WORKING WITH NATURE
TRAINING SERIES

FEB. 16, 2022

Nature-based solutions in roadway projects and programs
AGENDA

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

- Increased non-motorized opportunities
- LED traffic signals
- PV cell powered lighting
- Recycled pavement
- Utilize local materials

COMMUNITY

- Multifunctional street
- Streetside gathering space
- Public art elements
- Street plaza
- Wheel bumper seat
- Transit stops
- Midblock crossing zone
- Streetside pedestrian refugia

MOBILITY

- Continuous sidewalks
- Bike lanes / sharrows

HABITAT

- Tree canopy
- Urban forest understory
- Porous paving
- Stormwater planter
- Conveyance runnel

WATER

- Rain garden
- Streetside cisterns
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.)
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

- Pervious street
- Pervious parking lane
- Pervious bike lane
- Porous street
- Permeable parking
- Permeable walk
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
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

Context-appropriate design elements for roadway corridors
### Table 2.2: GSS Strategy and Applicability for Posted Speed Limit

<table>
<thead>
<tr>
<th>GSS Strategy</th>
<th>Residential</th>
<th>Commercial/Industrial/Public Facility</th>
<th>Resource Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention Swale, Shouldered Road</td>
<td>*</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>Bioretention Swale, Curbed Road</td>
<td>*</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>Bioretention Planter, Curbed Road</td>
<td>*</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>Bioretention Swale, Local Road Intersection</td>
<td>*</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>Permeable Pavement Shoulder, Conveyance to Existing Ditch</td>
<td>*</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>Permeable Pavement Shoulder, Infiltration Trench</td>
<td>*</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>Permeable Pavement Curbed Parking Lane, Infiltration Trench</td>
<td>*</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>Filterra Unit, Curbed Road</td>
<td>*</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>Small Infiltration Basin/Drywell/Subsurface Bioretention with Suspended Pavement System</td>
<td>*</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>Basalt Filter Strip</td>
<td>*</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>Roadside Ditch Enhancement</td>
<td>*</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>Amended Embankments and Slopes</td>
<td>*</td>
<td>*</td>
<td>***</td>
</tr>
</tbody>
</table>

**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 Note 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
WORKING TOGETHER FOR SUSTAINABILITY AND RESILIENCE
LOUISIANA WATERSHED INITIATIVE

OVERVIEW

From: Lone Maple Ln NW
To: NW Vasquez Way
Functional Class: Principal Arterial
Zoning Character: Residential

Stromwater Water Quality Treatment Benefits

<table>
<thead>
<tr>
<th>Benefit Description</th>
<th>Project Details</th>
<th>Corridor Length (ft)</th>
<th>SWPPP Length (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Suspended Solids (lbs/yr)</td>
<td>690</td>
<td>2,313</td>
<td>1,895</td>
</tr>
<tr>
<td>GPM (MPN in 1000s/l)</td>
<td>315</td>
<td>2,160</td>
<td>1,590</td>
</tr>
<tr>
<td>Water Quality Treatment Standard</td>
<td>Yes</td>
<td>1,444</td>
<td>1,444</td>
</tr>
<tr>
<td>Annual Volume Treated (%)</td>
<td>96.7%</td>
<td>2,288</td>
<td>2,288</td>
</tr>
</tbody>
</table>

Stormwater Volume Reduction Benefits

<table>
<thead>
<tr>
<th>Benefit Description</th>
<th>Cost Summary</th>
</tr>
</thead>
</table>
| Annual Volume Reduction (sft)            | Low Range Project Cost: $146,000
                                             High Range Project Cost: $176,000 |

Note: The cost estimate includes: Design, development, permitting, construction and engineering, construction contingencies, and sales tax.

See back page for stormwater improvements.

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

Legend:
- Bioretention Swale, Curbed Road
- Bioretention Swale, Shouldered Road
- Permeable Pavement Shoulder, Infiltration Trench
- Grassed Swale, Local Road Intersection
- Basic Filter Strip
- Amended Shores and Ditch Enhancements

60% Coverage
50% Coverage
40% Coverage
50% Coverage
60% Coverage

In order to develop the Stormwater Green Streets Program, this project would need to be modified. The Stormwater Green Streets Program is currently being implemented on a phased basis, allowing for improvements to be developed in a manner that is consistent with community expectations and priorities.
Moving beyond pilot projects

Updates to city standards

- Typical street sections
- Stormwater structures
- Performance
### Complete Green Street Checklist

**Working Together for Sustainability and Resilience**

**Louisiana Watershed Initiative**

<table>
<thead>
<tr>
<th>Street Feature</th>
<th>General Street Feature Notes and Design Considerations</th>
<th>Specific Street Feature Design Considerations Based On Street Classification</th>
<th>Green Street Opportunity and Design Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Bicycle Facilities</td>
<td>Accommodate needs of bicycle traffic and pedestrians, established by local, state, federal guidelines and design requirements. Bicycle facilities and street layouts can be incorporated within the roadway to include the presence of cyclists in the median. Bicycle facilities can typically share the road with motorized vehicles on routes with design speeds less than 25 mph. Shoulder lane or signage may be sufficient.</td>
<td>Include features such as bicycle facilities, bicycle lanes, and bike racks.</td>
<td>Promote bicycle use by designing bike lanes and bike racks.</td>
</tr>
<tr>
<td>2 Bus Bulb</td>
<td>Applicable in locations with narrow sidewalk, in combination with on-street parking. To provide opportunities to enhance bus waiting areas, incorporate shelters, benches, and landscaping.</td>
<td>Appropriate at corners and mid-block where there is on-street parking; mid-block locations may be appropriate for mid-block crossings.</td>
<td>Promote bus use by creating comfortable waiting areas.</td>
</tr>
<tr>
<td>3 Curb Bulb</td>
<td>Construct opportunities to incorporate or prevent specific pedestrian crossings, create a legible pedestrian waiting area, integrate natural-Bridges, and provide pedestrian facilities. Construct islands to direct pedestrian and vehicle traffic, such as street sweeping, signing, and marking.</td>
<td>Appropriate on streets with sufficient right-of-way and on-street parking.</td>
<td>Promote pedestrian use by creating safe and comfortable waiting areas.</td>
</tr>
<tr>
<td>4 Curb Radius at Intersections</td>
<td>Curb radius should be consistent with pedestrian, vehicle turning, and pedestrian crossing requirements.</td>
<td>Sprayed curbs not required at uncontrolled intersections.</td>
<td>Promote pedestrian use by increasing the visibility of pedestrians and improving safety for pedestrians and cyclists.</td>
</tr>
<tr>
<td>5 Curb Ramps and Crosswalks</td>
<td>Curb ramps are required at all intersections and in each direction. Accommodate with local jurisdiction, ADA requirements, and PAVO guidelines. Provide pedestrian ramps to maintain path of travel.</td>
<td>Pedestrian ramps recommended across the street.</td>
<td>Promote pedestrian use by increasing the accessibility of pedestrian crossings.</td>
</tr>
<tr>
<td>6 Curb or Curb and gutter</td>
<td>Minimum curb height is required by local guidelines. Filled-in continuous curbs heighten pedestrian tripping hazards.</td>
<td>Curbs should be maintained to ensure pedestrian safety and accessibility.</td>
<td>Promote pedestrian use by maintaining safe and accessible sidewalks.</td>
</tr>
</tbody>
</table>

**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**

**Louisiana Watershed Initiative**

**Working Together for Sustainability and Resilience**

[Image of the city]
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.
Constructing 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

<table>
<thead>
<tr>
<th>Type of Project</th>
<th>Proposition Funding</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 capacity improvements</td>
<td>$636.2 million</td>
<td>$805.5 million</td>
</tr>
<tr>
<td>12 corridor improvements</td>
<td>$170 million</td>
<td>$204 million</td>
</tr>
<tr>
<td>10 community enhancement road projects+</td>
<td>$65.8 million</td>
<td>$68.6 million</td>
</tr>
<tr>
<td>Parishwide signal synchronization*</td>
<td>$40 million</td>
<td>$40 million</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$912 million</strong></td>
<td><strong>$1,118.1 billion</strong></td>
</tr>
</tbody>
</table>

* Parishwide projects

+ $49 million for community enhancement projects and $10 million for ADA compliance
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 PWM and associated experts, MEC, and Baton Rouge Green, to develop guidance on green infrastructure uses and installation. The ABK 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
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

*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.

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QUESTIONS?

CONTACT INFORMATION
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21st Street, Paso Robles, case study
1200 acre upstream drainage area

21st Street

Spring Street

Southern Pacific Railroad

School

Fairgrounds

Park

Salinas River

Louisiana Watershed Initiative

Working Together for Sustainability and Resilience
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
WORKING TOGETHER FOR SUSTAINABILITY AND RESILIENCE

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
• 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
21st Street, Paso Robles

Before

After
THANK YOU

WATERSHED.LA.GOV