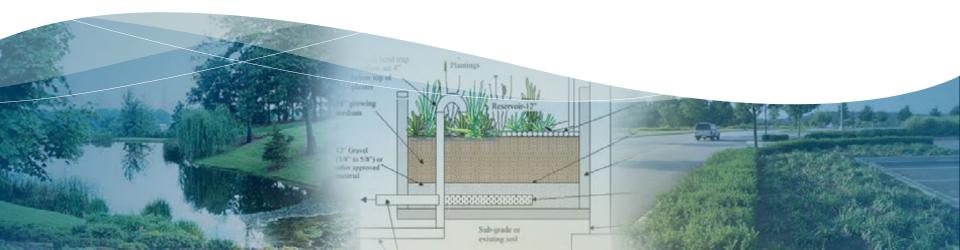


Water Quality for Street Design

SEPTEMBER 22, 2014



Presenters

NCTCOG

Jeff Rice

Freese and Nichols

Trey Shanks, CFM

City of Dallas

Dorcy Clark

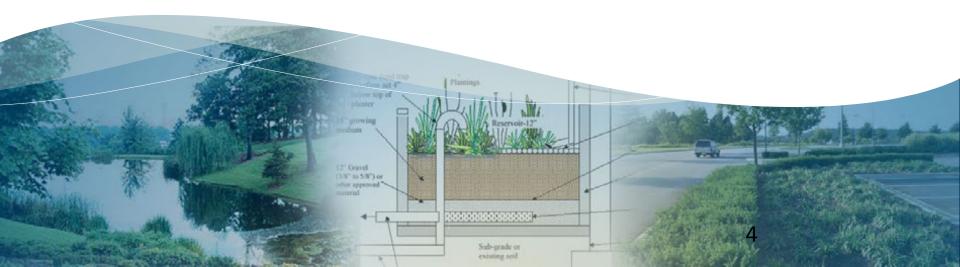
Chris Bosco, P.E., ENV SP

Lesley Brooks, P.E., CFM

Agenda

- Impact of Streets on Water Quality
- Water Quality Regulations
- TriSWM
- Complete Streets
- Water Quality Design for Streets
- Case Studies

Impact of Streets on Water Quality



Lots of Roads, Lots of Drivers

- Texas leads the nation with over 650,000 lane miles. Next closest is California with 380,000 lane miles.
- Roads and sidewalks comprise up to 33% of the total impervious surface in average urban and suburban areas.

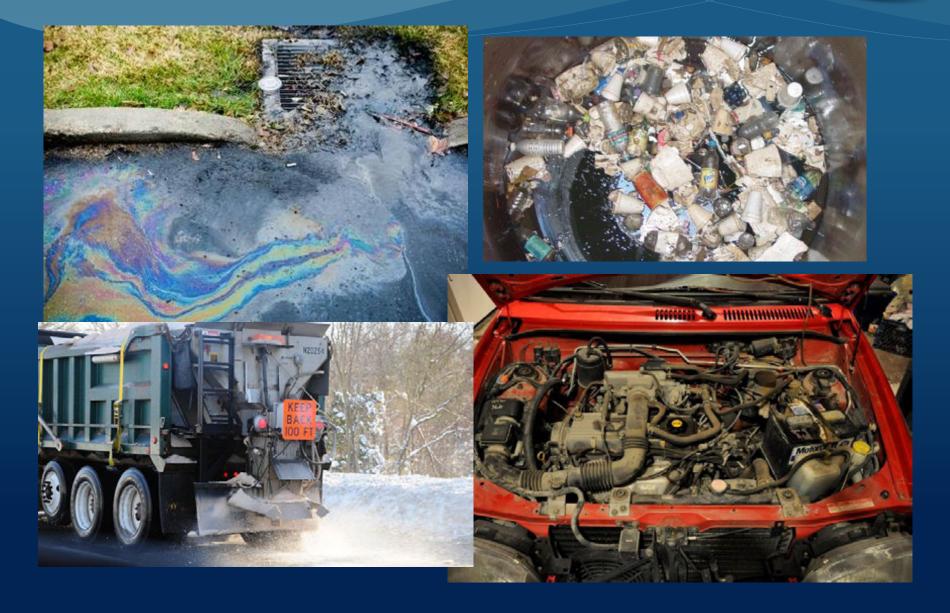


Lots of Roads, Lots of Drivers

- NCTCOG serves a region with a total population for 6.5 million
- Average person drives 15,000 miles per year



Sources of Pollution



Constituent	Source
Particulates	Pavement wear, vehicles, the atmosphere, and maintenance activities
Petroleum	Spills, leaks, antifreeze, and hydraulic fluids, and asphalt surface leachate
Nitrogen	Atmosphere and fertilizer application
Phosphorus	Atmosphere and fertilizer application
Copper	Metal plating, bearing and brushing wear, moving engine parts, brake lining wear, fungicides, and insecticides
Iron	Auto body rust, steel highway structures such as bridges and guardrails, and moving engine parts
Lead	Leaded gasoline from auto exhausts (previously) and tire wear
Zinc	Tire wear, motor oil, and grease
Cadmium	Tire wear and insecticides
Chromium	Metal plating, moving engine parts, and brake lining wear
Nickel	Diesel fuel, gasoline, lubricating oil, metal plating, brushing wear, brake lining wear, and asphalt paving
Manganese	Moving engine parts
Cyanide	Anti-caking compounds in deicing salt
Sodium, Calcium, and Chloride	Deicing salts
Sulphates	Roadway beds, fuels, and deicing salts

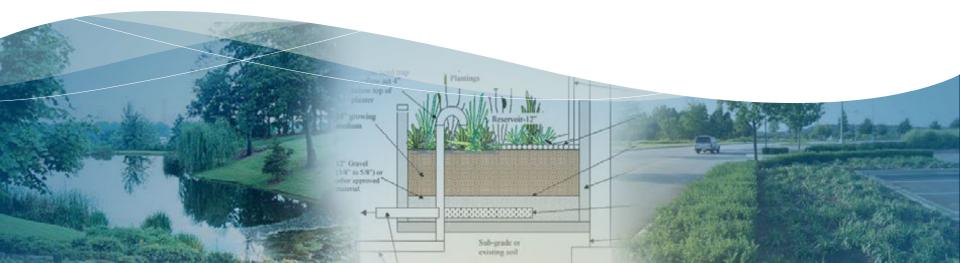
Sources of Pollution

Parameter	Concentration (mg/L, unless noted)
Total Suspended Solids (TSS)	45-798
Volatile Suspended Solids (VSS)	4.3-79
Total Organic Carbon (TOC)	24-77
Chemical Oxygen Demand (COD)	14.7-272
Biochemical Oxygen Demand (BOD)	12.7-37
Nitrate+Nitrite (NO3+NO2)	0.15-1.636
Total Kjeldahl Nitrogen (TKN)	0.335-55.0
Total Phosphorus (TP)	0.113-0.998
Copper (Cu)	0.022-7.033
Lead (Pb)	0.073-1.78
Zinc (Zn)	0.056-0.929
Fecal Coliform	50-590 (organisms/100ml)

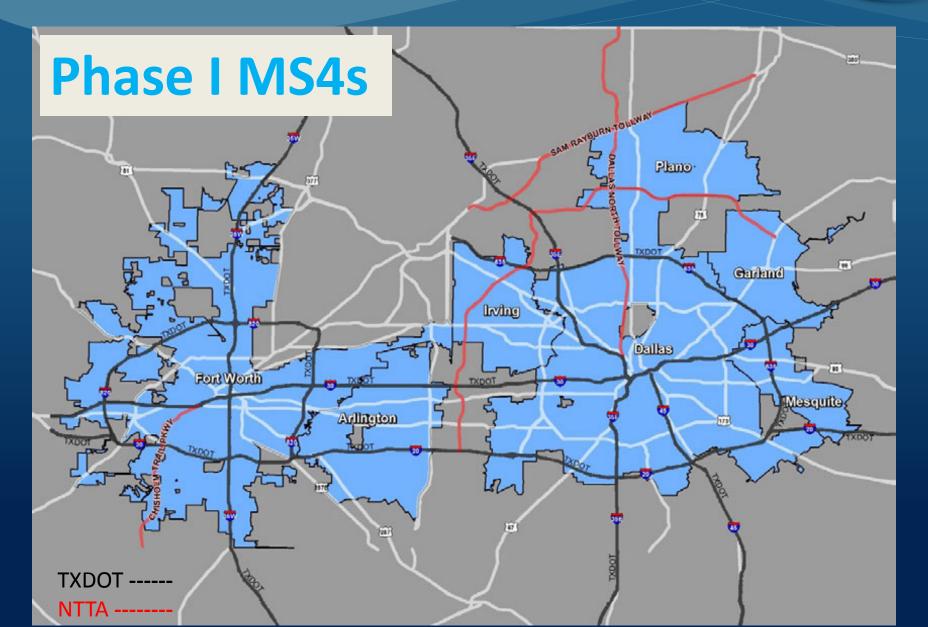
How to Address Street Pollution

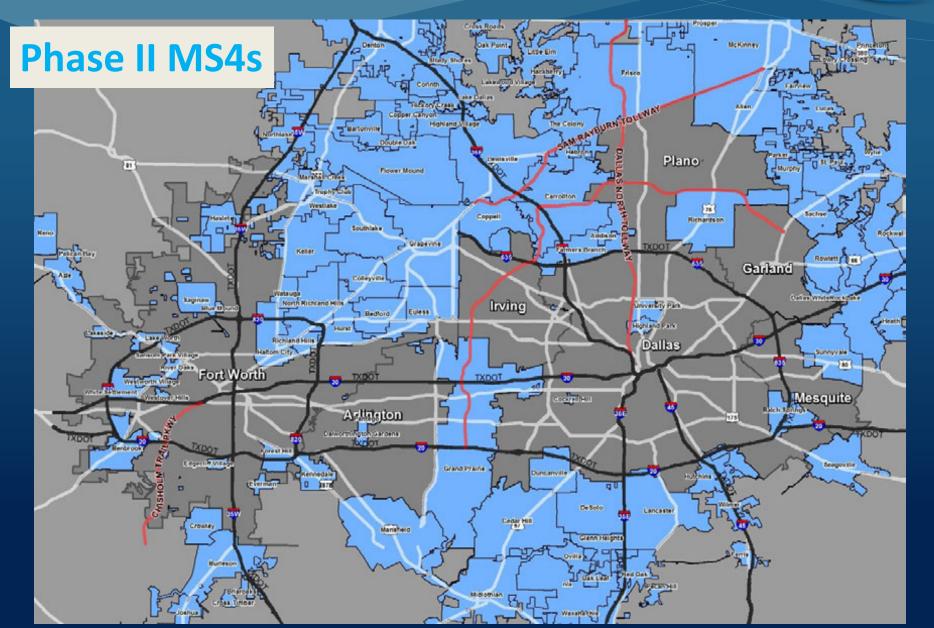
- Design sustainable right of ways
- Incorporate water quality into road design
- Monitor construction activities
- Outreach to the community
- Outfall protections
- Good practices (street sweeping, inlet cleaning, etc.)
- Develop and implement a spill response plan



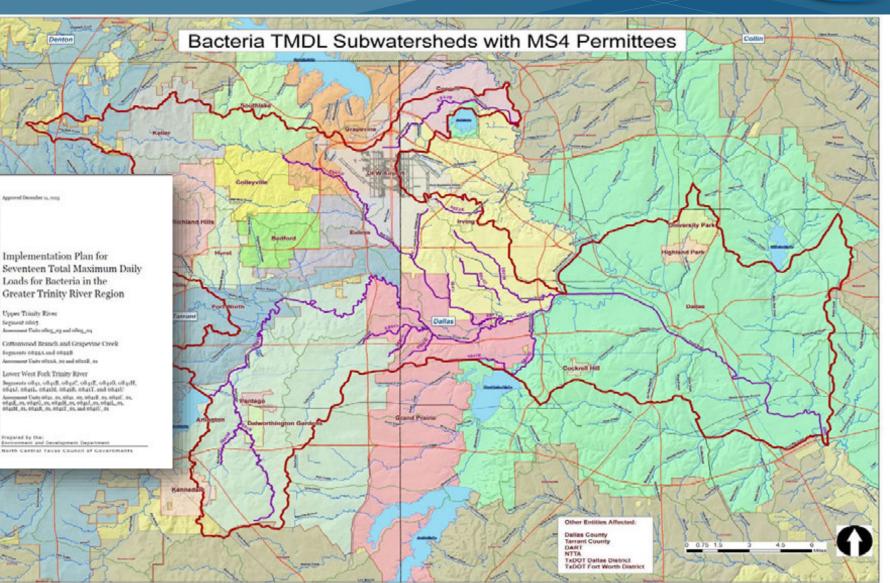


- State and federal regulations and permits require local governments and transportation agencies to control pollution in stormwater runoff
 - Municipal Separate Storm Sewer System (MS4)
 Permits
 - Construction General Permit
 - Industrial Stormwater Permit





Impaired Water Quality



Data Sources NCTCOG, TCEQ

Legend

TCEG

C3	Shudy Area	-	Bacteria Impaired Wellerways	N	Primary racy
03	WBD Subwatersheds				Secondary I
25	Major Lakes	10	Other Otles	14	Access Ran
			Unincorporated		Major Arteria

PREPARED IN COOPERATION WITH THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY AND U.S. ENVIRONMENTAL PROTECTION ADENCY

The preparation of this report was trianced through grants from the U.S. Environmental Protection Agency through the Texas Commission on Environmental Quality. This mapricate was created by the North Central Texas Council of Covernments NOTCOQ) for use "rais" and as a said in graphic representation only. The sails is not vented by a frequence Professional Land Sun-syor for the State of Texas and is not intended to be used as tools. NOTCOQ, its officials, and its employees do not accept faitfilly for any discrepances, errors, or valances that may thirt.

Watershed Boundary Dataset (WBD) by USDA - Natural Resources Conservation Service

North Central Texas Council of Governments



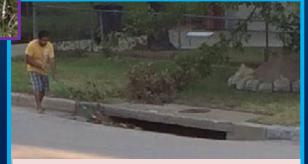


Public Education/ Involvement





iSWA



Illicit Discharge Detection/Elimination



Construction Site Runoff Control





Good Housekeeping/ Municipal Operations



Post-Construction Stormwater Control Measures

Phase I MS4	Phase II MS4	Permit Requirement
\bigstar	\bigstar	Minimize the discharge of pollutants from new development and redevelopment projects
\bigstar	\bigstar	Applies to projects that disturb <a>2 1 acre
		Applies to projects smaller sites part of larger common plan of development (CIP, bond program, etc.)
\bigstar	\bigstar	Must provide for long-term operation and maintenance of BMPs
	\bigstar	"The program must be established for private and public development sites."

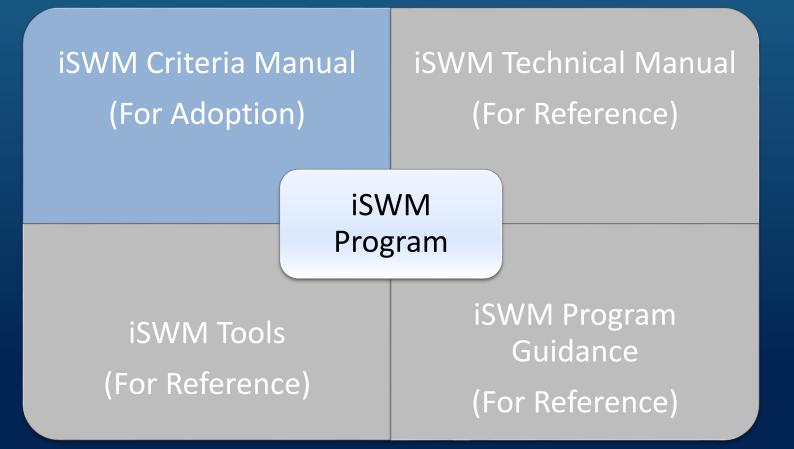
- Construction General Permit
 - Applies to applicable construction activities for all private and public entities (except Small MS4s that use optional "7th MCM" for municipal construction activities)
 - Applicable to all construction activities that result in land disturbance of one acre or more
 - Also applicable to smaller sites part of common plan of development
 - Requirements for erosion, sediment, and waste controls and stabilization practices
 - Provide description of any measures to control pollutants in runoff after construction complete



 In 2002, NCTCOG put together a team to create a regional stormwater manual to address some of these water quality regulations

- iSWM Manual completed in 2006
- Updated in 2009 to separate Criteria and Technical content

http://iswm.nctcog.org



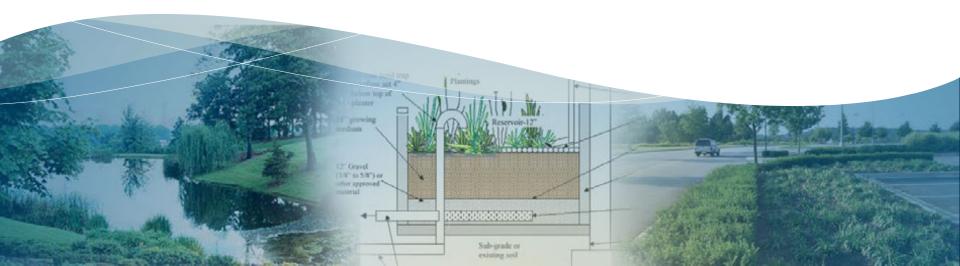
Adoption of iSWM to Date

- 2006 Fort Worth, Grand Prairie
- 2007 Roanoke, Southlake
- 2008 Benbrook
- 2009 Lakeside, Mansfield
- 2010 Dallas*, Glenn Heights, Northlake
- 2011 Duncanville, University Park
- 2012 Azle
- 2013 Hurst
- Dallas has not yet adopted iSWM, but allows use of iSWM as an alternative to standard requirements

- Addressing water quality on a linear system can be difficult
- NCTCOG developed TriSWM to apply iSWM principles to the planning and design of stormwater management facilities for streets and roadways in DFW
- Provide guidance to local governments and transportation agencies
- Includes planning tools and criteria to manage the quality and quantity of runoff



TriSWM Overview



TriSWM Background

- Developed in partnership with NCTCOG's Transportation Department
- Replaces certain sections of the iSWM[™] Criteria Manual for planning and design of stormwater controls for streets and roadways

Originally Appendix J of 2006 iSWM Design Manual for Site Development

APPENDIX

Transportation integrated Storm Water Management (TriSWM)

Updated and added as the TriSWM Appendix of the iSWM Criteria Manual

Transportation *integrated* Stormwater Management (TriSWM) Appendix

TriSWM Applicability

- TriSWM developed to be used for collectors, arterials, and highways
 - Stormwater infrastructure for residential streets better addressed along with overall site development using main iSWM Criteria Manual
 - iSWM Criteria Manual planning and design process based on city regulation of private site (parcel) development
 - TriSWM Guide planning and design process reflects the development of public transportation infrastructure by local governments and transportation agencies

Compatibility with iSWM

- Most of iSWM Criteria Manual applicable to development of streets and roadways
 - Hydrologic Methods
 - Downstream Assessment
 - Streambank Protection
 - Flood Mitigation
 - Conveyance System Design
 - Construction Criteria
 - Most Stormwater Controls
- Most of iSWM Technical Manual also applicable

Compatibility with iSWM

- TriSWM replaces Chapter 1, Overview and Chapter 2, *integrated* Development Process
 - Project development process description
 - Site analysis and inventory
 - Special planning considerations (floodplains, wetlands impaired water bodies, hazardous cargo routes, etc.)
- TriSWM modifies part of Chapter 3, integrated Design Criteria
 - Water Quality Protection criteria based on receiving water characteristics and traffic volume
 - Stormwater control selection criteria

TriSWM Benefits

- Water Quality Protection:
 - Establishes treatment requirements based on projected traffic volume and environmental factors
- Streambank Protection:
 - Determines potential impacts and establishes criteria for protection
- Flood Control:
 - Determines potential impacts and provides flood impact reduction measures

Water Quality Treatment Levels

	Receiving Water / Riparian Area Susceptibility			
Traffic Volume	Minimal	Moderate	High	
Low (<30,000 VPD)	Level I	Level I	Level II	
High (>30,000 VPD)	Level I	Level II	Level III	

High	 Exceptional Quality Aquatic Habitat (TCEQ) or Endangered/Protected Species Habitat (TPW) Proximity to drinking water supply
Moderate	 Three or more designated uses on the Texas Surface Water Quality Standards, or any perennial stream not classified Wetlands receiving more than 10% of total flow from project
Minimal	 All receiving waters not categorized above

Level I Treatment





- Program of scheduled P2 practices (street sweeping, storm drain inlet cleaning, etc.)
- Off-site practices (regional detention, Dallas CBD sumps, etc.)

Level I Treatment

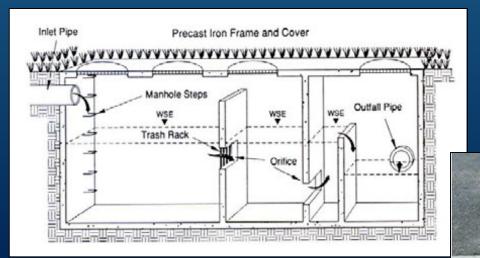
Grass channelsFilter strips





LevelITreatment

Gravity (oil-grit) separator
Porous concrete / Porous paver systems





Level II Treatment

- Enhanced swales
- Bioretention areas
- Dry detention or Extended dry detention
- Supplement with any Level I BMPs







Level III Treatment

- Sand filter, Underground sand filter
- Organic filter
- Infiltration trenches







Level III Treatment

- Stormwater (wet) ponds
- Stormwater wetlands
- Alum treatment systems (used as pretreatment in conjunction with wet pond)
- Supplement with any Level I and II BMPs



Pollutant Removal Rates

Structural Control	TSS	ТР	TN	Fecal Coliform	Metals
Level I					
Grass channels	50	25	20		30
Gravity separator	40	5	5		
Porous concrete	**	50	65		60
Level II					
Enhanced swale	80	50	50		40
Bioretention	80	60	50		80
Dry detention	65	50	30	70	
Level III					
Sand filter	80	50	25	40	50
Organic filter	80	60	40	50	75
Infiltration trench	80	60	60	90	90
Wet ponds	80	50	30	70	50
Wetlands	80	40	30	70	50
Alum treatment	80	80	60	90	75

Planning and Design Considerations

- Conduct downstream assessment to determine/address water quantity impacts
- If possible, avoid sensitive areas:
 - Endangered/protected species habitat
 - Wetlands
 - Floodplains, streams, riparian areas
- Other considerations:
 - Impaired water bodies
 - Hazardous materials routes
- Acquire sufficient right of way to allow for placement of stormwater controls

Outreach

• Updated iSWM website:

- Revised iSWM Criteria page
- TriSWM Guide page
- TriSWM brochure
- Training workshops

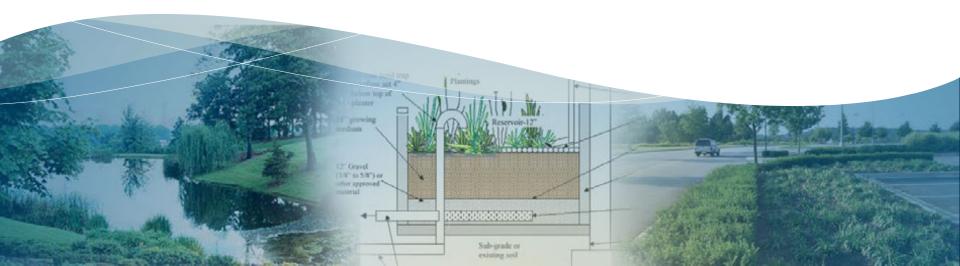
Transportation *integrated* Stormwater Management (<u>TriSWM</u>)

A Guide for Street and Roadway Stormwater Management





Complete Streets



Complete Streets Approach



Sustainable Public Rights of Way

NCTCOG Sustainable Public Rights of Way (SPRoW)
To create safe and context sensitive solutions for all users
List of resources and ideas



"...meet the needs of the present without compromising the ability of future generations to meet their own needs."

-World Commission on Environment and Development, 1987



Create <u>environmentally</u> friendly, <u>economically</u> feasible, and <u>socially</u> acceptable public rights of way



Triple Bottom Line

- Improve performance and reduce lifecycle and maintenance costs
- Ensure regulatory compliance
- Promote economic development
- Provide safer and healthier neighborhoods



- Involve stakeholders and coordinate from start to finish
- Create pedestrian and bicycle friendly communities
- Improve air quality
- Improve water quality





Complete Streets Approaches

Improvements in Water Quality & Sustainable Roadway Design Go Together Hand In Hand





Complete Streets Approaches

Improvements in Water Quality:

- Reduce Pollutants:
 - Reduce Number of Vehicles
 - Encourage Multi-Modal use
 - Bike Lanes
 - Hike/Bike Trails
 - Mass Transit (Train/Bus)
- Reduce Impervious Cover
 - Reduce Lane Widths
 - Increase Parkway Width
 - Increase Planting Beds



Complete Streets Approaches

Improvements in Water Quality:

- Implement Best Management Practices
 - Raingardens
 - Vegetated Swales/Medians
 - Bioretention





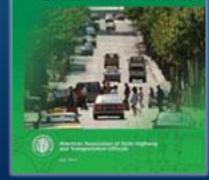
Design Resources



National Complete Streets Coalition



NACTO Urban Street Design Guide Guide for the Planning, Design, and Operation of Pedestrian Facilities



AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities Guide for the Development of **Bicycle Facilities**

2012 • Fourth Edition



AASHTO Guide for the Development of Bicycle Facilities

TxDOT - Bicycle and Pedestrian Accommodation Toolkit

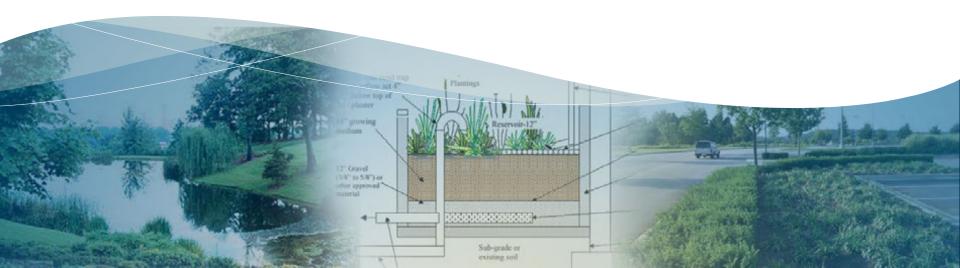
Rating Systems



ENVISION[™] Infrastructure Rating System

- Evaluates, grades, and gives recognition to sustainable infrastructure projects
- 60 Individual Credits
- Recognition Levels of:
 - Bronze, Silver, Gold, and Platinum

Water Quality Design for Streets



Water Quality Design for Streets

Different types of streets call for different water quality solutions.

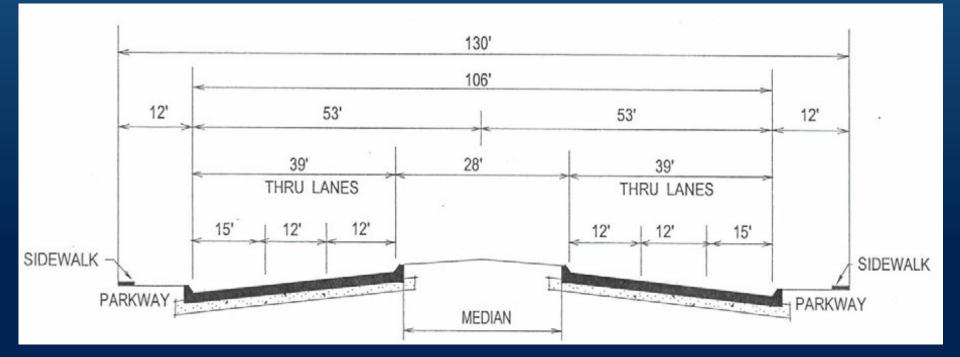
TriSWM

- Arterials and Collectors
- Highways
- Highly Urbanized Streets

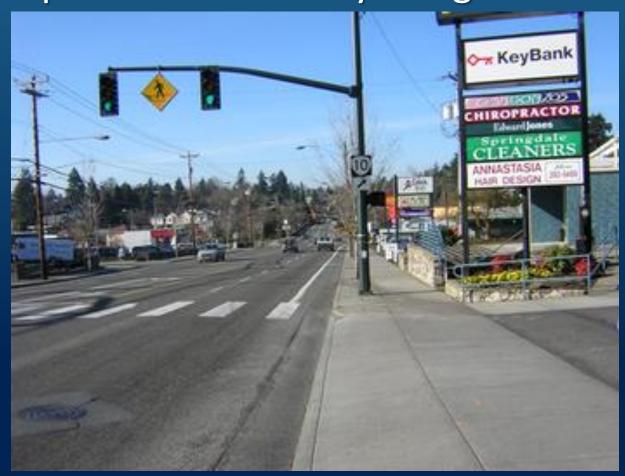
iSWM

Residential

- A high level of service at high speeds that collects traffic from local roads and connects them to highways
- Typically along commercial properties



Typical design is very car-centric
Not a pedestrian-friendly design



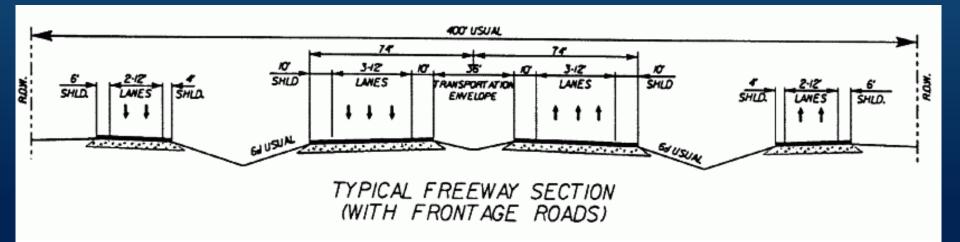
• Water quality can be incorporated in ways that generate foot traffic and increase business



 In other cases, medians can be used for water quality treatment

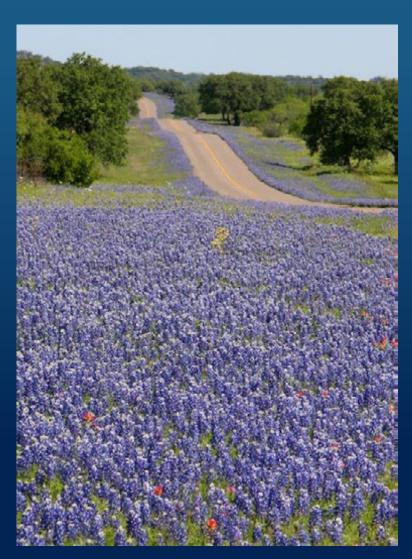


- Can be urban or rural
- High mobility, low degree of access
- Multiple lanes, with or without median



- Rural highways allow for a number of water quality designs
- Utilizing grass swales instead of curb and gutter provides some water quality treatment





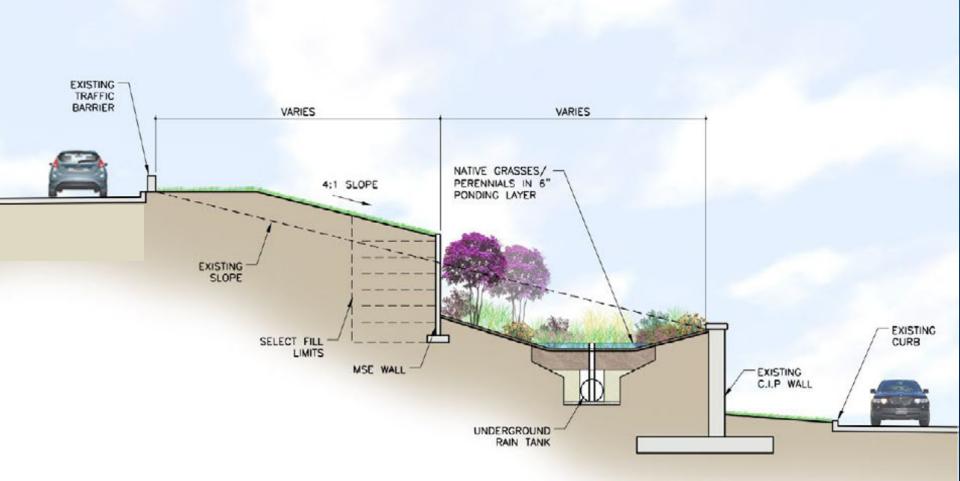
- In maximized urban highways, "inlet level" water quality not always feasible
- Consider outfall treatment measures



 Consider several types of wet ponds including extended detention or micropool extended detention







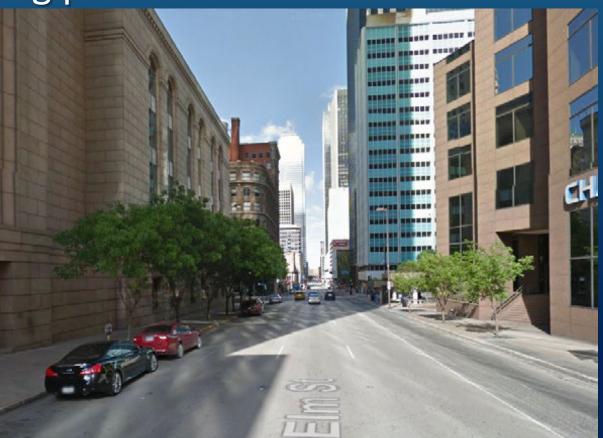
iSW

 Maintaining a median will help create water quality opportunities





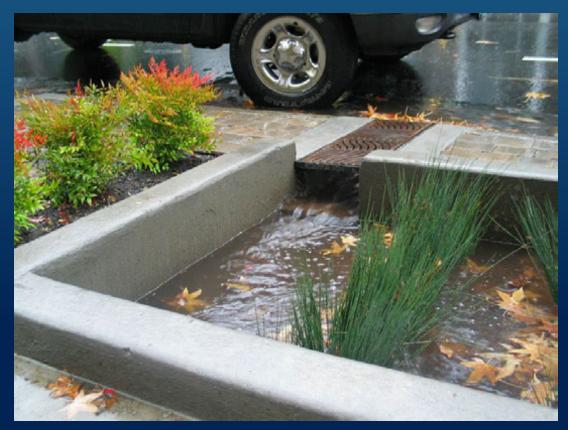
- Typically one-way streets or two-way with no medians
- Building to building pavement
- Street parking
- Heavy pedestrian traffic
- Business districts



- Utilize sidewalk landscaping for water quality treatment
- Creates a pedestrian buffer to traffic

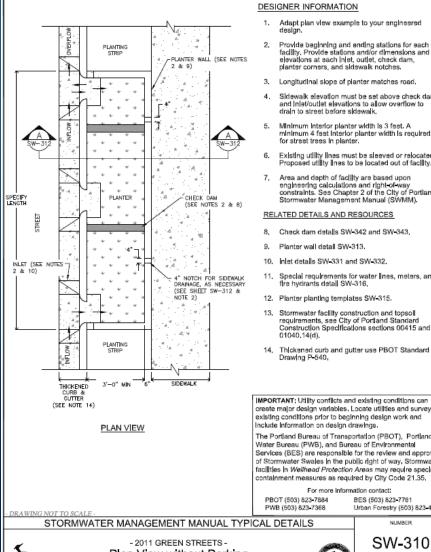


- Acts as a typical inlet
- Provides a small level of detention and slows down time of concentration









DESIGNER INFORMATION

- Adapt plan view example to your engineered design.
- elevations at each inlet, outlet, check dam, planter corners, and sidewalk notches.
- 3. Longitudinal slope of planter matches road.
- Sidewalk elevation must be set above check dam and inlet/outlet elevations to allow overflow to drain to street before sidewalk,
- Minimum Interior planter width is 3 feet. A minimum 4 feet interior planter width is required for street trees in planter.
- Existing utility lines must be sleeved or relocated. Proposed utility lines to be located out of facility.
- Area and depth of facility are based upon engineering calculations and right-of-way constraints. See Chapter 2 of the City of Portland Stormwater Management Manual (SWMM).

RELATED DETAILS AND RESOURCES

- Check dam deta s SW-342 and SW-343
- Planter wall detail SW-313.
- 10. In et details SW-331 and SW-332.
- Special regulrements for water ines, meters, and fire hydrants detail SW-316.
- 12. Planter planting templates SW-315.
- Stormwater facility construction and topsoll requirements, see City of Portland Standard Construction Specifications sections 00415 and 01040,14(d),
- 14. Thickened curb and gutter use PBOT Standard Drawing P-540.

[MPORTANT: Utility conflicts and existing conditions can create major design variables. Locate utilities and survey existing conditions prior to beginning design work and Include Information on design drawings

The Portland Bureau of Transportation (PBOT), Portland Water Bureau (PWB), and Bureau of Environmental Services (BES) are responsible for the review and approval of Stormwater Swales in the public right of way, Stormwater facilities in Wellhead Protection Areas may require special containment measures as required by City Code 21.35.

For more information contact: PBOT (503) 823-7884 BES (503) 823-7761 Urban Forestry (503) 823-4489 PWB (503) 823-7368

City of Portland

NUMBER

SW-310

SET REVISED: 12-08-2011

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

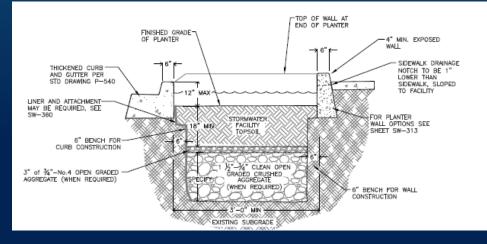
Plan View without Parking Planters

Bureau of Environmental Services

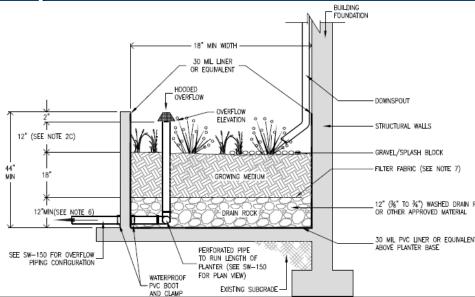
 Don't have to start from scratch

 Several cities have existing details and DWG files online

 https://www.portland oregon.gov/bes/47963



- Sidewalk planters can also be used to treat rooftop runoff
- Overflow connects directly to storm drain system





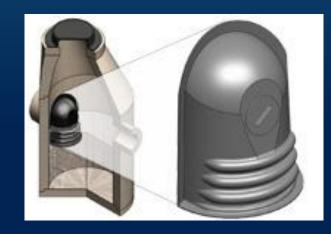
Consider porous concrete for bike lanes and sidewalks

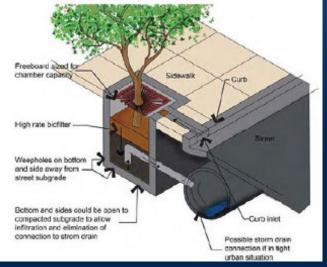


- Propriety devices can be used when space is limited
 - Gravity and vortex separators
 - Filtration systems
 - Catch basin inserts
 - Underground infiltration detention









Residential Streets

- Typical curb and gutter residential street
- Widths vary from 24 feet to 36 feet
- Some street parking is common



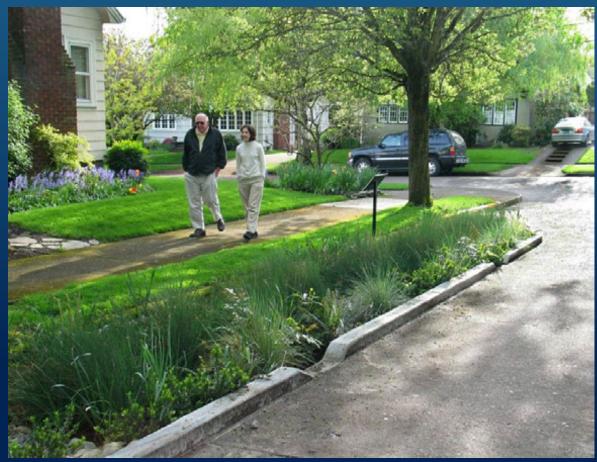
• Where medians are present, take advantage by directly inlet flow over grassy areas



• Utilize right-of-way by creating vegetated bioretention areas



• Install "bump-outs" or curb-extensions to retrofit residential streets for water quality

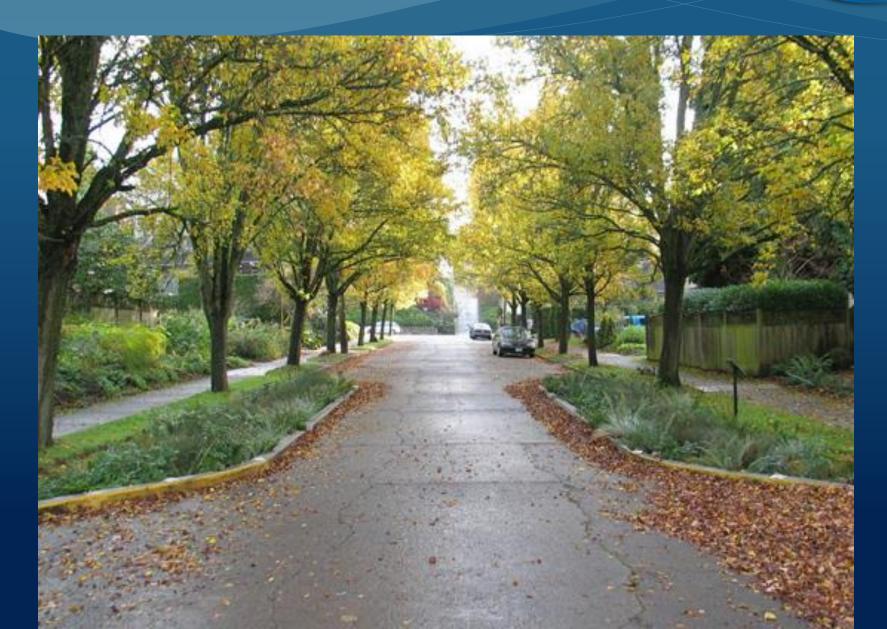


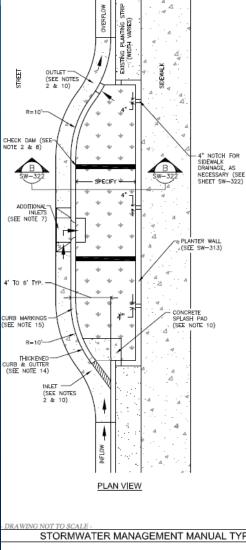


iSW

 Add signage to educate and inform the community







DESIGNER INFORMATION

- Adapt plan view example to your engineered 1. deslan.
- Provide beginning and ending stations for each facility, Provide stations and/or dimensions and 2 elevations at each inlet, outlet, check dam, planter corners, and sidewalk notches.
- Longitudinal slope of the curb extension matches 3. road
- 4. Sidewalk elevation must be set above check dam and Inlet/outlet elevations to allow overflow to drain to street before sidewalk
- 5. Existing utility lines must be sleeved or relocated. Proposed utility lines to be located out of facility,
- Area and depth of facility are based on 6. engineering calculations and right-of-way constraints. See Chapter 2 of the City of Portland Stormwater Management Manual (SWMM),
- 7. Additional injets in facilities over 25 ft in length. per BES requirements, or site specific needs,
- RELATED DETAILS AND RESOURCES
- 8. Check Dam details SW-340 thru SW 343.
- 9 Wall detail SW-313,

City of Portland

- Inlet details SW-331 thru SW-334. 10.
- Special requirements for water lines, meters, and fire hydrants detail SW-324. 11.
- 12. Curb Extension Planting Templates SW-323.
- 13 Stormwater facility construction and topsoll requirements, see City of Portland Standard Construction Specifications sections 00415 and 01040,14(d),
- Thickened curb and gutter use PBOT Standard 14. Drawing P-540.
- 15. Pavement markings use PBOT Standard Drawing P-434.

MPORTANT: Utility conflicts and existing conditions can create major design variables. Locate utilities and survey existing conditions prior to beginning design work and Include Information on design drawings.

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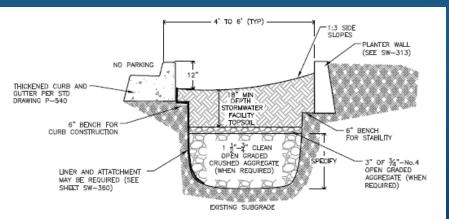
> NUMBER SW-321

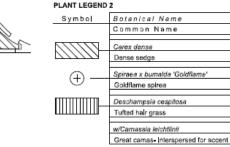
SET REVISED: 12-08-2011

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS



TEMPLATE 2





Encouraging Design

What are other Cities doing?

 Providing standard details (Portland)
 Offering developer incentives such as increased floor-area-ratio (FAR) or other land use code departures (Seattle)
 Providing financial assistance (Austin)

Encouraging Design

What you do to encourage and promote these designs?

- Provide alternative standard details
- Open communication between engineers, planners and landscape architects
- Talk to developers and design engineers early on in a project
- Communicate with the public and property owners to gather support

Landscaping

- Consult a professional landscape architect
- iSWM Landscaping Technical Manual
- Texas SmartScape www.txsmartscape.com
- Lady Bird Johnson Wildflower Center www.wildflower.org





A Word on Maintenance

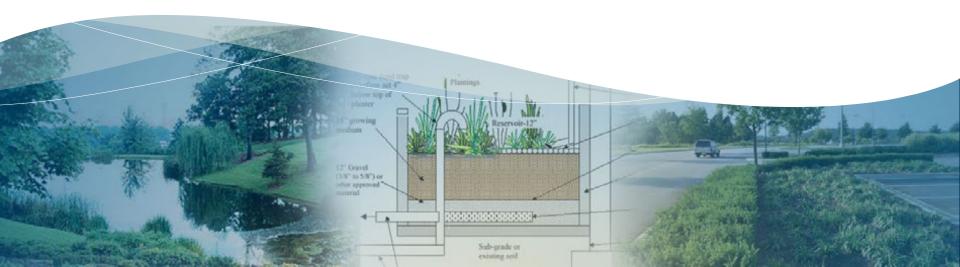
- Typical maintenance practices provided in iSWM
- Maintenance responsibility options
 - Privately maintained
 - Publicly maintained
 - Publicly maintained and contracted out
- Important to develop a location database
- Use training and signage to educate maintenance staff
- Develop ordinances that detail maintenance, inspection and enforcement of privately maintained areas http://iswm.nctcog.org/training.asp

Additional Resources

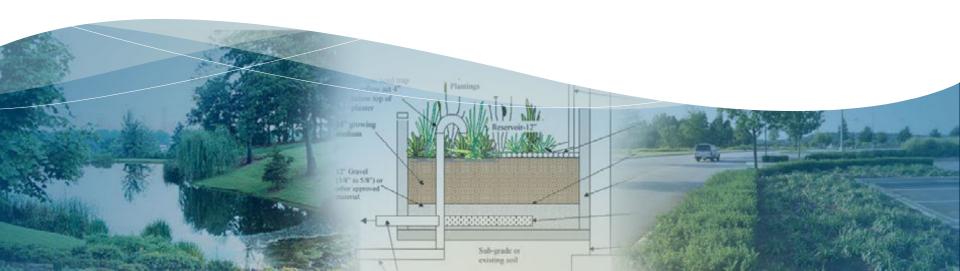
- EPA's 2005 National Management Measures to Control Nonpoint Source Pollution from Urban Areas (Chapter 7)
- National Cooperative Highway Research Program (NCHRP) Report 565: Evaluation of Best Practices for Highway Runoff Control
- FHWA's 2002 Stormwater Best Management Practices in an Ultra-Urban Setting
- AASHTO's Center for Environmental Excellence
- International BMP Database www.bmpdatabase.org



Case Studies



Dallas Initiatives and Projects





 The City of Dallas is undergoing a paradigm shift in how we design roads

- Old way of thinking of roadway design:
 - Mode by Mode
 - Focus on delivery of quantity
 - Single transportation focus



Overview

• City transitioning to new focus on...

- Systems and Network
- Integration of Modes
- Quality of Life
- Conservation of Resources/Energy
- Economic Development
- With this paradigm shift, we have challenged consultants to think differently

Demonstration Projects

- A push to transform the Trinity River Corridor has provided the opportunity to implement this new way of thinking, focusing on context sensitive design
- The Margaret Hunt Hill Bridge was built for many reasons, not just to add more road miles
- Studies showed that this roadway project would lead to economic development...

Demonstration Projects



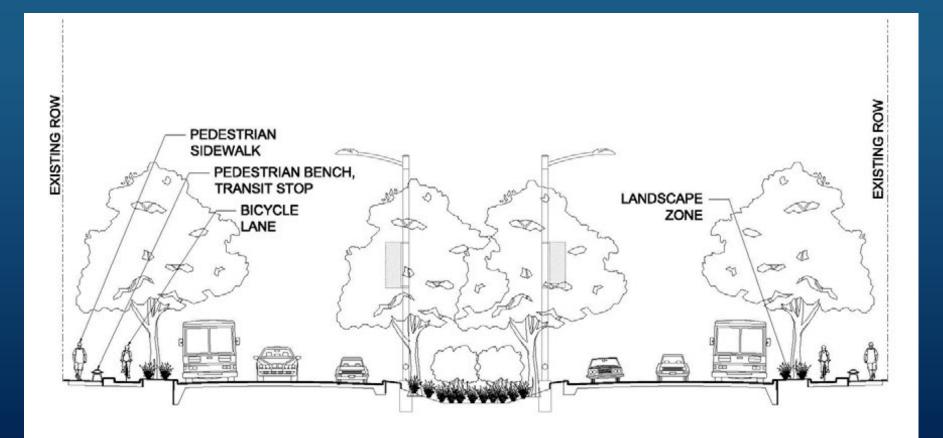
Demonstration Projects

- Although the first Calatrava Bridge (MHH Bridge) has been a success, it fell short as a complete street
- The McDermott Bridge portion of the Horseshoe Project (I30 and I35) will contain separate lanes for cyclists/pedestrians



- Reconstruction from Continental Avenue to Cadiz Street
- 6 traffic lanes, cycle track, bioswales, landscaping
- Cost: \$42.5 million City, County, COG
- Schedule
 - Phase 1 construction began June 2014 (lasting 23 months)
 - Phase 2 construction to begin Jan 2015 (lasting 36 months)





PROPOSED TYPICAL SECTION RIVERFRONT BLVD.



Beckley/Commerce, Dallas

 Redesigned to satisfy neighbors, expecting a complete street



Complete Streets Project History

2006 Bond Program Complete Street Conversion Projects

- Greenville Avenue
- Bishop Street
- Herbert Street
- Congo Street
- Locust Street
- Elm Street
- Bexar Street



Lower Greenville, Dallas

Complete Street Components

- Street Furniture
- Extensive Landscaping
- Enhanced Traffic
 Calming Crosswalks
- Indented Parking
- Wide, upgraded sidewalks
- Traffic Calming
- Lane Diet



Lower Greenville, Dallas



Lower Greenville, Dallas



Herbert Street, Dallas



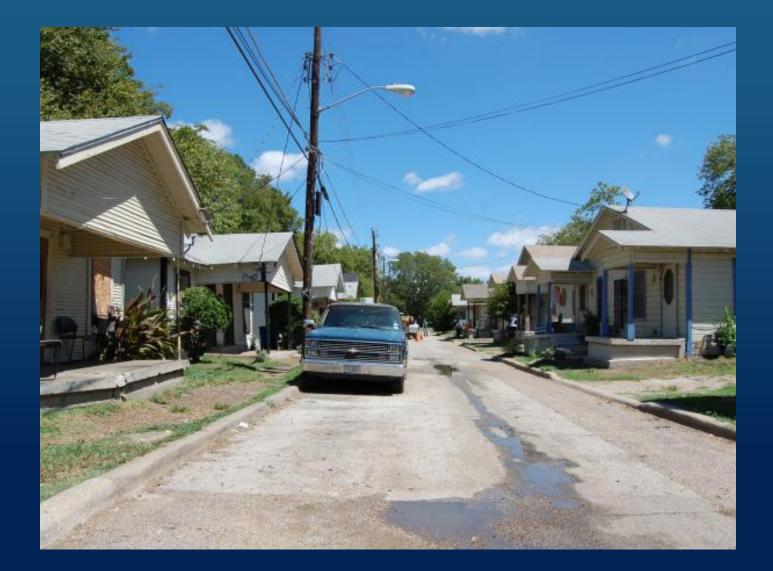
Hebert at Pablo

Herbert Street, Dallas



Reduced pavement width to 18', added indented parking, landscaping, increased green space, improved walks

- Completed in 2012
- Rebuild of a one-block long street in an East Dallas community
- An alternative strategy for an area targeted for demolition and redevelopment
- Incorporates permeable pavement and biofiltration













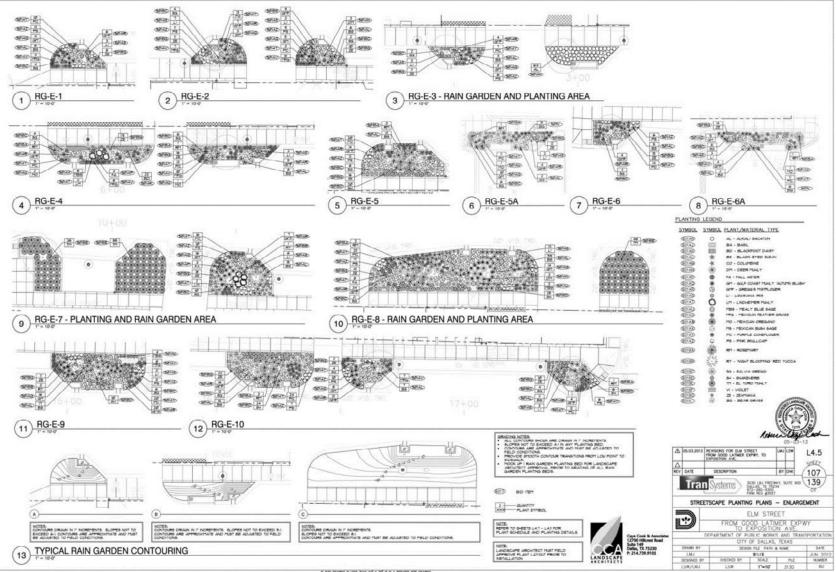


- To be completed in Spring 2015
- 3,400 LF of roadway and parkway reconstruction
- Complete Street Components
 - Street Furniture
 - Extensive Landscaping
 - Rain Gardens
 - Permeable sidewalk pavers
 - Enhanced Traffic Calming Crosswalks
 - Indented Parking
 - Wide, upgraded sidewalks
 - Narrowing traffic lanes
 - Designed for future conversion to 2-way traffic flow

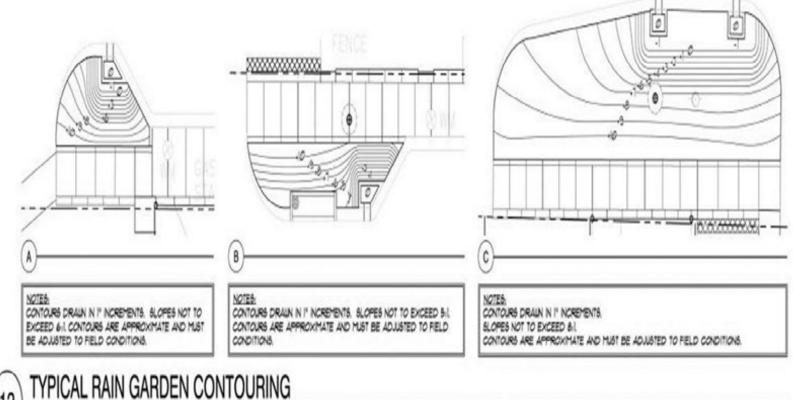


Proposed sidewalk paving pattern

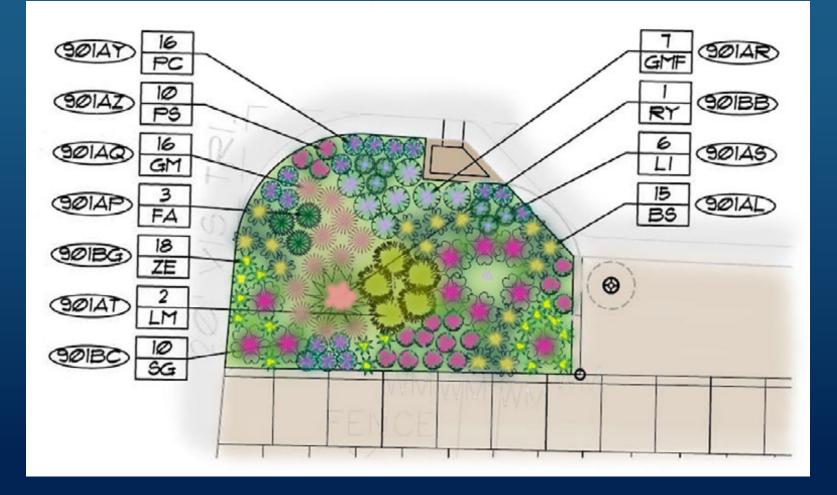
Sidewalk areas adjacent to landscaped areas are proposed to utilize permeable paver system



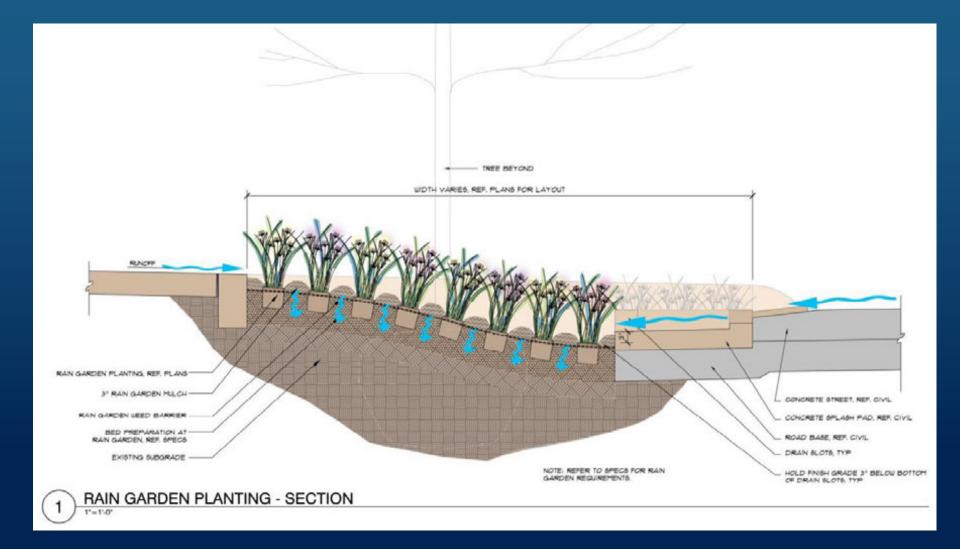
IF THIS DRAWING IS LESS THAN 24" X 38" IT IS A REDUCED SZE DRAWING

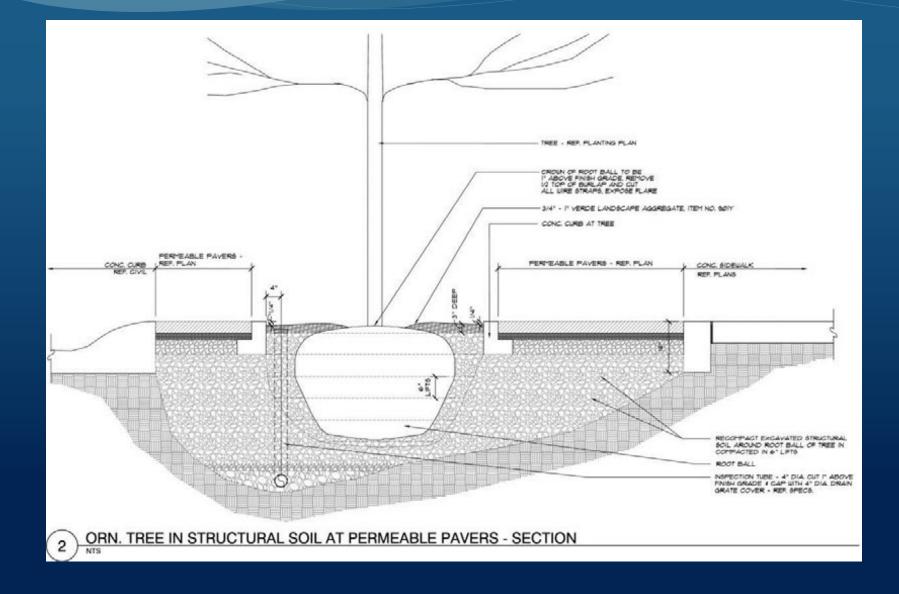


13) 1"= 10-0"



isw











2012 Bond Program

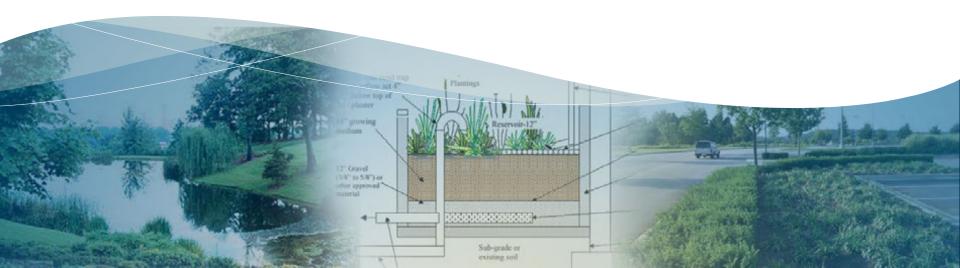
- The paradigm shift from single mode, "point A to point B" thinking called for adjustments in seeking consultants in our last bond program, expanding complete street concept projects throughout Dallas
- 2012 RFQ for Bond Program
 - Called for consultants to have experience in green infrastructure (iSWM and/or Envision)
 - Expectation that roadways would be designed and built as complete streets

2012 Bond Program

- Bond Program Size \$642 Million
- Proposition 1 Street and Transportation Improvements \$260,625,000
 - \$22.2 Million for complete streets (sustainable/complete projects)
 - \$22.5 Million for trails
 - \$22.5 Million for joint Dallas County or TxDOT projects
 - \$193.5 Million for residential streets, alleys and thoroughfares (sustainable/complete project goals for all applicable projects)



Additional Case Studies



- Part of the North Texas LID Competition
- Green Roadway Category
- Design anticipated to be complete December 2014; Construction award late spring 2015



Freese and Nichols was selected as the winner for the Green Roadway Category.







- Redeveloped right-of-way drains approximately 13.6 acres
- Drainage on S. Lamar Street comprises only 7.4% of entire watershed

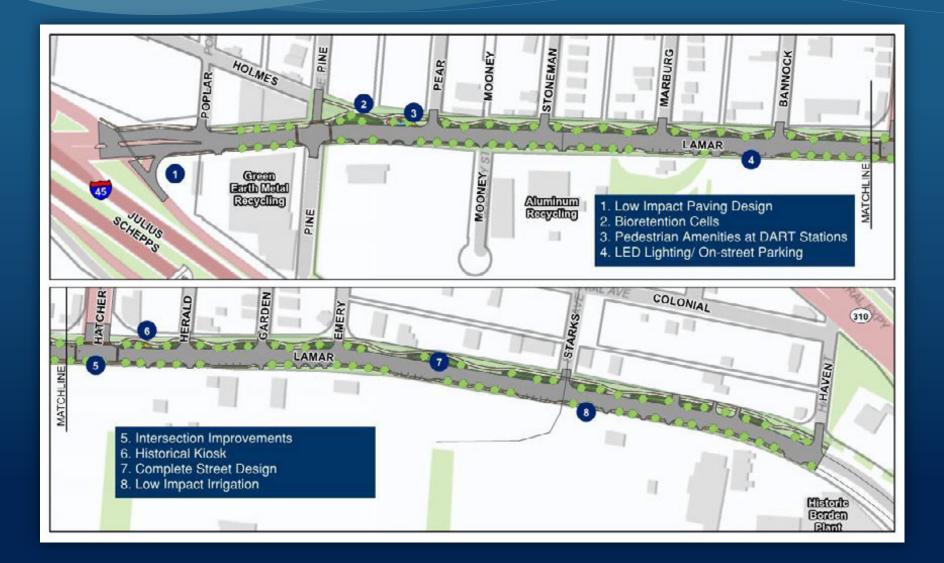
Right-of-Way Drainage = 13/6

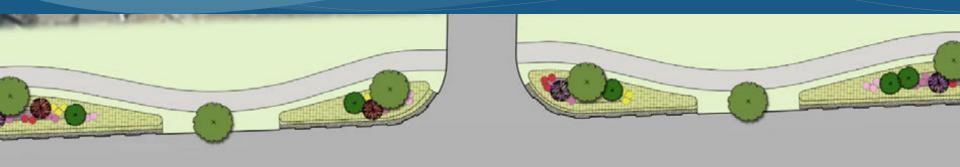
ac

• 5 Sub-basins delineated within ROW to drain to determined design points



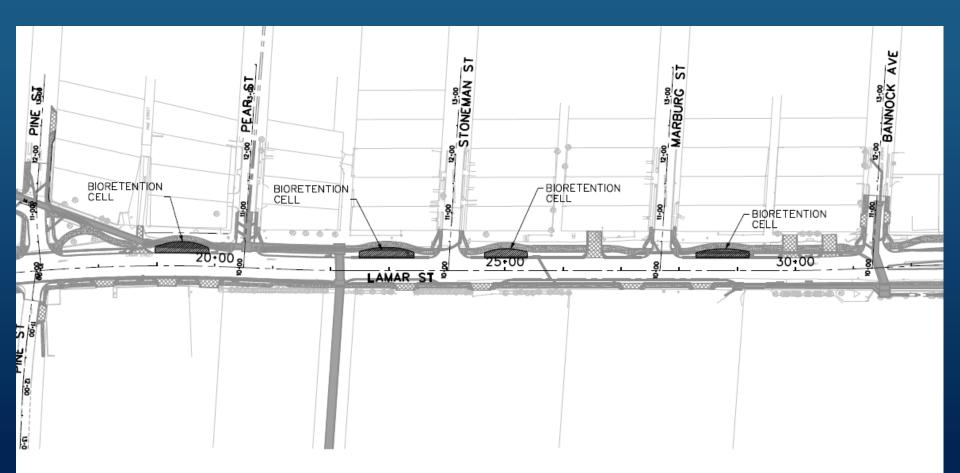
Design Point

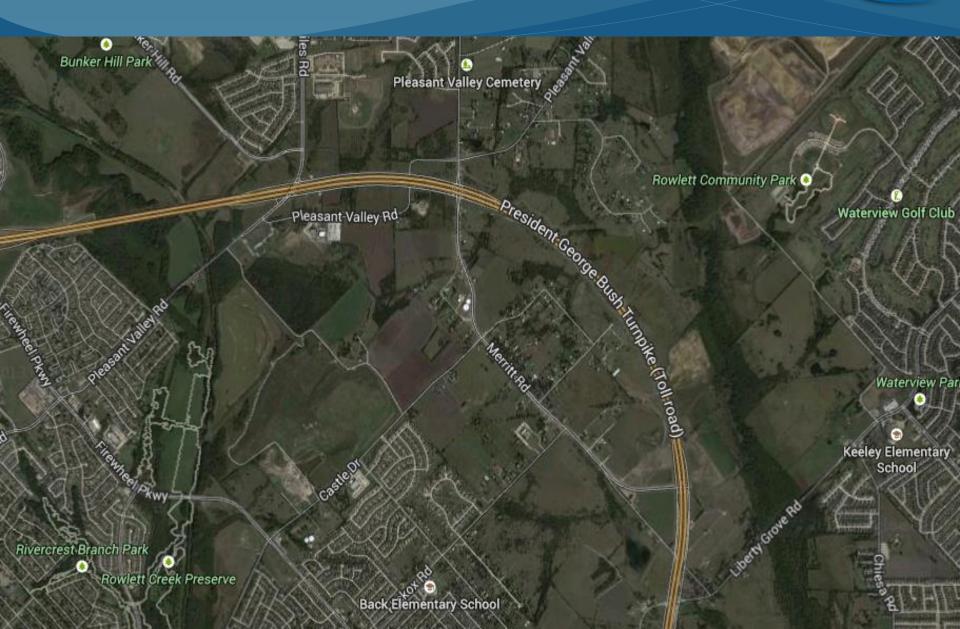












iSWN

Existing

- 2-lane, unimproved
- Large residential lots

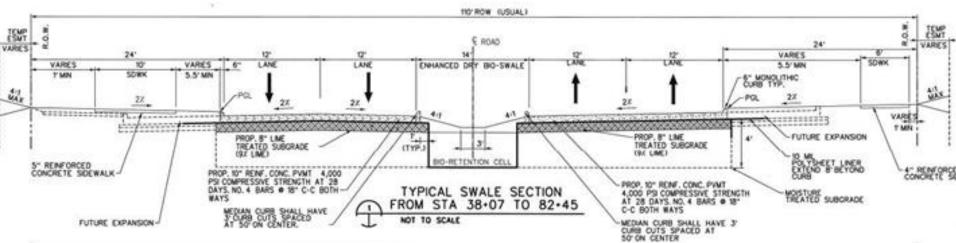
Planned

- 6-lane arterial
- Commercial and higher density residential

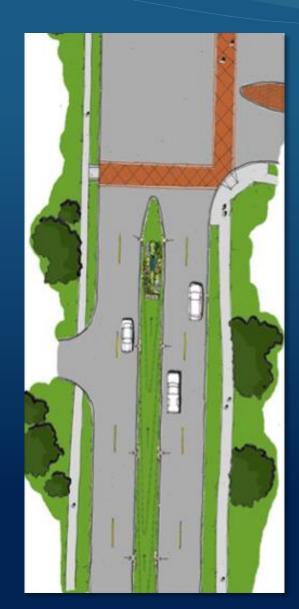


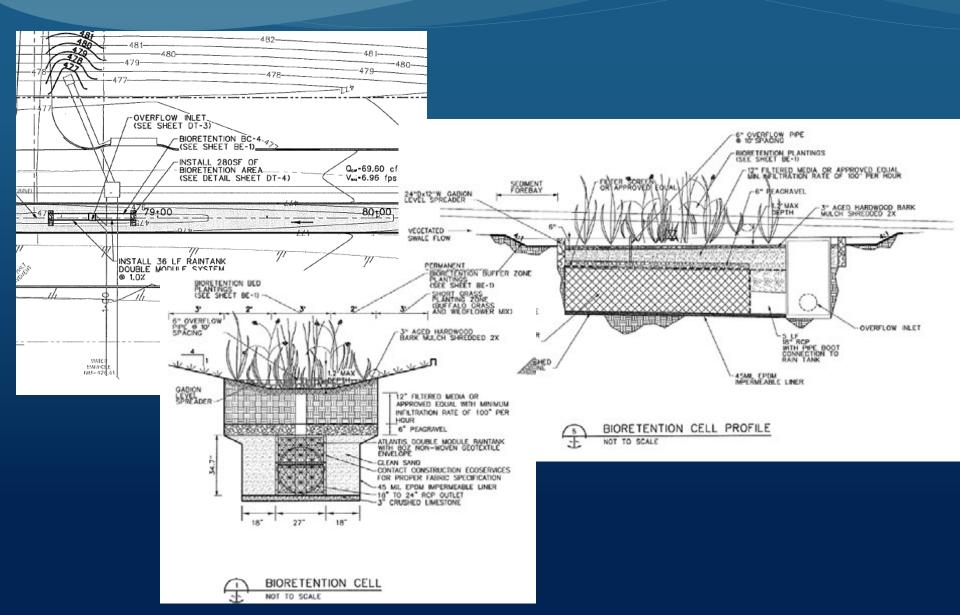






- Grass medians to low points to minimize cost of retention and treatment
- Avoid plantings in sight triangles at intersections
- Minimize median breaks
- Carefully grade intersections to avoid low points







iswn

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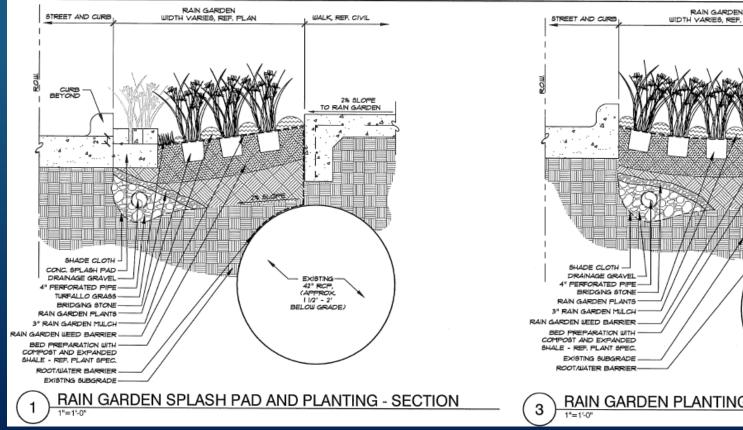
ISW

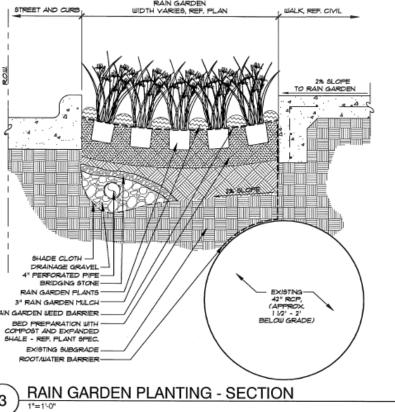
Lessons Learned

- Sight triangles
- Contractor should purchase product in advance
- Installers available
- Establishment of plantings

- Historic Handley Urban Village Streetscape
- Between Forest Avenue and Handley Drive
- Completed June 2014
- 175 feet of rain garden landscaping
- New sidewalk, ADA ramps, accessible pedestrian push button pedestal
- Total cost \$275,533
- Drainage cost \$59,000









The Dallas Urban Reserve

- Located in North Dallas
- A 10.5 acre housing development
- 50 single family lots for modernist homes
- Includes a biofiltration street with reed and cypress planted rain gardens



The Dallas Urban Reserve



The Dallas Urban Reserve

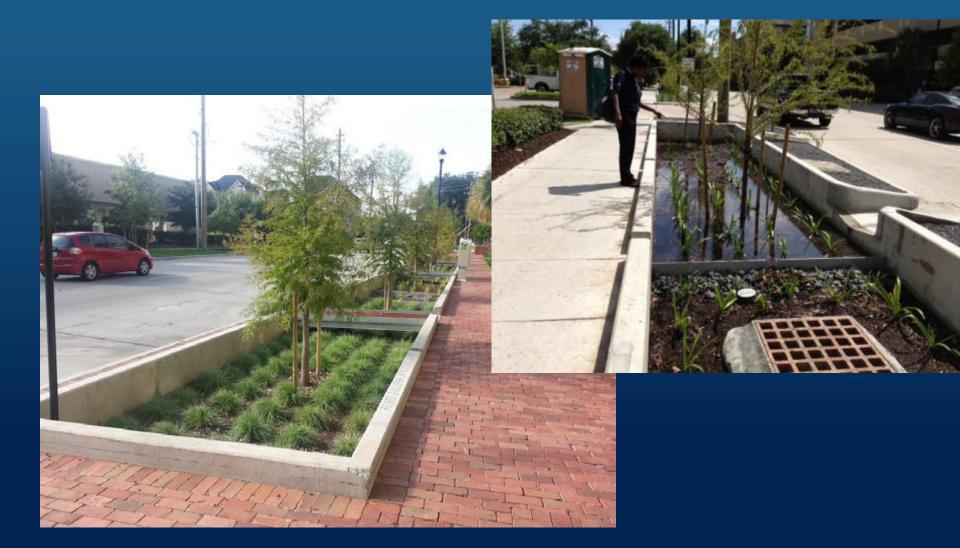


The Dallas Urban Reserve



- Reconstruction Project in Midtown Park near Downtown Houston
- A major collector in a dense urban area
- Features rain gardens, artistic elements, and LED lighting
- First Greenroads[™] street in Texas, Silver Certified

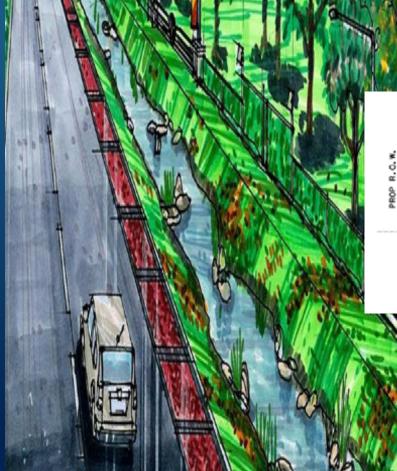


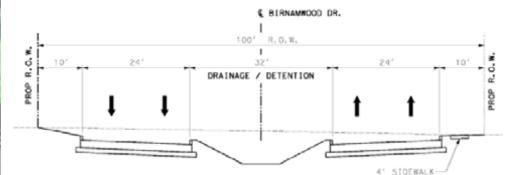






- Northern Harris County, east of Spring
- New section is 0.68 miles
- Includes native landscaping, high infiltration engineered soils, and modular rain tanks
- 27 acre drainage area

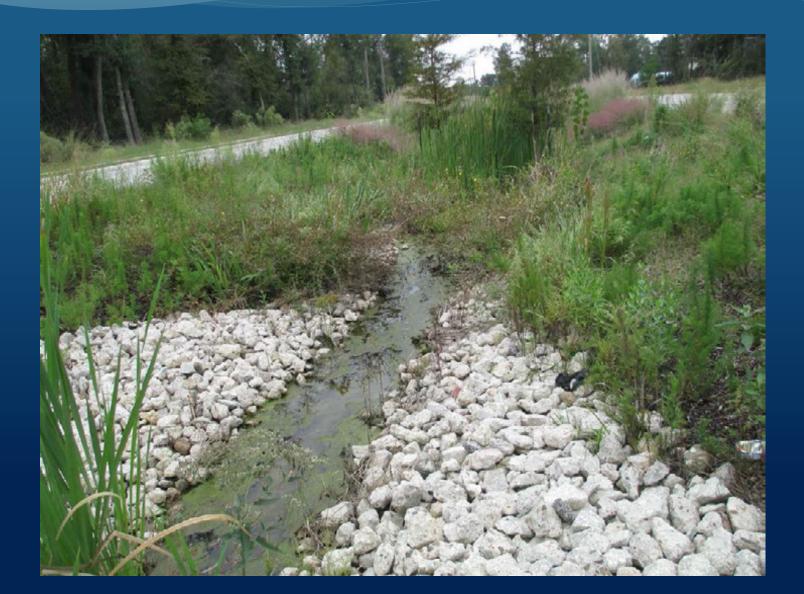




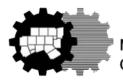








Questions?



North Central Texas **Council of Governments**

Jeff Rice jrice@nctcog.org 817-695-9212

Jack Tidwell, AICP, CFM jtidwell@nctcog.org 817-695-9220

FREESE

Lesley Brooks, P.E., CFM Lesley.Brooks@freese.com 214-217-2248

iswm.nctcog.org

existing soil

Trey Shanks

214-217-2221

817-735-7517 Chris Bosco Trey.Shanks@freese.com 817-735-7359

Chris.Bosco@freese.com

Todd Buckingham, P.E., ENV SP

Todd.Buckingham@freese.com