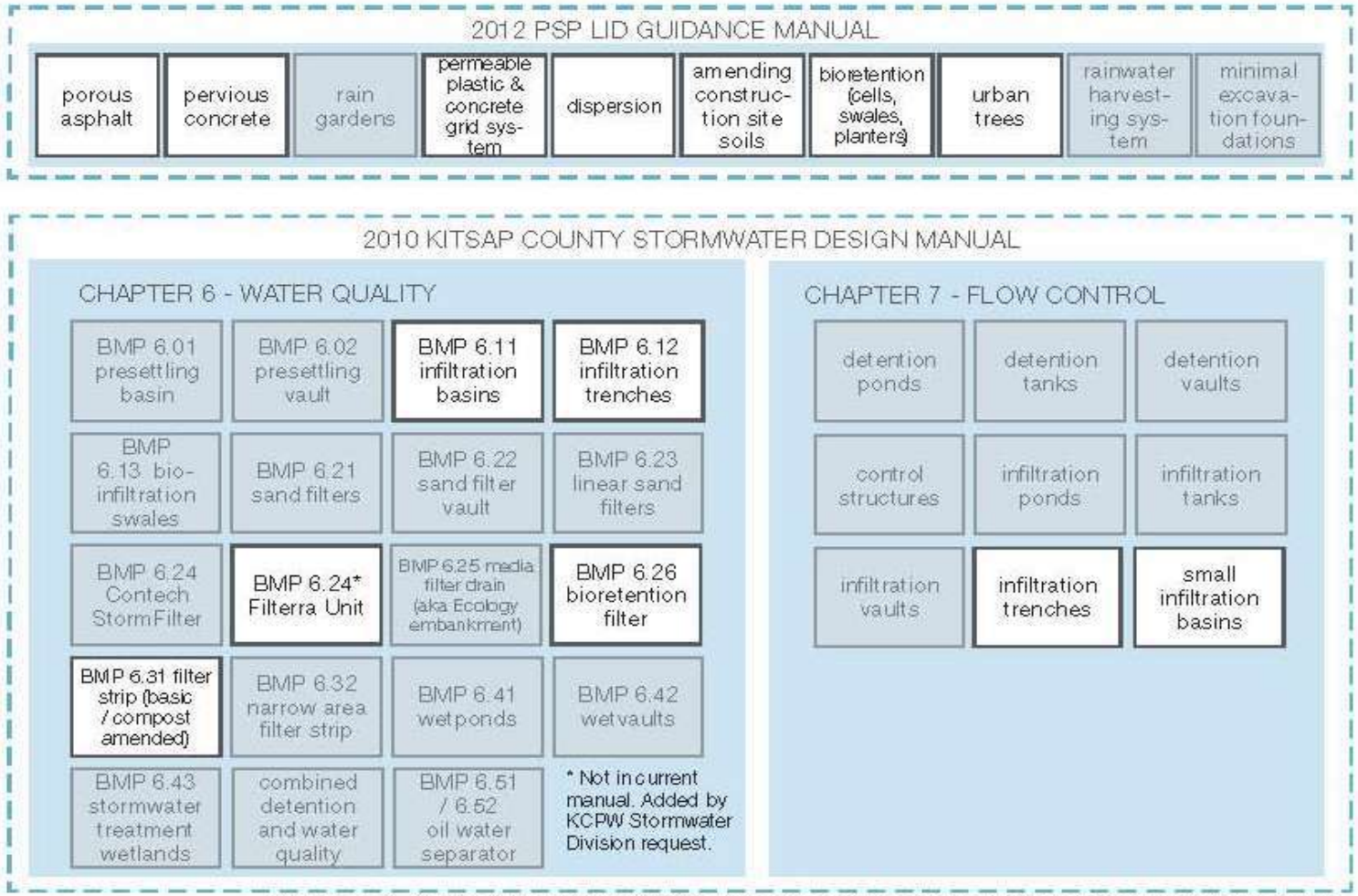


Figure 2.1. Applicable roadway GSS elements selected from LID and Stormwater strategies.

← Context-appropriate design elements for roadway corridors

Introduce basic principles

Table 2.2 GSS Strategy and Applicability for Posted Speed Limit
S=Slow Speed[1] (≤ 25 mph) **M**=Moderate Speed (30-35 mph) **H**=High Speed (≥ 40 mph)

GSS Strategy	Residential			Commercial/ Industrial/ Public Facility			Resource Land		
	S	M	H[2]	S	M	H	S[2]	M	H
Bioretention Swale, Shouldered Road	● [5]	●		● [5]	●	● [3]		●	● [3]
Bioretention Swale, Curbed Road	● [5]	●		● [5]	●				
Bioretention Planter, Curbed Road				● [5]	● [4]				
Bioretention Swale, Local Road Intersection	● [5]	●		● [5]	●	●		●	●
Permeable Pavement Shoulder, Conveyance to Existing Ditch	●	●		●	●	●		●	●
Permeable Pavement Shoulder, Infiltration Trench	●	●		●	●	●		●	●
Permeable Pavement Curbed Parking Lane, Infiltration Trench				●	●				
Filterra Unit, Curbed Road	●	● [4]		●	● [4]				
Small Infiltration Basin/Drywell/Subsurface Bioretention with Suspended Pavement System	●	● [4]		●	● [4]	● [4]		● [4]	● [4]
Basic Filter Strip	●	●		●	●	●		●	●
Roadside Ditch Enhancement	● [5]	●		● [5]	●	●		●	●
Amended Embankments and Slopes	● [5]	●		● [5]	●	●		●	●

Notes:
This table identifies GSS strategies that may be acceptable for siting along the roadway corridor based on adjacent zoning and the posted speed limit. All green street projects are to be reviewed with KCPW for appropriateness and context sensitive design. Roadside conditions (i.e. curbed vs. shouldered) and water quality treatment standards to be determined by the County Roads & Traffic Division.

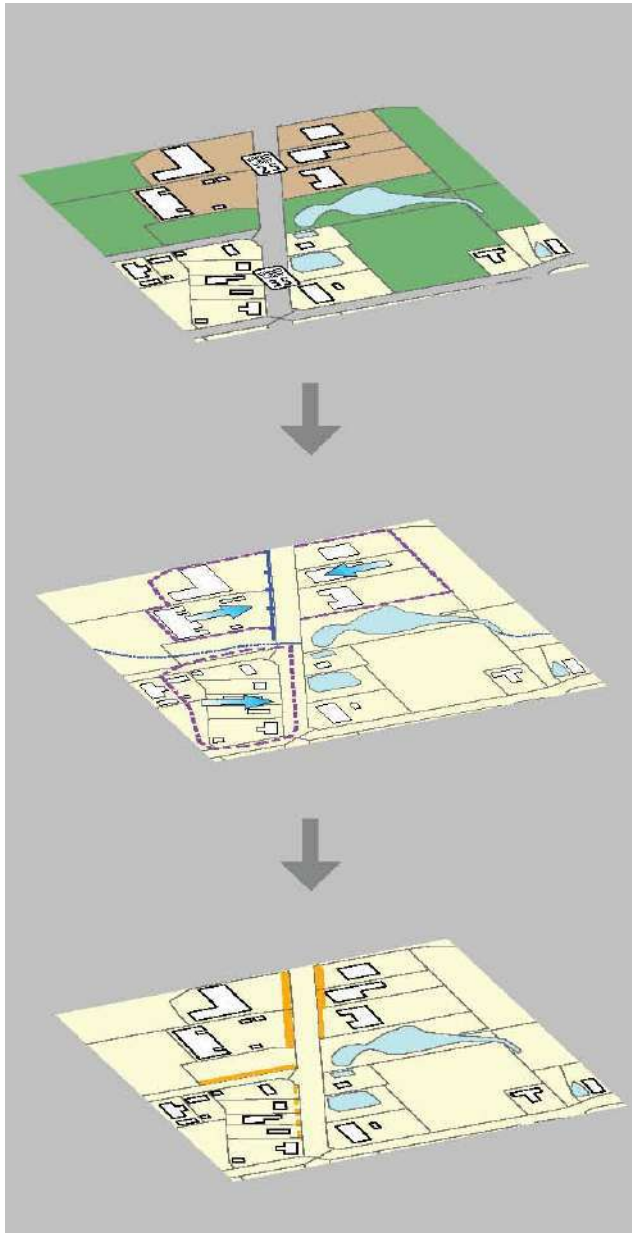
[1] Assumes slow speed roads to be designed with curbed roadsides, see also Notes above.
[2] Assumes road speed is not applicable for the adjacent zoning character.
[3] Assumes GSS strategy cross section works within existing ROW (no property acquisition).
[4] Requires project specific review and approval by the County Roads & Traffic Division.
[5] Indicates conditions more likely to incorporate tree canopy as an additional GSS layer.

← Acceptable strategies for siting along roadway corridor based on adjacent zoning and posted speed limit

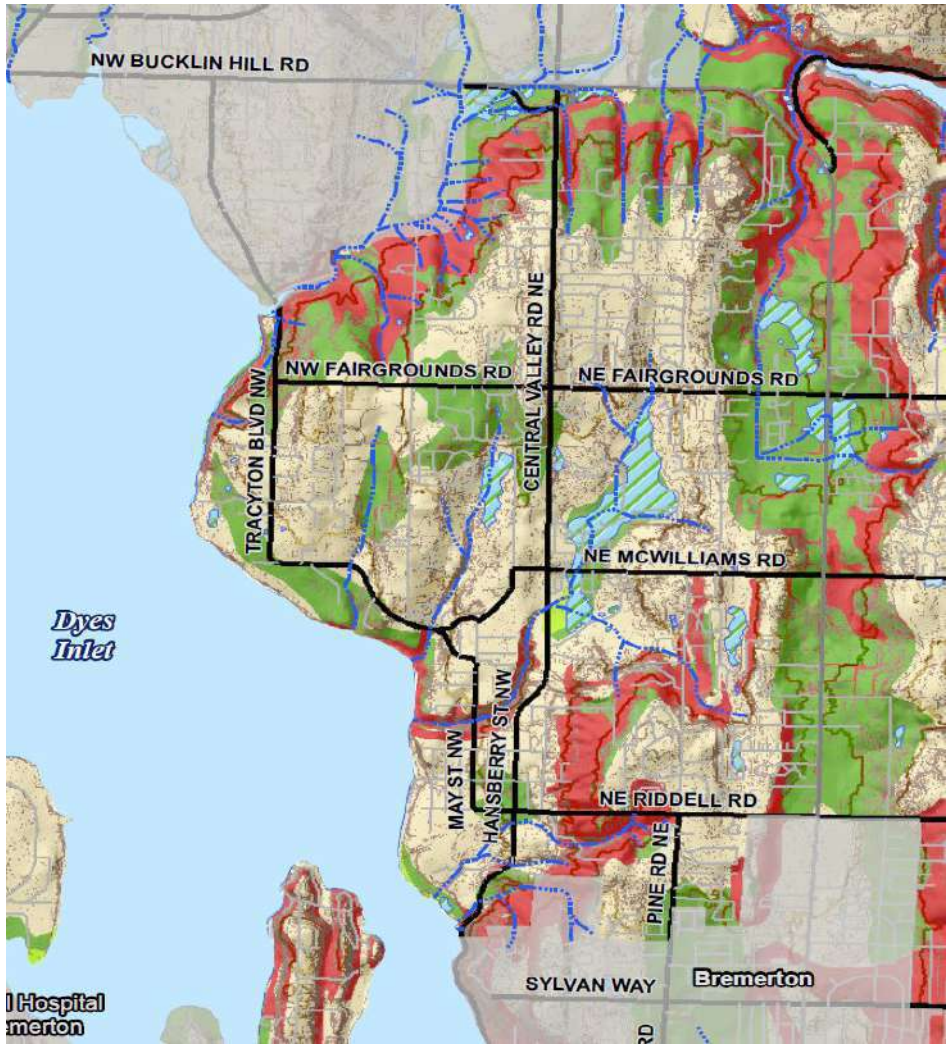
Corridor evaluation

Design Approach

- Step 1: Identify corridor characteristics
- Step 2: Verify stormwater infrastructure opportunities
- Step 3: Evaluate roadside and select green infrastructure solution

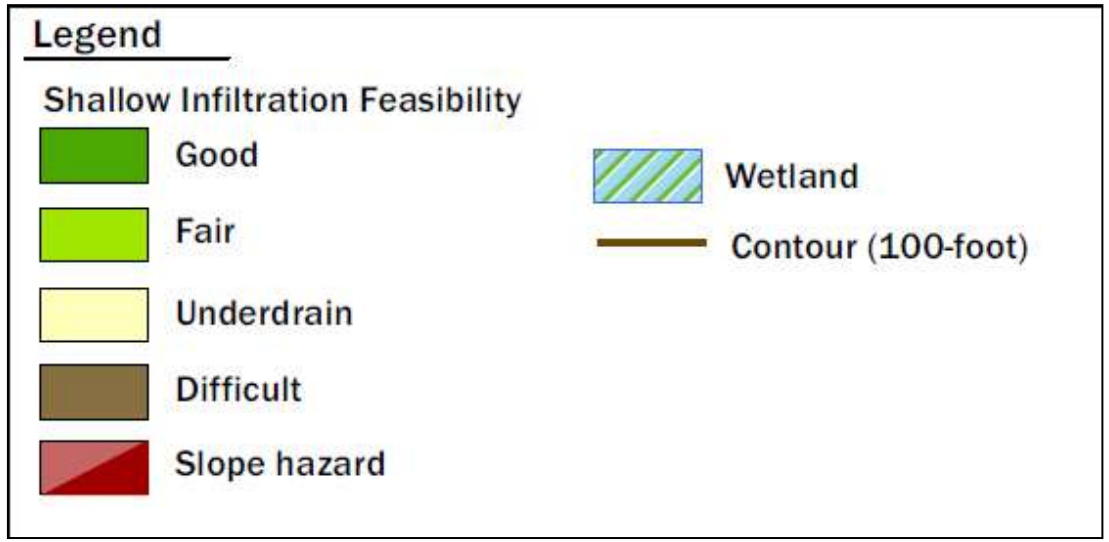


GIS-based planning level assessment



Subsurface/soils assessment

- Soils classification—infiltration assessment, stability
- Proximity of wetlands and streams
- Topography



Assessment

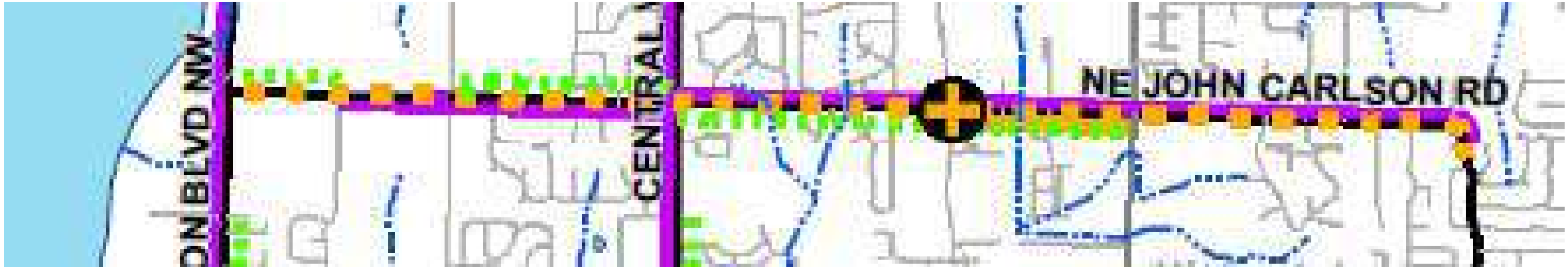
Transportation Planning

- Transportation Improvement Project (TIP)
- Capital Facilities Project (CFP)
- Regional priority bike route
- Shared use path
- 1/4-mile destination buffer

Destinations

Assessment

Transportation Safety



Assessment

Environmental Conditions

Opportunities and constraints mapping

Transportation Planning

+

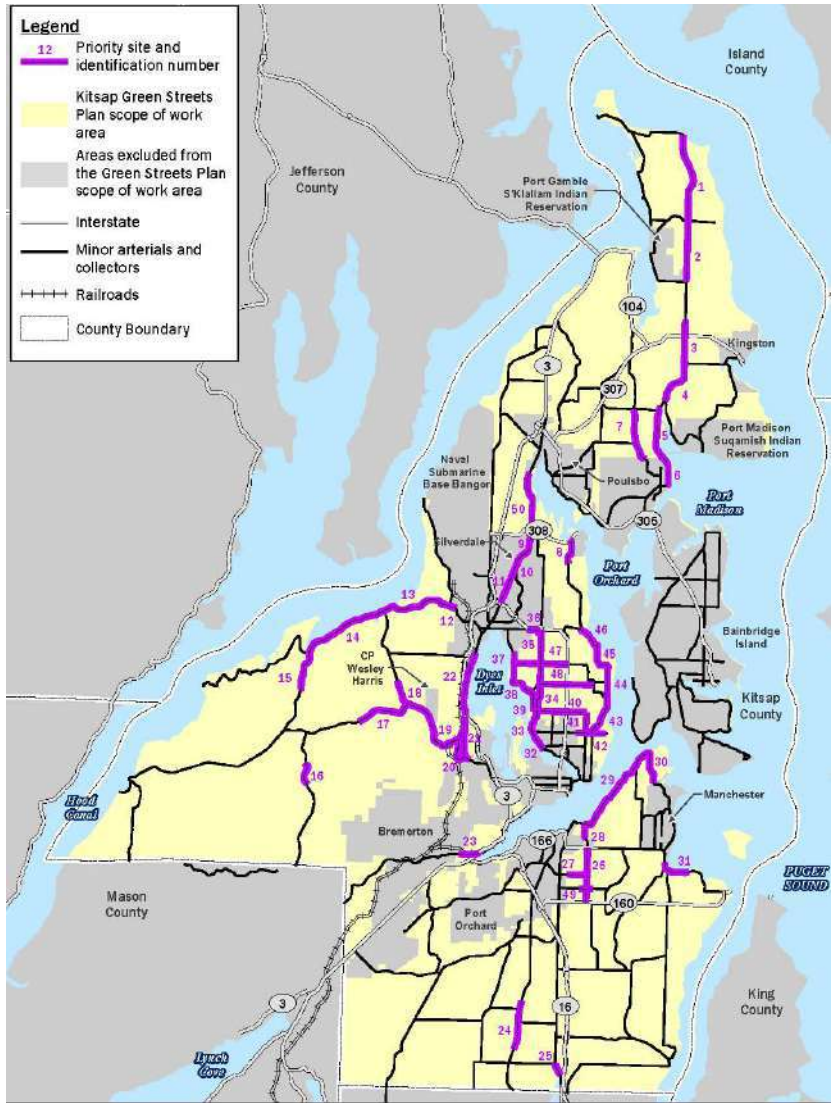
Transportation Safety

+

Environmental Conditions

=

Combined Scoring



Kitsap Green Streets Program
Green Stormwater Solutions Project Summary Sheet

Corridor Name: Silverdale Way NW ID #: 10

OVERVIEW

From:	Lone Maple Ln NW	**Speed Limit (mph):**	45
To:	NW Vasquez Way	**ADT (year):**	11507 (2006)
Functional Class:	Principal Arterial	**Length (miles):**	1
Zoning Character:	Residential	**ROW Width (feet):**	100

PROJECT DESCRIPTION

Existing Conditions:

Wide, heavily travelled road with existing roadway shoulders and varying but manageable roadside conditions for existing slopes and vegetation.

See back page for stormwater improvements

Corridor Challenges:

Roadside topography and slopes; removal of roadside vegetation; existing traffic speeds; proximity to critical areas

Vicinity Map

Site Photo

STORMWATER BENEFITS AND ESTIMATED PROJECT COST

Stormwater Water Quality Treatment Benefits	
TMDL Watershed:	Yes
Receiving Water:	Dyes Inlet
Total Suspended Solids (lb/yr):	1690
Dissolved Zinc (lb/yr):	1.67
Coliform (MPN in billions/yr):	115
Water Quality Treatment Standard:	Yes
Annual Volume Treated (%)	98.73%
Total Annual Volume Treated (ac-ft):	16.2

Project Details	Corridor Length (ft)	BMP Length/# (ft)
Bioretention Swale, Curbed Road:		
Bioretention Swale, Shouldered Road:	2,513	1,195
Permeable Pavement Shoulder to Infiltration Trench:		
Bioretention Swale, Local Road Intersection:		
Basic Filter Strip:	2,380	1,190
Amended Slopes and Ditch Enhancements:	1,444	1,444
Number of Small Basin Infiltration:		
Number of Filterra Units:	2,288	4

Stormwater Volume Reduction Benefits	
Annual Volume Reduction (%):	62.62%
Total Annual Volume Reduction (ac-ft):	10.3

Planning Level Project Costs	
Low Range Project Cost:	$526,000
High Range Project Cost:	$579,000

Note: The flow duration standard and the LID performance standard were not met for this project, but are not required to be met if the project is considered a retrofit project.

Date: 6-20-2014

Project costs include: Design, management, permitting, overhead and profit, design contingency, construction contingency, and sales tax.

SvR HERRERA

Kitsap Green Streets Program
Project Summary Sheet

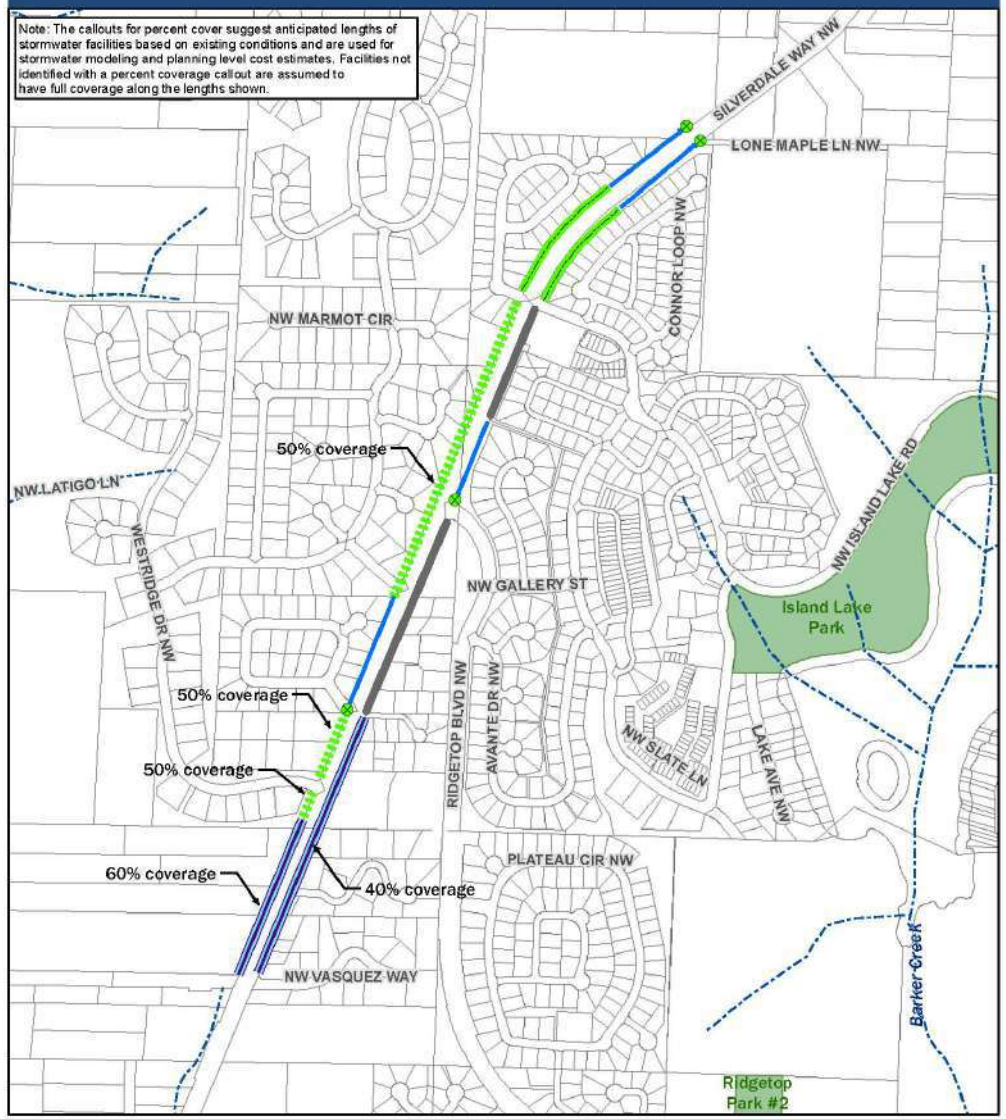
Corridor Name: Silverdale Way NW ID #: 10

From: Lone Maple Ln NW
To: NW Vasquez Way

0 375 750 Feet

Legend

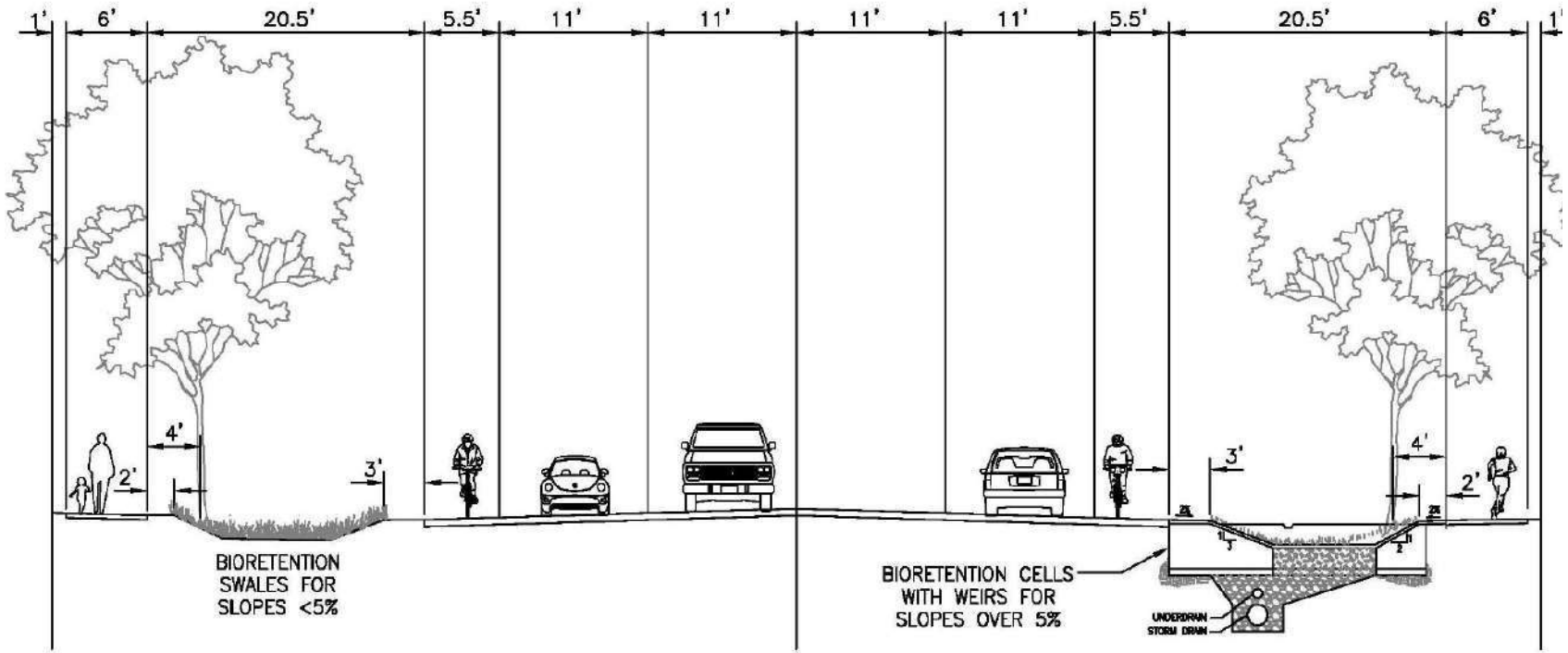
- Bioretention Swale, Shouldered Road
- Amended Slopes and Ditch Enhancements
- Basic Filter Strip
- No Improvements Due to Roadside Conditions/ Existing Stormwater Facilities



Moving beyond pilot projects

Updates to city standards

- Typical street sections
- Stormwater structures
- Performance



ESD SECTION – WIDER SIDEWALKS, ADD BIORETENTION
BASED ON: SUBURBAN ARTERIAL ROAD (DRAFT MC-2004.14)
OPEN SECTION: 4 LANES W/BIKE LANES

Complete Green Street Checklist

Please see attached sections and intersection perspective.

Street Feature (#)		General Street Feature Notes and Design Considerations	Specific Street Feature Design Considerations Based On Street Classification		Green Street Opportunity and Design Considerations
			Minor Arterial Cross Section (maximum two lanes each direction) Typical ROW width 80 feet - 100 feet	Local, Residential Street Cross Section (two lanes each direction) Typical ROW width 60 feet - 80feet	
1	Bicycle Facilities	Accommodate needs of bicycle traffic and install/implement facilities on designated bicycle routes in accordance with local, state, and federal guidelines and/or requirements.	Bike facilities and street markings can be incorporated within the travelway to indicate the presense of cyclists in the roadway.	Cyclists can typically share the road with motorized vehicles on roads with design speeds less than 25 mph. Sharrow markings or signage may be sufficient.	**Permeable Pavements:** Consider aggregate size in regards to surface texture. Edges/joints of permeable pavers may result in a rougher pavement surface for cyclists. Pavement material different from adjacent roadway helps to delineate bicycle lane from vehicular travel lane.
2	Bus Bulbs	Appropriate in locations with transit service in combination with on-street parking.	To provide opportunities to enhance bus waiting areas, incorporate shelters, benches, and trash/recycling receptacles and maintain clear pedestrian zones in the public sidewalk.	Not applicable.	**Permeable Pavements:** Where bus bulbs are adjacent to, or include street trees, permeable pavement provides opportunity to direct surface water to tree roots.
3	Curb Bulbs	Consider opportunities to incorporate or preserve significant trees, create enlarged gathering or planting areas, integrate natural drainage facilities, and provide traffic calming functions. Consider impacts to street operations and maintenance, such street sweeping/cleaning.	Appropriate at corners and mid-block where there is on-street parking; mid-block locations may be appropriate to support mid-block crossings.	Appropriate on streets with sufficient right of way and on-street parking.	**Permeable Pavements:** Consider for curb bulbs surfacing. **Biofiltration/Bioretention:** Curb cuts and lowered planting areas provide opportunities for bioretention and infiltration, as well as storage during larger storm events in vegetated biofiltration or bioinfiltration planters.
4	Curb Radius at Intersections	Curb radius should be sized to minimize crossing distances for pedestrians while maintaining required turning radii for buses, emergency vehicles, waste management vehicles and commercial deliveries. Choose appropriate design vehicle and consider potential impacts, or lack of impacts, where design vehicle turning movements cross lane lines.	Emphasis on incorporation of curb bulbs where on-street parking exists.	Small radii are encouraged to reduce speed of turning movements onto residential streets.	Curb bulbs along a corridor may reduce the contributing pollutant generating impervious surface. Consider use of permeable pavement to reduce impervious surface area.
5	Curb Ramps and Crosswalks	Curb ramps required at all intersections and in each direction. In accordance with local jurisdiction, ADA requirements, and PROWAG guidelines. Provide perpendicular ramps to maintain path of travel. Explore widening ramps to accommodate higher pedestrian volumes (i.e. near schools or parks).	Striped crosswalks recommended across the arterial.	Striped crosswalks not required at uncontrolled intersections.	**Permeable Pavements:** Consider use of permeable pavement in crosswalks to reduce impervious surface area and provide contrast between crosswalk and adjacent roadway pavement. To meet ADA requirements, curb ramps will likely have to be constructed with impervious concrete.
6	Curb or Curb and Gutter	Minimum curb height as requried by local guidelines. Maintain continuous curb height to minimize tripping hazards.	Appropriate along minor arterials especially with parking and/or bus stops to prevent the vehicles from encroaching on the pedestrian area.	Optional adjacent to single family uses; encouraged adjacent to non-single family uses (e.g. parks, community centers, schools)	**Permeable pavements:** Consider for the gutter line in locations which will receive water with lower total suspended solid levele. Explore opportunities to incorporate curb cuts or flush curbs to integrate natural drainage facilities, improve accessibility or provide flexibility to streetscape.

- Street features
  - Bicycle facilities
  - Bulbs (bus, curb)
  - Curb/curb and gutter
  - Landscape zones
- General design considerations
- Design considerations based on street classification
- Green infrastructure opportunities and considerations

MOVEBR PROGRAM CASE STUDY

Tom Stephens, PE

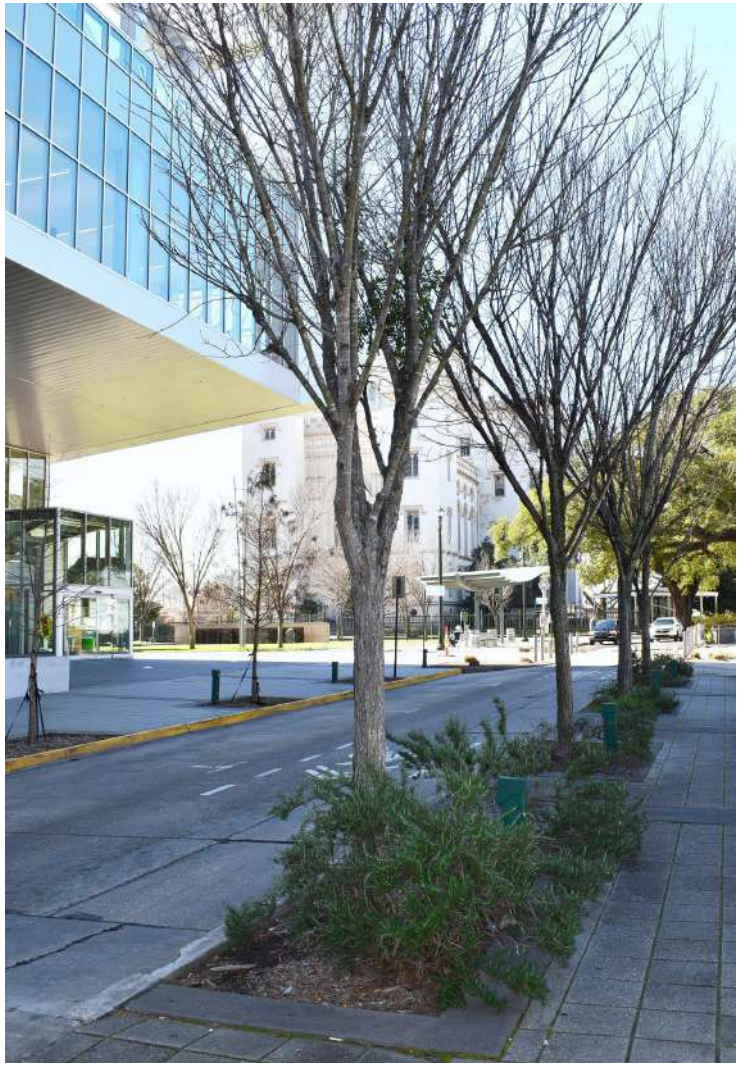
CHIEF DESIGN AND CONSTRUCTION ENGINEER, EAST BATON ROUGE PARISH DEPARTMENT OF PUBLIC WORKS

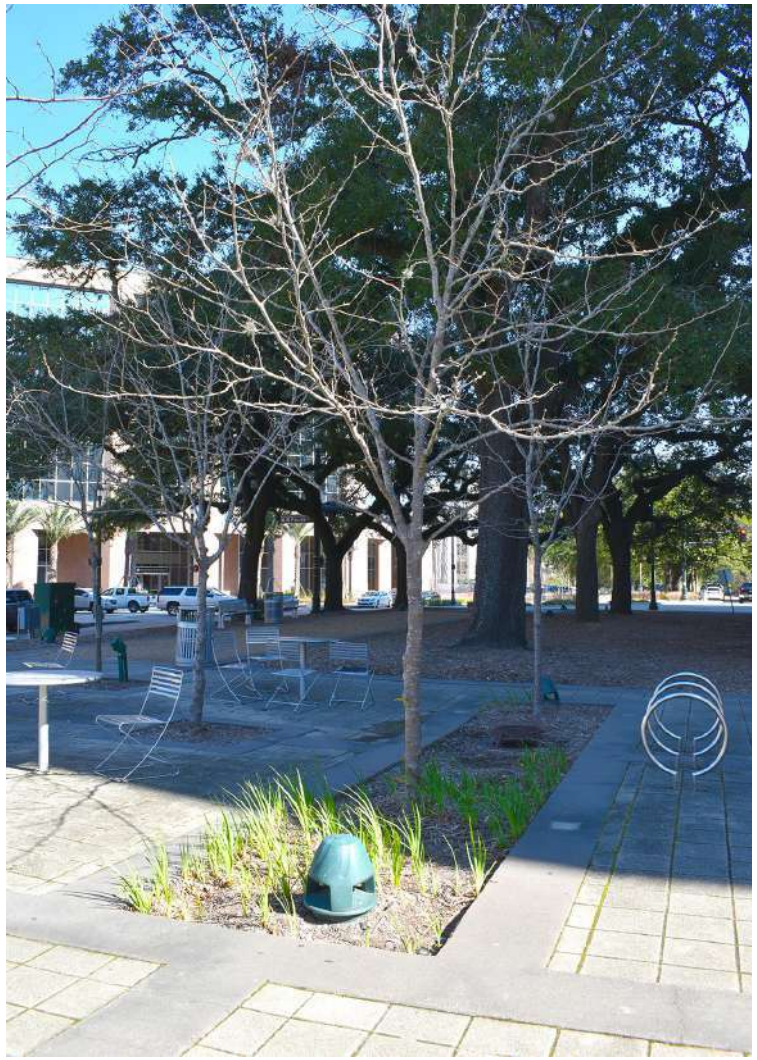
Tom Stephens has more than 40 years of experience in civil and structural engineering, including the design of industrial, commercial and residential buildings; local streets and highways; bridges and bridge hydraulic studies; and other projects. He is a member of the leadership team overseeing the $1.3 billion MOVEBR transportation improvement program.


MOVEBR

Constructed streetscapes

- Green infrastructure installations include tree wells and rain gardens along roadways and walking paths.





Vision statement

MOVEBR will be the industry standard of excellence in delivering transportation solutions that will move our region in a safe, sustainable manner and further enhance strong neighborhoods, communities and economic vitality for all residents of East Baton Rouge Parish.

Program overview

- Launched April 1, 2019, and continues through March 31, 2049
- Funded by a half-cent sales tax for 30 years
  - Food and medical prescriptions exempt
- Total $1 billion investment
- Can ONLY be spent on APPROVED list of projects

Projects

Type of Project	Proposition Funding	Estimated Cost
40 capacity improvements	$636.2 million	$805.5 million
12 corridor improvements	$170 million	$204 million
10 community enhancement road projects+	$65.8 million	$68.6 million
Parishwide signal synchronization*	$40 million	$40 million
Total	**$912 million**	**$1,118.1 billion**

+ $49 million for community enhancement projects and $10 million for ADA compliance

* Parishwide projects

MOVEBR

Infrastructure Enhancement and Traffic Mitigation Program

Design Guidelines

BR

CITY OF BATON ROUGE
PARISH OF EAST BATON ROUGE

Department of Transportation and Drainage

Submitted by

MOVEBR PROGRAM MANAGEMENT TEAM

Capacity Improvements – CSRS
Community Enhancements – Stantec

***Revised* May 2020**

11 Green Infrastructure

11.1. Overview

Green infrastructure is a resilient approach to managing stormwater runoff that aims to protect, restore, and mimic the natural water cycle. Green Infrastructure employs vegetated, nature-based practices that are engineered to increase infiltration, evapotranspiration and transpiration to enhance water quality. The traditional approach to stormwater management focuses on collecting stormwater runoff in a closed pipe network and conveying it away from developed areas to be managed elsewhere. Conversely, Green Infrastructure aims to treat stormwater as a resource and to manage stormwater runoff at its source with vegetated practices and storage systems. In this way, Green Infrastructure provides social and environmental benefits beyond stormwater management, such as improved air and water quality, improved habitat, reduced surface temperature and urban heat island effect, and improved health outcomes. In addition, Green Infrastructure can be used to optimize the storage capacity of existing infrastructure, while providing an amenity with aesthetic value.

As part of the project delivery process, a diverse group of planners and engineers were consulted, including the PMT and associated experts, BREC, and Baton Rouge Green, to develop guidance on Green Infrastructure uses and installation. The *EBR Stormwater Drainage Masterplan and Stormwater Best Management Practices for East Baton Rouge Parish – Master Development Program* were also referenced during the development of this guidance.

11.2. Planning for Green Infrastructure

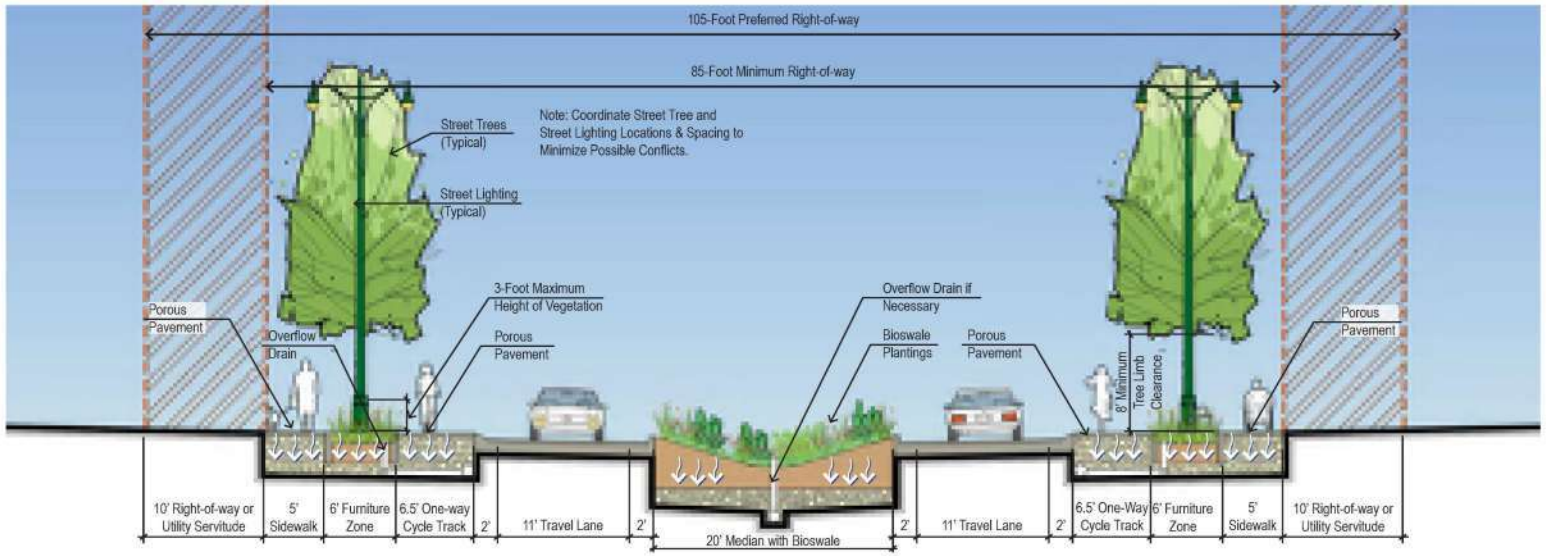
Planning for Green Infrastructure helps to identify and prioritize project opportunities, but also to identify potential stakeholders. As these projects are located within the public ROW, project stakeholders could include, but are not limited to, adjacent property owners, community groups and organizations, utility companies, other local or state agencies, and private organizations. Engaging these stakeholders early in the process will contribute to the long-term success of the systems and practices utilized throughout the life of the MOVEBR Program.

11.2.1. Planning Strategy and Approach

All planning efforts should be completed within the Design Study phase. The main objectives of the planning process are to identify and prioritize Green Infrastructure opportunity areas and stakeholders and to provide recommendations for Green Infrastructure implementation.

Standard typical sections

- Revised typical street sections to include green infrastructure



SUBURBAN 2-LANE (Option 2: With Median Bioswale)

SCALE: 1/8" = 1'-0"

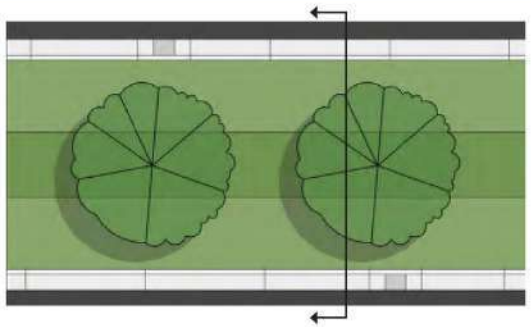
MOBILITY	ACCESS	DESIGN VEHICLE	DESIGN SPEED	LANE WIDTH	SHOULDERS	FURNITURE ZONE	BIKE FACILITY	PEDESTRIAN	CROSS SLOPE	MEDIAN WIDTH	MEDIAN OPENING SPACING
Medium	Medium	SU	30-MPH	11-Feet	2-Foot (Edge of Travel Lane to BOC; Curb and Gutter)	6-Foot Preferred; Rain Garden Preferred; 1.5-Foot Minimum Lateral offset for Fixed Objects	6-Foot 6-Inches One-way Cycle Track	5-Foot Wide Sidewalk	2.0%	20-Foot Wide Preferred	0.5-Mile With Offset Lefts

TYPICAL SECTIONS
November 7, 2019
Sheet 5

MOVEBR

Median Bioswale

1. Site-specific vegetation filters and transpires stormwater while enhancing the streetscape
2. Engineered soil media filters stormwater and provides environment for vegetation to grow
3. Stormwater runoff from roadway and sidewalk flows into system through curb cuts and catch basins*
4. Drainage rock, soil, or modular storage system provides stormwater storage
5. Overflow limits amount of surface ponding, connected to traditional infrastructure
6. Underdrain ensures proper drain-down of stormwater runoff, connected to traditional infrastructure
7. Stormwater infiltrates into subgrade
8. Leveled subgrade



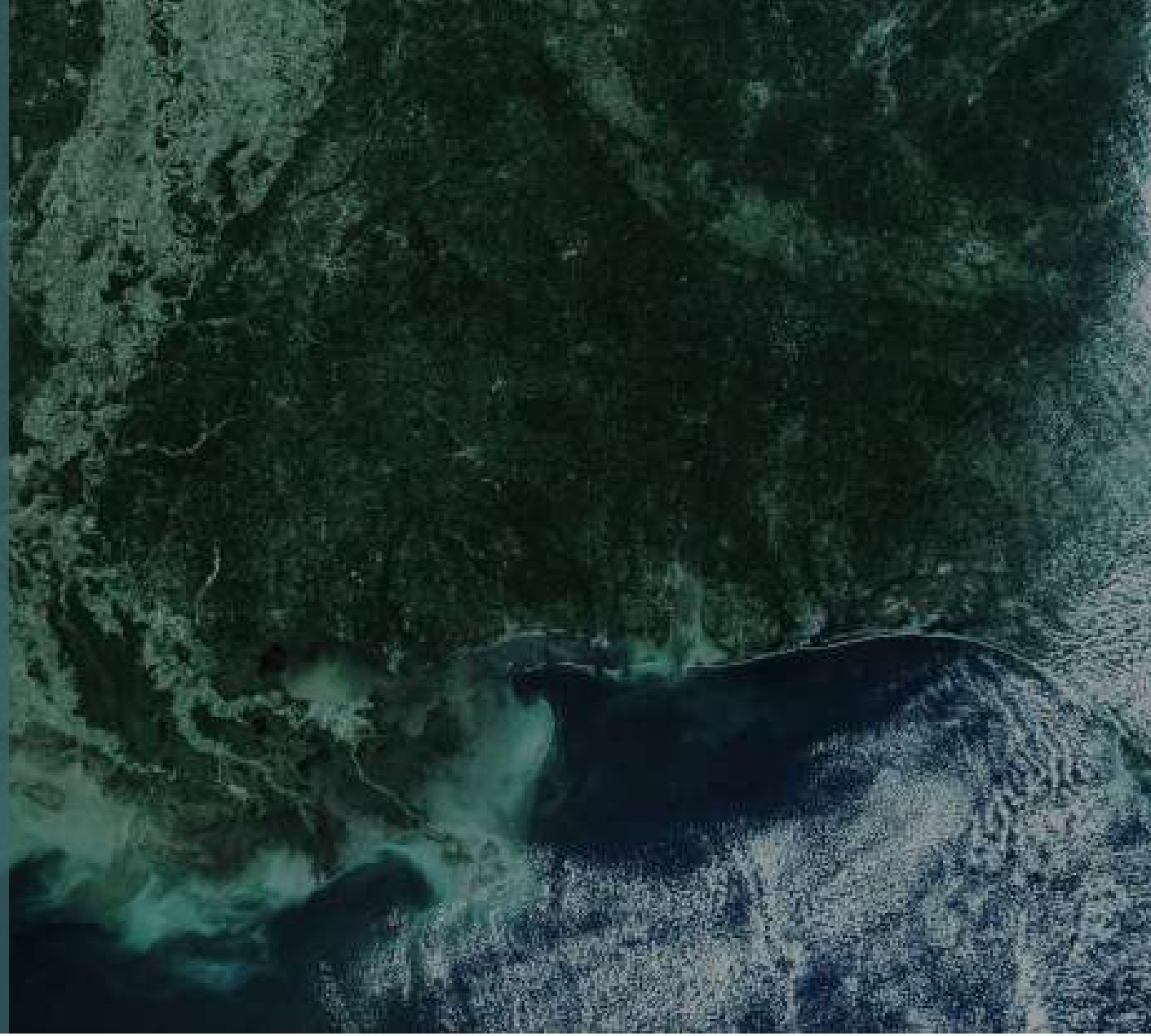
Alternate Planting Design

*Refer to the Complete Streets Typical Sections for application of roadway features adjacent to the proposed travel lanes for various context applications.

For more information, visit movebr.brla.gov.

@movebrla

QUESTIONS?



CONTACT INFORMATION

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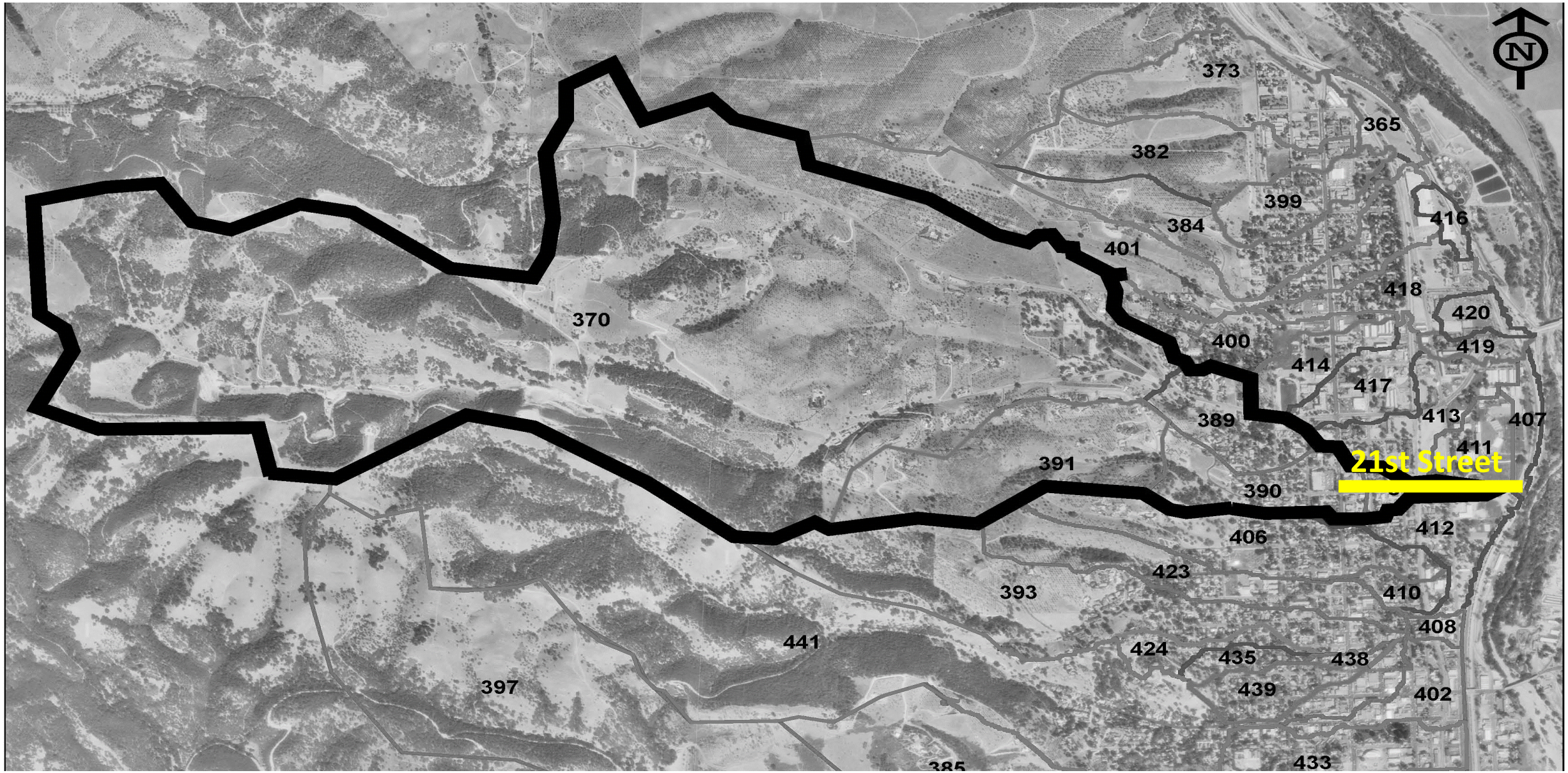
21st Street, Paso Robles, case study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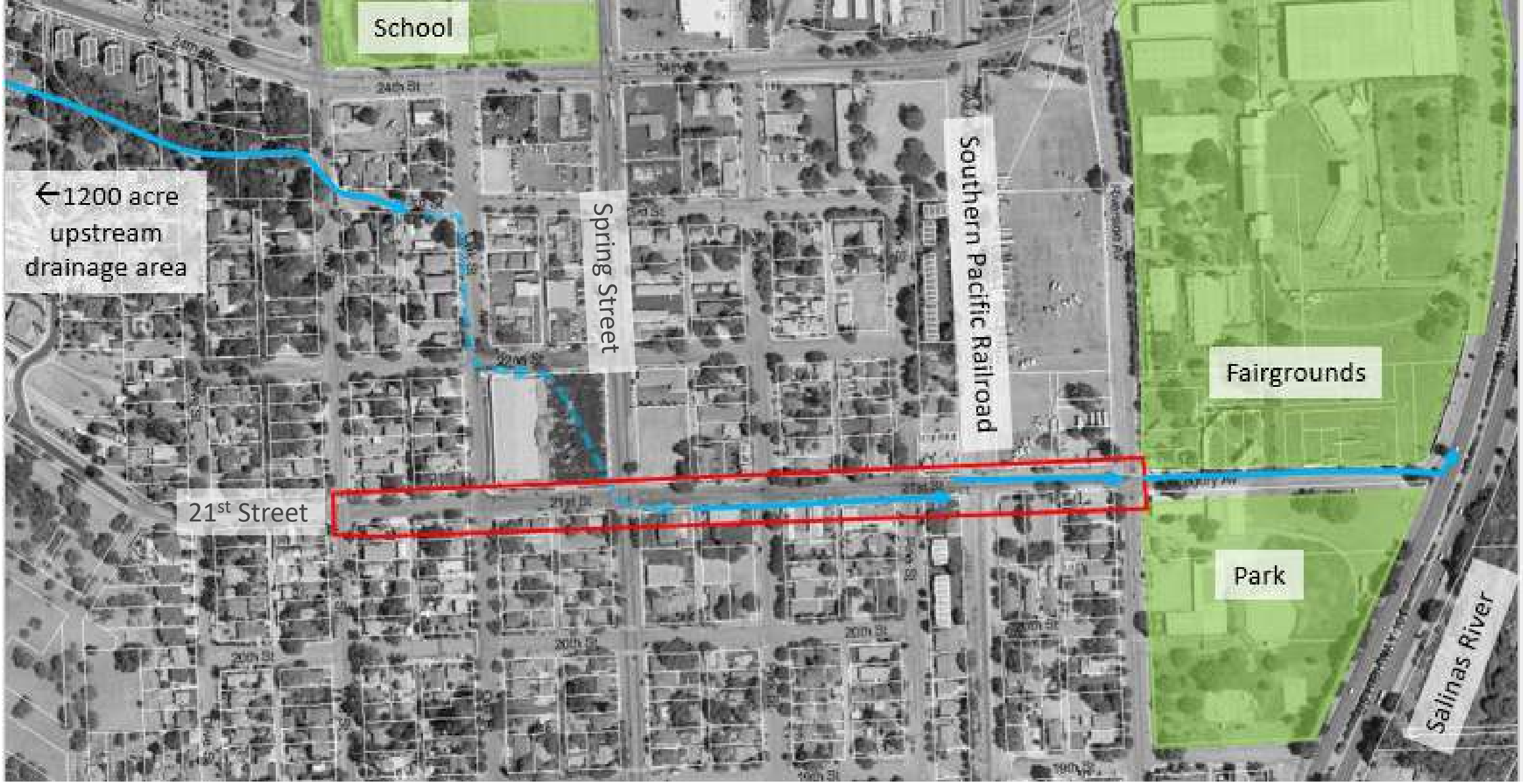
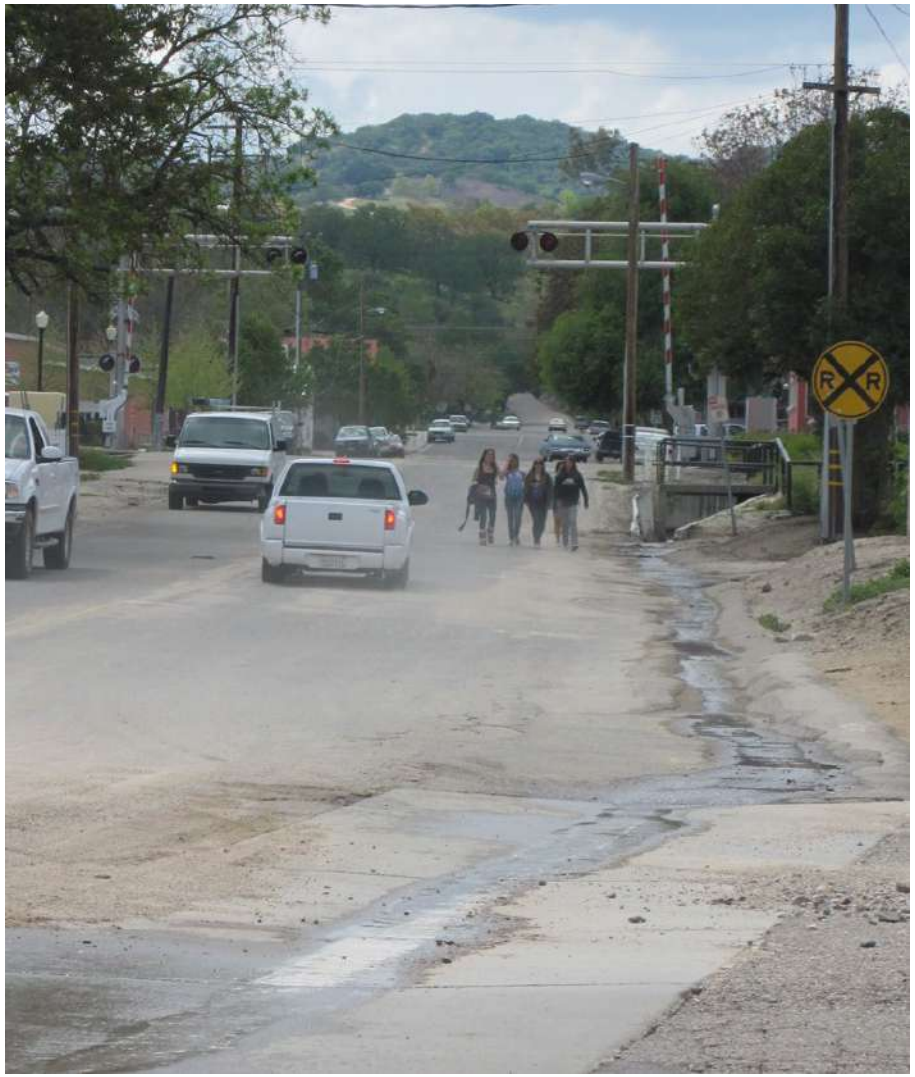

School
←1200 acre upstream drainage area
Spring Street
Southern Pacific Railroad
Fairgrounds
21st Street
Park
Salinas River


Salinas River

Project catalyst

1.6-inch rain event—Jan. 20, 2010

Project catalyst



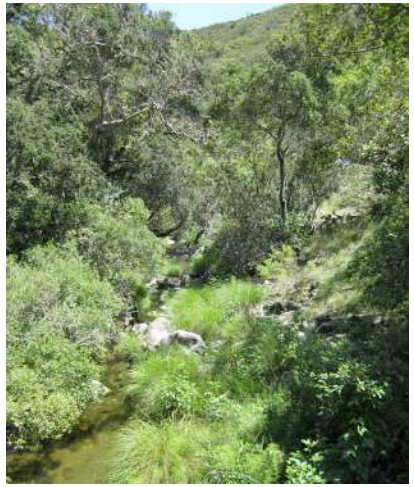
- Incomplete pedestrian facilities
- Poor pavement conditions

Engagement

- Reduce the 85th percentile speed (31 mph) by 30%
- No increase in traffic accidents
- Increase pedestrian and bicycle miles traveled by 200% by 2015
- Capture and infiltrate runoff from 90% of storm events
- Maintain existing trees and establish at least 60 new street trees
- Increase cumulative value of properties fronting 21st Street by 20%

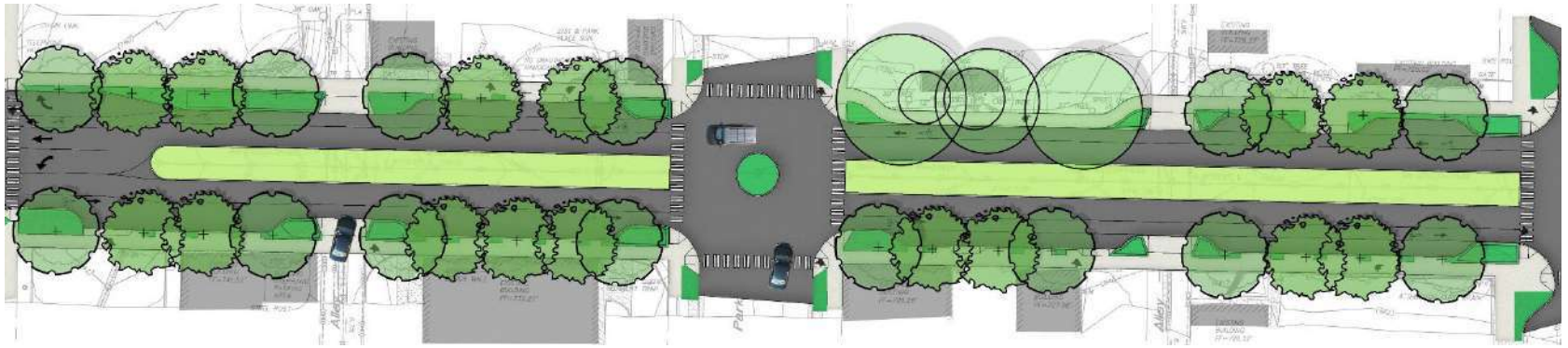
Concept design

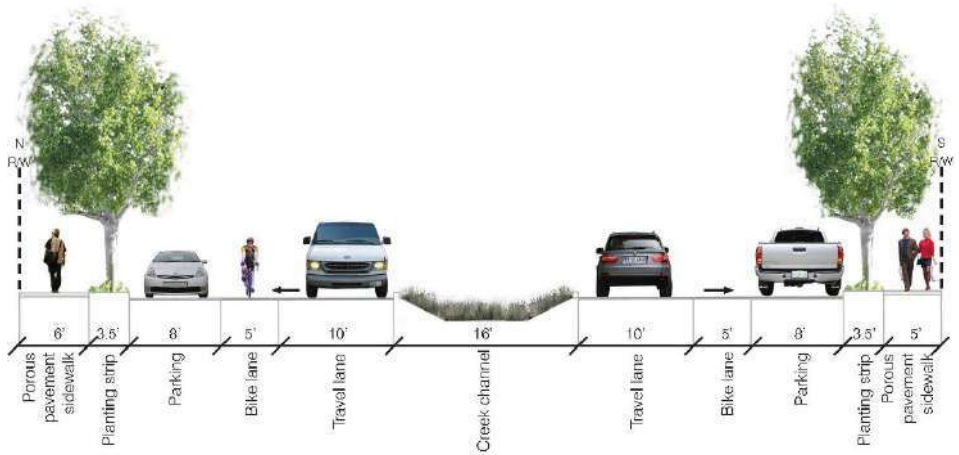
Form and material references



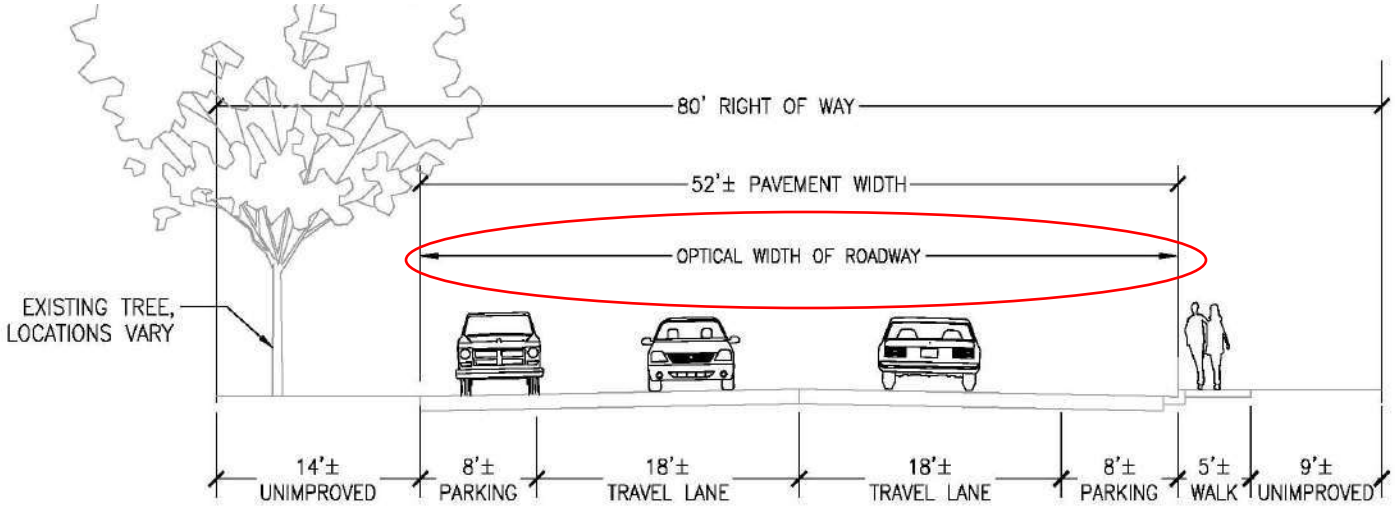
Landscape character

Concept design

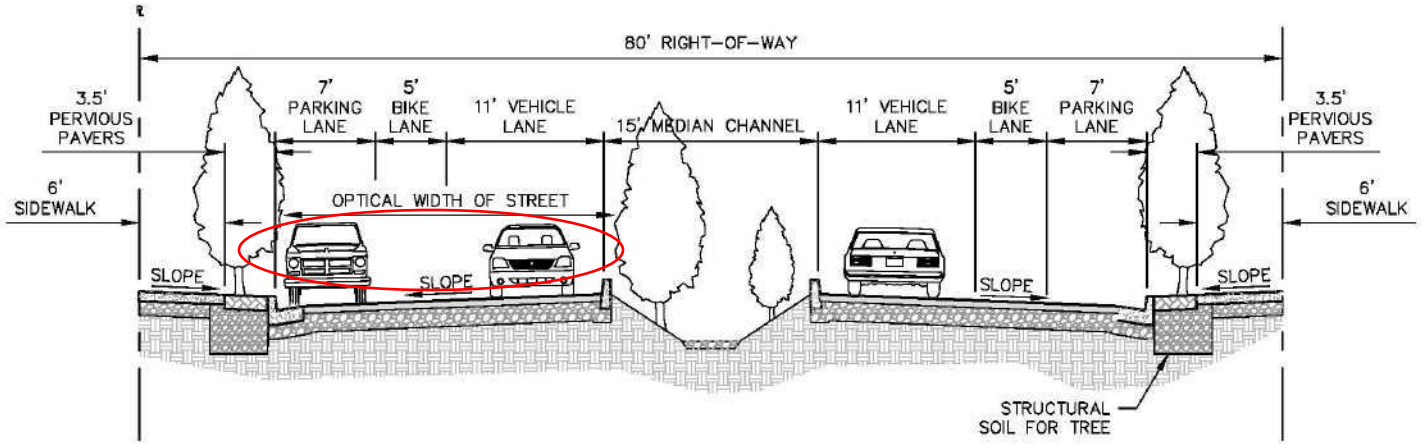




Complete + green streets



EXISTING TYPICAL STREET CROSS SECTION



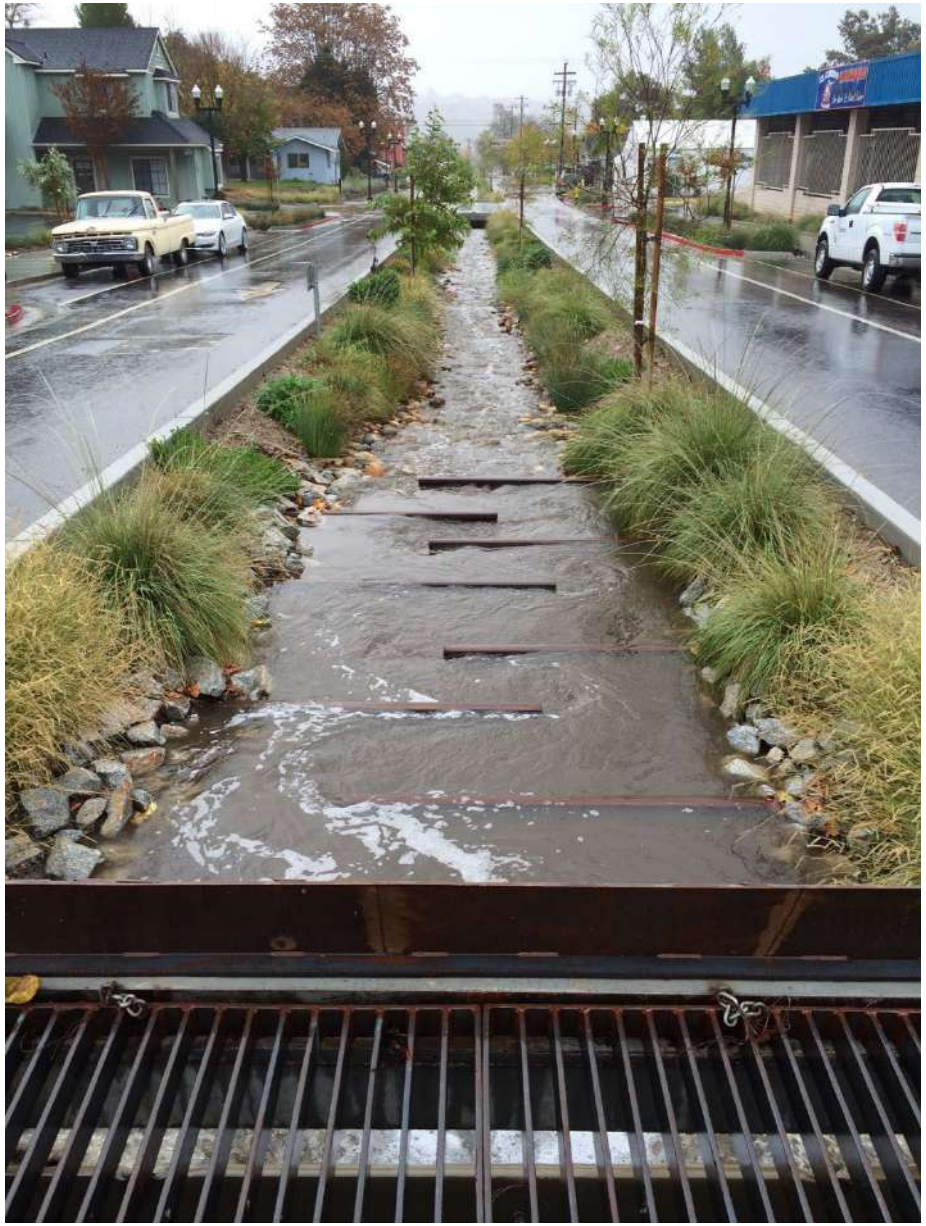
PROPOSED TYPICAL STREET CROSS SECTION

Complete Street principles

Complete Street principles

Integrating green street elements

Urban stream channel (high flow bypass)

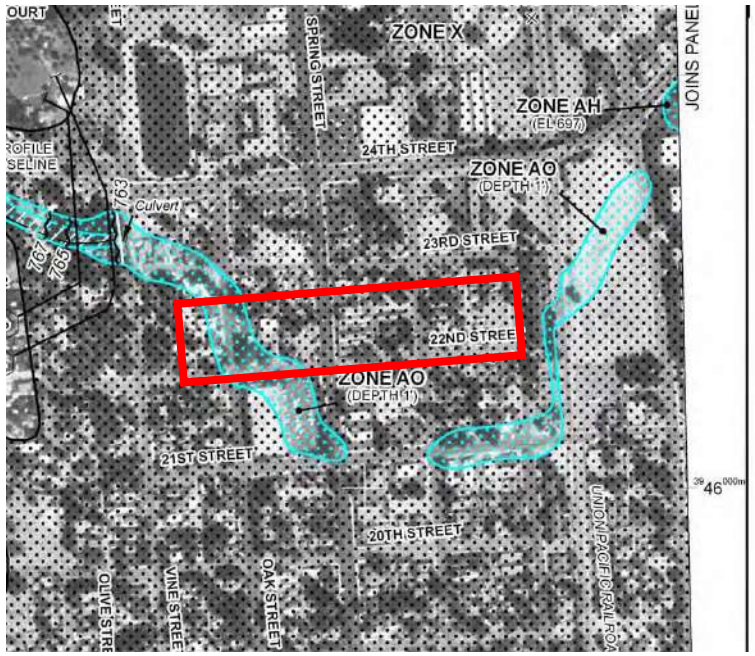


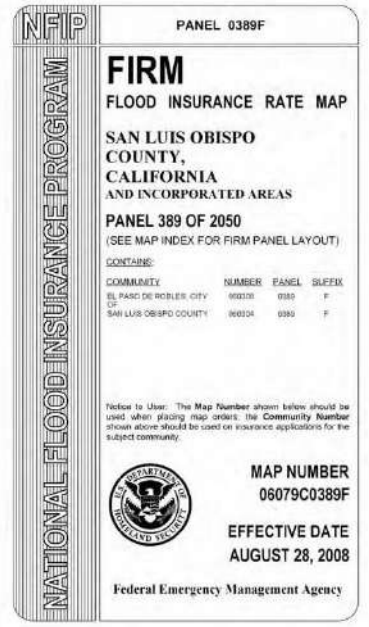
Challenges: right-of-way constraints

Challenges: channel establishment

21st Street, Paso Robles

- 7 mph reduction in 85th percentile speed (31 mph to 24 mph)
- No new traffic accidents
- Anecdotal evidence suggests increase in nonmotorized use
- Less frequent and less severe flooding (2.3 inches of rain/24 hours, Dec. 12)
- Groundwater recharge (50,000 gallons per 0.5-inch rain event)
- Goal to redraw FEMA's 100-year floodplain boundary
- 73 new street trees





Metrics and evaluation

21st Street, Paso Robles

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THANK YOU

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