FREESE AND NICHOLS

Low Impact Development in North Texas

October 11, 2013

North Central Texas Council of Governments

iSWM

PRESENTERS

Lesley Brooks, P.E., CFM

Ben McWhorter, EIT, CFM

Janna Tidwell, RLA

Larry Stone, P.E.

Agenda

What is LID?

Overview of the North Texas LID Design Competition

Process of Creating an LID Site Plan

Examples of LID Site Design (LID Competition, Regional Examples, EPA Case Studies)

Construction Cost Comparison between LID and Traditional Designs

“Roadblocks” to LID

Case Study: UTA College Park Phased Development

Q&A / Closing

Optional Walking Tour of The Green at College Park

What is Low Impact Development?

North Central Texas
Council of Governments

What is Low Impact Development?

<u>Impacts of current development approach:</u>

- Increased imperviousness results in increased runoff quantity
- Increase in nonpoint source pollutants
- Reduced open space
- Large detention structures
- Reduced aesthetics in new and re-developments
- Loss of natural resources

iSWM

What is Low Impact Development?

<u>Change in philosophy of stormwater management</u>

<u>EPA Definition:</u> "an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible."

Principles of LID:

- Preserving and recreating **natural features**
- Minimizing imperviousness
- Treat **stormwater as a resource** rather than a waste product
- Manage stormwater in **small, distributed** stormwater controls

What is Low Impact Development?

<u>Component #1:</u> Site Planning

- Adopts the new philosophy of stormwater management
- Focus on stormwater in early stages of development
- Use stormwater as a resource on new or re-developments
- Conserve natural resources
- Reduce Imperviousness / Reduce runoff

What is Low Impact Development?

Component #2: Managing Stormwater with LID Stormwater Controls

- System of controls to slow down, infiltrate, or retain stormwater near the source
- Sometimes called “Structural Controls”
- Can consist of:
    - Permeable Pavers
    - Bioretention
    - Green Roofs
    - Rain Barrels
    - Enhanced or Grassed Swales
    - Stormwater Infiltration Systems
    - Others

Quantity and size of BMPs can be reduced with good site planning practices

What is Low Impact Development?

LID is more than just stormwater:

- Stormwater is the main focus but there are many other benefits from LID:
  - Mitigation of “urban heat island” effect
  - Absorption of air pollutants such as dust, smog, nitrates, aerosol contaminants.
  - Provide natural habitat for wildlife
  - Muffled urban noise due to reduction in reflective sound

FREESE AND NICHOLS

Overview of LID Competition

North Central Texas
Council of Governments

iSWM

Overview of North Texas LID Competition

Competition Background

- Texas Land/Water Sustainability Forum (TLWSF) founded in 2007
- TLWSF developed idea of an LID Competition to help encourage LID in the Houston region
- Held first competition in Houston in 2009
- Houston Competition was largely successful for the promotion and acceptance of LID in Houston and Harris County

"The bottom line is they just implemented an amazing consciousness-raising process that has hundreds (at least) of developers, civil engineers, architects, landscape architects, etc., thinking differently about stormwater than they did 6 months ago."

-Dov Weitman, Juror for Houston Competition
Chief, Nonpoint Source Control Branch, EPA

Overview of North Texas LID Competition

Competition Background

- Various organizations collaborated to bring design competition to North Texas
- TLWSF created a North Texas Branch, the North Texas Land/Water Sustainability Forum to lead the competition

LAND/WATER SUSTAINABILITY FORUM NORTH TEXAS
www.lwsforum.org

Others Involved in Collaboration

<u>Cities:</u>
Dallas
Fort Worth
Arlington
Denton

North Central Texas Council of Governments

iSWM

Overview of North Texas LID Competition

Competition Objectives*

- "Provide a hands-on learning experience with LID & *integrated* Stormwater Management (iSWM™)"
- "Demonstrate the economic, environmental and marketing benefits inherent in projects developed using sustainable site practices."
- "Encourage greater use of sustainable development practices"
- "Recognize the creative adaption and application of sustainable site practices"

* - Competition Objectives provided in the design competition Kick-Off meeting

Overview of North Texas LID Competition

Four Design Challenge Categories

- Urban Redevelopment
  - Arlington Central Library
    (City of Arlington)
- Urban Mixed-Use Development
  - Cedars West – Dallas
    (Matthews Southwest)
- Mixed Use Development
  - Northern Crossing – Fort Worth
    (Clarion / TIG)
- Green Roadway
  - South Lamar Street- Dallas
    (City of Dallas)

ARLINGTON

MATTHEWS SOUTHWEST

TIG

City of Dallas

iSWM

Overview of North Texas LID Competition

Competition Requirements

- Utilize low impact development techniques as primary stormwater infrastructure
- Proposed design must be equal or less than predevelopment conditions for water quantity and quality
- Use *integrated* Site Design Practices according to the iSWM™ Manual
- Use LID Stormwater Controls to treat first 1.5” of rainfall
- Use iSWM™ Technical Manual for design guidance

Overview of North Texas LID Competition

Competition Participants

- 20 integrated teams submitted designs for the 4 projects
- The teams included a total of 55 firms from the region and across the nation
- Teams included:
  - Civil Engineers
  - Hydrologists
  - Architects
  - Landscape Architects
  - Environmentalists
  - Others

Finalists were announced on October 1st, 2012. Each category had 2-3 finalists.

iSWM

Overview of North Texas LID Competition

Final Event

- 9 finalist teams
- Worthington Hotel's Grand Ballroom with over 300 in attendance
- Finalist Teams presented 'lightning' presentations
- Judges panel made up of top developers and civic and governmental leaders from the area
- Winners in each category were awarded prizes of $15,000

iSWM

FREESE AND NICHOLS

PROCESS OF CREATING AN LID SITE PLAN

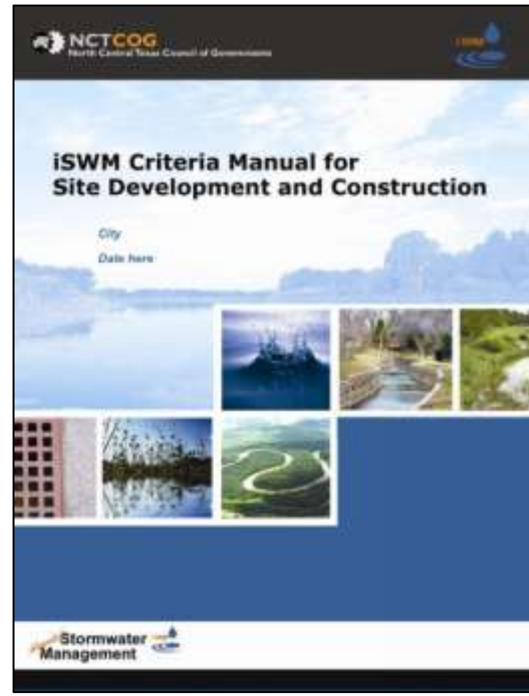
North Central Texas
Council of Governments

iSWM

Process of Creating an LID Site Plan: iSWM™

Site Plans According to iSWM™

- More focus on stormwater in the *development process*
  - ➢ *Section 2.0 in Criteria Manual for Site Development and Construction*



- iSWM™ *integrated* Site Design Practices
  - ➢ *Section 3.2.2 in Criteria Manual for Site Development and Construction*
  - ➢ *Section 2.0 in Planning Technical Manual*
- iSWM™ Stormwater Controls
  - ➢ *Section 3.2.3 in Criteria Manual for Site Development and Construction*
  - ➢ *Site Development Controls Technical Manual*

Process of Creating an LID Site Plan: iSWM™ Development Process

STEP 1

Review Local Requirements and Municipality Processes

↓

STEP 2

Collect Data and Perform Site Analysis

↓

STEP 3

Prepare Conceptual/Preliminary iSWM Plans

↓

STEP 4

Prepare Final iSWM Plans and iSWM Construction Plans

↓

STEP 5

Complete Operations and Maintenance Plan

Process of Creating an LID Site Plan: iSWM™ Development Process

STEP 1

Review Local Requirements and Municipality Processes

STEP 2

Collect Data and Perform Site Analysis

STEP 3

Prepare Conceptual/Preliminary iSWM Plans

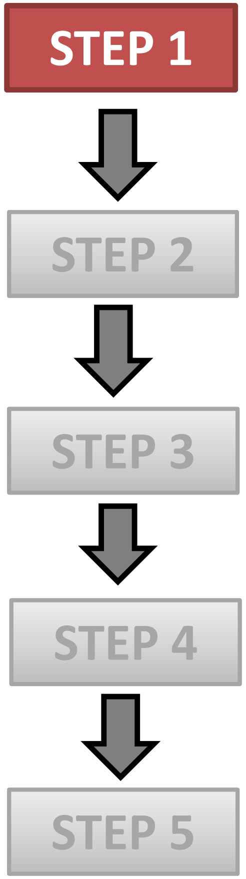
STEP 4

Prepare Final iSWM Plans and iSWM Construction Plans

STEP 5

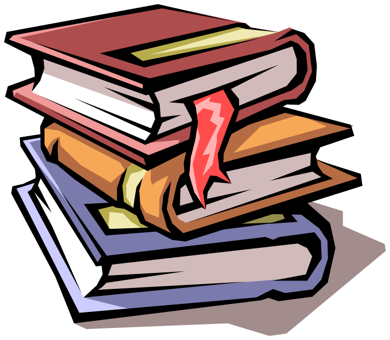
Complete Operations and Maintenance Plan

Process of Creating an LID Site Plan: iSWM™ Development Process



<u>STEP 1:</u> Review Local Requirements and Municipality Processes

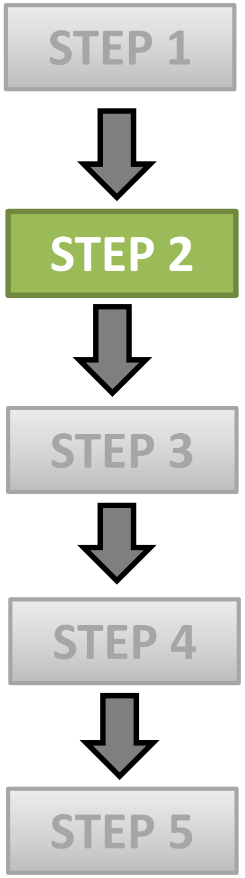
- iSWM Criteria Manual for Site Development and Construction (including local provisions) if adopted by local government or other drainage requirements
- Other available iSWM Program documents
- State and Federal Regulatory Requirements
- Other Local Municipal Ordinances/Criteria
  - *Development Codes*
  - *Tree and Landscape Requirements*
  - *Erosion Control Plans*
  - *Floodplain Ordinances*
  - *Any other applicable requirements*

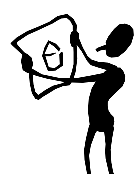


Process of Creating an LID Site Plan: iSWM™ Development Process

STEP 2: Collect Data and Perform Site Analysis

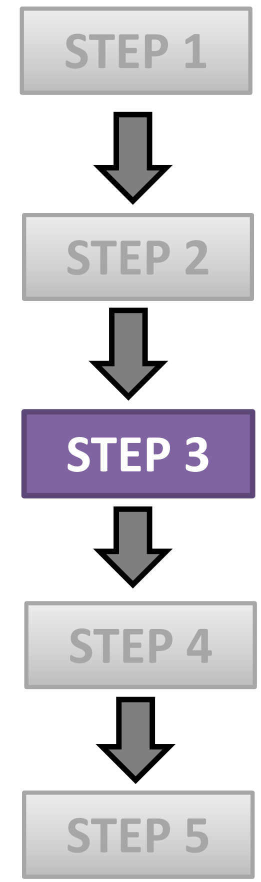
- Topography
- Drainage patterns and basins
- Intermittent and perennial streams on-site and off-site that will receive discharges from development
- Soil types
- Ground cover and vegetation
- Existing development
- Existing stormwater facilities on and off-site that receive discharges from development
- Wetland and critical habitat areas
- Boundaries of wooded areas and tree clusters
- Floodplain boundaries
- State and Federal Regulatory Requirements
- Steep Slopes
- Required buffers and setbacks
- Proposed stream crossings
- Other protection areas





Process of Creating an LID Site Plan: iSWM™ Development Process

<u>STEP 3a:</u> Conceptual iSWM Plans

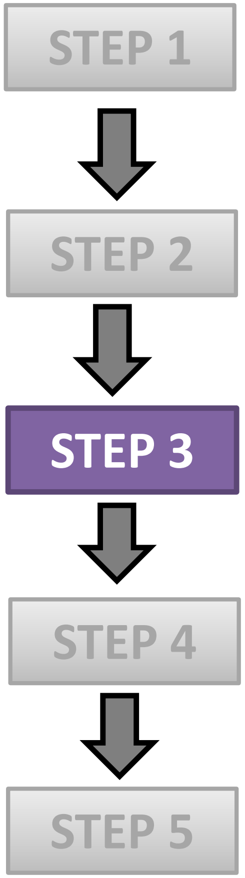


- Essentially a brainstorming meeting before plan development
- All parties should evaluate the site to determine what *integrated* Site Design practices are applicable
- No calculations should be provided at this point
- Opportunity for City, developer/consultants to get on the same page about stormwater expectations

PROCESS OF CREATING AN LID SITE PLAN: iSWM™ DEVELOPMENT PROCESS

<u>STEP 3b:</u> Preliminary iSWM Plans

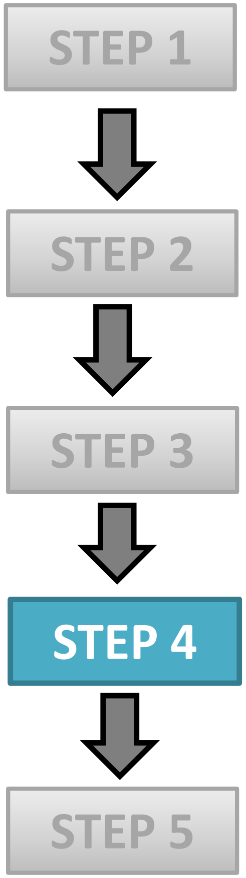
- Use <u>*integrated* Site Design Practices</u> to develop site layout:
  - Preserve natural features defined in **Step 2**
  - Fit development to the terrain and minimize land disturbance
  - Reduce impervious surface
  - Preserve and utilize natural drainage system whenever possible
- Use LID compatible stormwater controls



Process of Creating an LID Site Plan: iSWM™ Development Process

STEP 4: Prepare Final iSWM Plans and iSWM Construction Plans

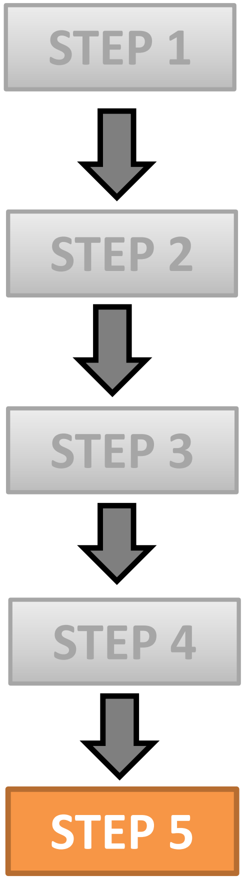
- Provide additional detail to the Preliminary iSWM Plan and reflect changes requested by local authority
- Includes:
  - Revised elements of the Preliminary iSWM Plans
  - Landscape Plan
  - Operation and Maintenance Plan
  - Permits/waiver request
- Requirements outlined in Chapter 5 checklist (can be customized)



Process of Creating an LID Site Plan: iSWM™ Development Process

STEP 5: Operations and Maintenance Plan

- Provided with the Final iSWM Plan
- Defines which entity has responsibility of O&M
- Includes items such as:
  - Responsible party for all tasks in plan
  - Inspection and maintenance information
  - Maintenance of permanent controls and drainage facilities *during construction*
  - Cleaning and repair of stormwater controls and drainage facilities *before transfer of ownership*
  - *Frequency of inspections* for the life of the permanent structures



PROCESS OF CREATING AN LID SITE PLAN: *integrated* SITE DESIGN

What is *integrated* Site Design:

Section 3.2.2 of *iSWM Criteria Manual*

Section 2 of *iSWM Planning Technical Manual*

- General Goals:
  - Conserve Natural Areas
  - Reduce Impervious Cover
  - Better integrate stormwater treatment

- Site Design Practices can help to:
  - Reduce amount of runoff and pollutants generated from the site
  - Provide nonstructural on-site treatment and control of runoff

Process of Creating an LID Site Plan: *integrated* Site Design

Goals of *integrated* Site Design:

- Manage stormwater as close to point of origin as possible
- Prevent stormwater impacts rather than mitigate them
- Use of simple, nonstructural methods that are lower cost and lower maintenance than structural controls
- Create a multifunctional landscape

- Hydrology is the framework for site design
- Reduction in PEAK FLOW and VOLUMES =
  Reduction in SIZE and COST

iSWM

PROCESS OF CREATING AN LID SITE PLAN: *integrated* SITE DESIGN

Examples of *integrated* Site Design:

Conservation of Natural Features and Resources:

- Preserve undisturbed natural areas
- Preserve riparian buffers
- Avoid floodplains
- Avoid steep slopes
- Minimize siting on porous or erodible soils

Lower Impact Site Design Techniques:

- Fit design to the terrain
- Locate development in less sensitive areas
- Reduce limits of clearing and grading
- Utilize open space development
- Consider creative designs

iSWM

Process of Creating an LID Site Plan: *integrated* Site Design

Examples of *integrated* Site Design:

Reduction of Impervious Cover

- Reduce roadway lengths and widths
- Reduce building footprints
- Reduce parking footprint
- Reduce setbacks and frontages
- Use fewer or alternative cul-de-sacs
- Create parking lot stormwater "islands"

Utilization of Natural Features for Stormwater Management:

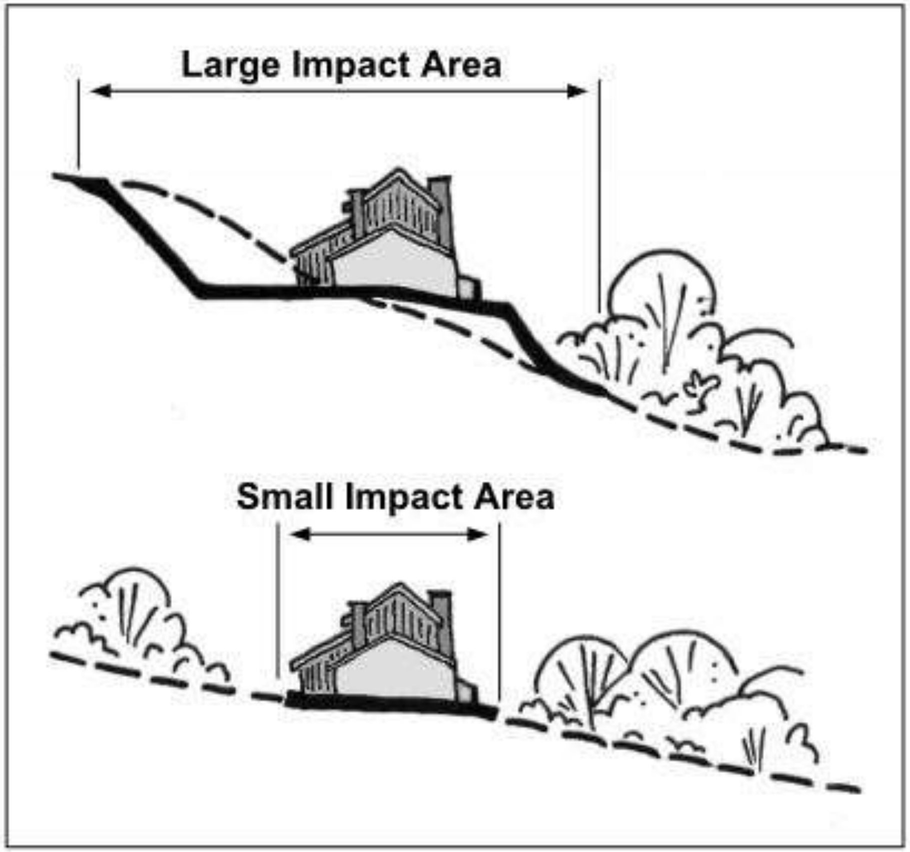
- Use buffers and undisturbed areas
- Use natural drainageways instead of storm sewers
- Use vegetated swale instead of curb gutters
- Drain rooftop runoff to pervious area

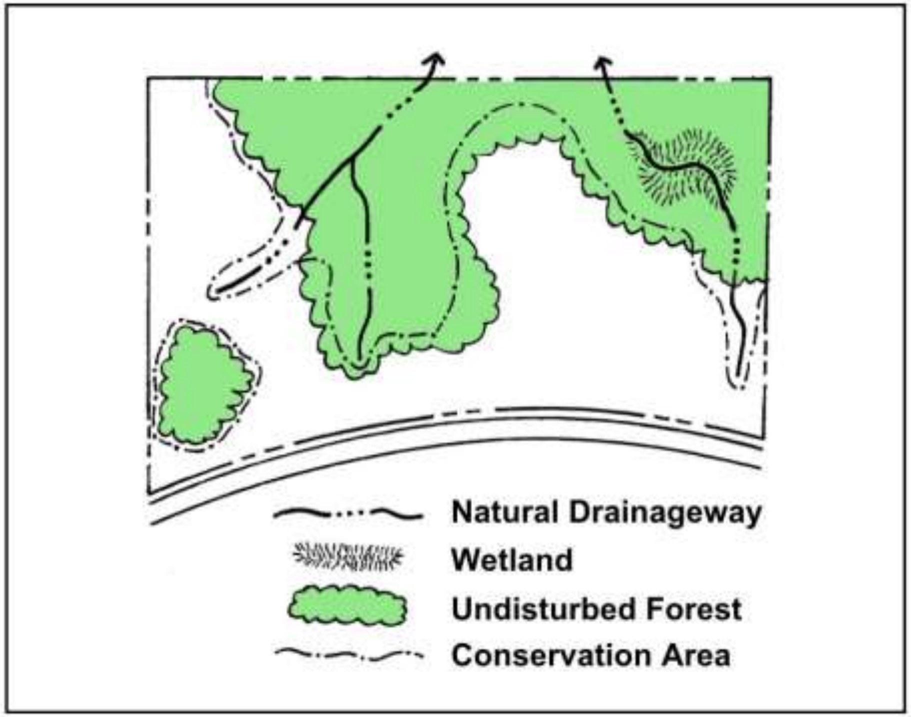
iSWM

PROCESS OF CREATING AN LID SITE PLAN: *integrated* SITE DESIGN

Examples of Conserving Natural Features and Resources:

Avoiding Steep Slopes





Preserve undisturbed natural areas

Figures from Section 2.0 of iSWM Planning Technical Manual

Process of Creating an LID Site Plan: *integrated* Site Design

Examples of Lower Impact Site Design Techniques:

- Subdivision design for hilly or steep terrain utilizes branching streets from collectors that preserves natural drainageways and stream corridors

- Open space subdivision design reduces the limits of clearing and grading and preserves natural features

Figures from Section 2.0 of iSWM Planning Technical Manual

Process of Creating an LID Site Plan: *integrated* Site Design

Examples of Reducing Impervious Cover:

Cul-de-sac with landscaped island

Narrower residential street

Landscaped roadway median

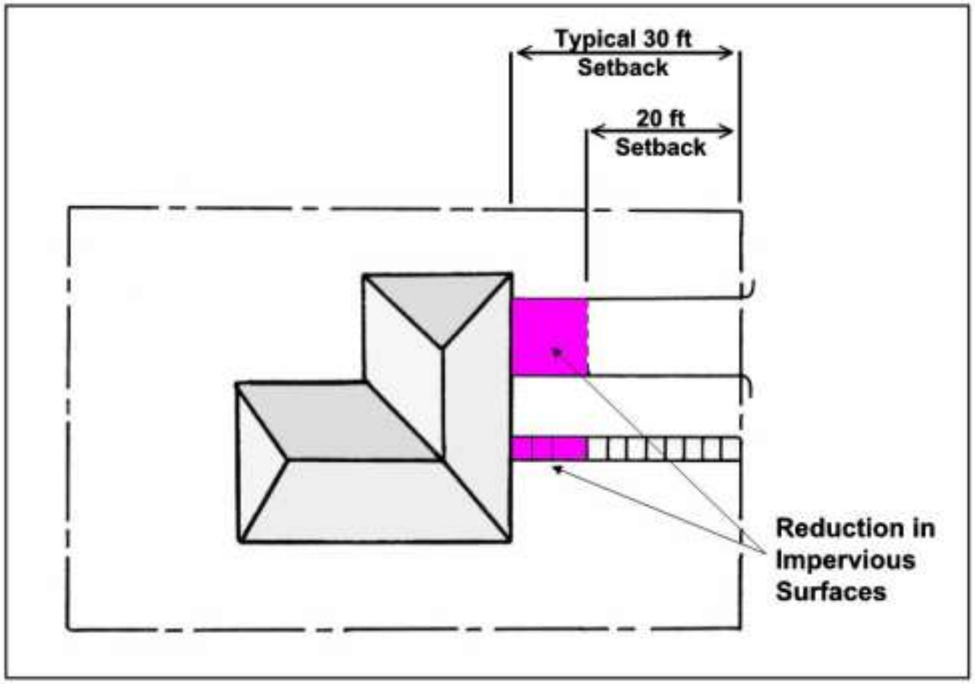
Landscaped parking lot islands

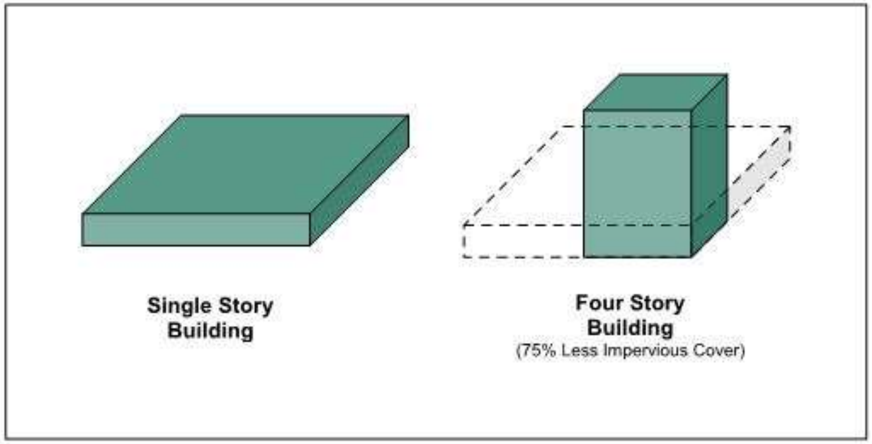
Figures from Section 2.0 of iSWM Planning Technical Manual

Process of Creating an LID Site Plan: *integrated* Site Design

Examples of Reducing Impervious Cover:

Reduced impervious cover by using smaller setbacks





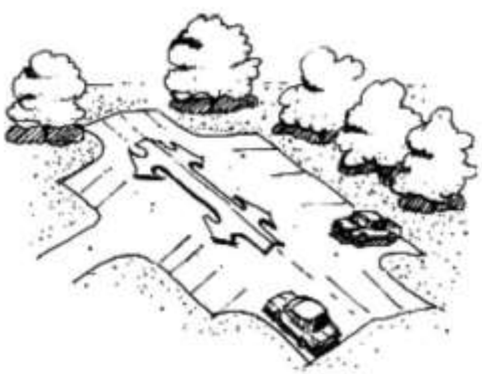
Building up rather than building out can reduce the amount of impervious cover

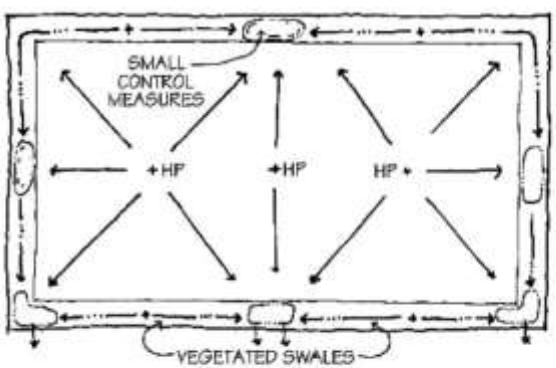
Figures from Section 2.0 of iSWM Planning Technical Manual

Process of Creating an LID Site Plan: *integrated* Site Design

Examples of Utilizing Natural Features for Stormwater Management:

Use vegetated swales instead of curb and gutter





Design paved surfaces to disperse flow to vegetated areas

Figures from Section 2.0 of iSWM Planning Technical Manual

Process of Creating an LID Site Plan: Stormwater Controls

integrated Site Design

vs.

Stormwater Controls

integrated Site Design

- Used to help reduce volume to be treated
- Typically reduces const. costs
- Best practice even if not focused on treatment

Stormwater Controls

- Used to achieve desired treatment of runoff
- More costly component of LID
- Many options for different levels of treatment

Process of Creating an LID Site Plan: Stormwater Controls

<u>Stormwater Controls</u> are used to provide additional stormwater management

What are "LID Stormwater Controls"?

- Stormwater Infrastructure that treats runoff using infiltration, evapotranspiration, biological uptake, etc.
- Green Infrastructure
- Types of LID structural controls:

➢ Bioretention	➢ Planter Box
➢ Enhanced Swale	➢ Infiltration Trench
➢ Porous Pavement	➢ Stormwater Ponds
➢ Underground Detention	➢ Green Roof
➢ Filter Strip	➢ Many others

iSWM

Process of Creating an LID Site Plan: Stormwater Controls

How is treatment in stormwater controls measured?

- Required treatment level based on local criteria
- Typical treatment levels require that the 85th percentile storm be treated
- This is also known as the "first flush"
- In North Texas 85th percentile is about 1.5 inches

Process of Creating an LID Site Plan: Stormwater Controls

What pollutants should be removed?

- Dependent on location and local criteria
- Total Suspended Solids (TSS)
- Nutrients such as nitrogen, phosphorus, etc.

Process of Creating an LID Site Plan: Stormwater Controls

Bioretention

- Most common stormwater control used
- Applicable for small drainage areas (5 acres or less)
- Good retrofit capability
- Can serve as an aesthetic feature

POLLUTANT REMOVAL

80%	**Total Suspended Solids**
60/50%	**Nutrients** - Total Phosphorus / Total Nitrogen removal
M	**Metals** - Cadmium, Copper, Lead, and Zinc removal
No Data	**Pathogens** - Coliform, Streptococci, E. Coli removal

Process of Creating an LID Site Plan: Stormwater Controls

Enhanced Swales

- Combines treatment with conveyance system
- Less expensive than curb/gutter
- Reduces runoff velocity
- Can be higher maintenance than curb/gutter systems

POLLUTANT REMOVAL (DRY SWALE)

80%	**Total Suspended Solids**
25/40%	**Nutrients** - Total Phosphorus / Total Nitrogen removal
40%	**Metals** - Cadmium, Copper, Lead, and Zinc removal
No data	**Pathogens** - Coliform, Streptococci, E.Coli removal

iSWM

Process of Creating an LID Site Plan: Stormwater Controls

Filter Strip

- Distribute runoff from impervious area as sheet flow across a pervious area
- Low construction cost
- Used as part of a larger system to provide *pretreatment*
- Cannot alone achieve 80% TSS removal

POLLUTANT REMOVAL

50%	**Total Suspended Solids**
20/20%	**Nutrients** - Total Phosphorus / Total Nitrogen removal
40%	**Metals** - Cadmium, Copper, Lead, and Zinc removal
No data	**Pathogens** - Coliform, Streptococci, E.Coli removal

iSWM

Process of Creating an LID Site Plan: Stormwater Controls

Planter Box

- Pollutant removal achieved through filtration – similar to bioretention
- Storage can create decrease in peak flow
- Used in heavy urban applications when space is limited

POLLUTANT REMOVAL

80%	**Total Suspended Solids**
60/40%	**Nutrients** - Total Phosphorus / Total Nitrogen removal
No data	**Metals** - Cadmium, Copper, Lead, and Zinc removal
No data	**Pathogens** - Coliform, Streptococci, E.Coli removal

iSWM

Process of Creating an LID Site Plan: Stormwater Controls

Infiltration Trench

- Excavated trench filled with stone media, pea gravel, and sand filter layers
- Requires a sediment forebay
- Good for small sites with existing porous soils
- Less aesthetic design than bioretention

POLLUTANT REMOVAL (DRY SWALE)

80%	**Total Suspended Solids**
60/60%	**Nutrients** - Total Phosphorus / Total Nitrogen removal
90%	**Metals** - Cadmium, Copper, Lead, and Zinc removal
90%	**Pathogens** - Coliform, Streptococci, E.Coli removal

iSWM

Process of Creating an LID Site Plan: Stormwater Controls

Green Roof

- Provides reduction in runoff volume, especially in heavy urban areas
- Higher initial cost but potential lower life cycle cost through longevity
- Requires additional roof support and special design attention

POLLUTANT REMOVAL

85%	**Total Suspended Solids**
95/16%	**Nutrients** - Total Phosphorus / Total Nitrogen removal
25%	**Metals** - Cadmium, Copper, Lead, and Zinc removal
No Data	**Pathogens** - Coliform, Streptococci, E. Coli removal

iSWM

Process of Creating an LID Site Plan: Stormwater Controls

Porous Pavement

- Types:
  - Modular porous pavers (upper right)
  - Porous Concrete/Asphalt (lower right)
- Good for applications in low traffic parking lots in soils with high permeability
- Higher maintenance requirements than typical pavement
- Pollutant removal varies based on the type of system used (typically used as a secondary treatment option)

Comparison of Traditional Design and Innovative Site Plan for a Residential Subdivision

(Example #2 from Section 2.3 of iSWM Planning Technical Manual)

PROCESS OF CREATING AN LID SITE PLAN: *integrated* SITE DESIGN

<u>Traditional Design:</u>

- Most of the site is cleared and graded
- Little to no buffer provided for small stream through development
- Wide Streets and large, paved cul-de-sacs

Figures from Section 2.0 of iSWM Planning Technical Manual

Process of Creating an LID Site Plan: *integrated* Site Design

Innovative Design:

- Site conforms to natural terrain
- Wider main thoroughfare winds along ridgeline
- Smaller loop roads with landscaped islands provide access to homes
- Large riparian buffers and conservation area close to 1/3 of site

Figures from Section 2.0 of iSWM Planning Technical Manual

Process of Creating an LID Site Plan

Examples from LID Competition

North Central Texas
Council of Governments

Overview of North Texas LID Competition

Urban Redevelopment – Central Arlington Library

- 9 acre site in Downtown Arlington
- Library in need of substantial improvements
- Two options for moving forward
  - Expand and renovate by adding a 3rd floor and parking structure
  - Build a new library structure on the same site

CHALLENGE: Design a property that has the potential of meeting the vision for the Central Library and Civic Center and serving as a catalyst for Downtown Arlington while incorporating LID techniques

Process of Creating an LID Site Plan: Examples from LID Competition

URBAN INFILL / CENTRAL LIBRARY PROJECT

ARLINGTON, TX

Schrickel, Rollins, and Associates, Inc.

iSWM

LID Success Strategy:
Social Interaction for Environmental Success

The original city center of Arlington
was the intersection of CENTER & MAIN

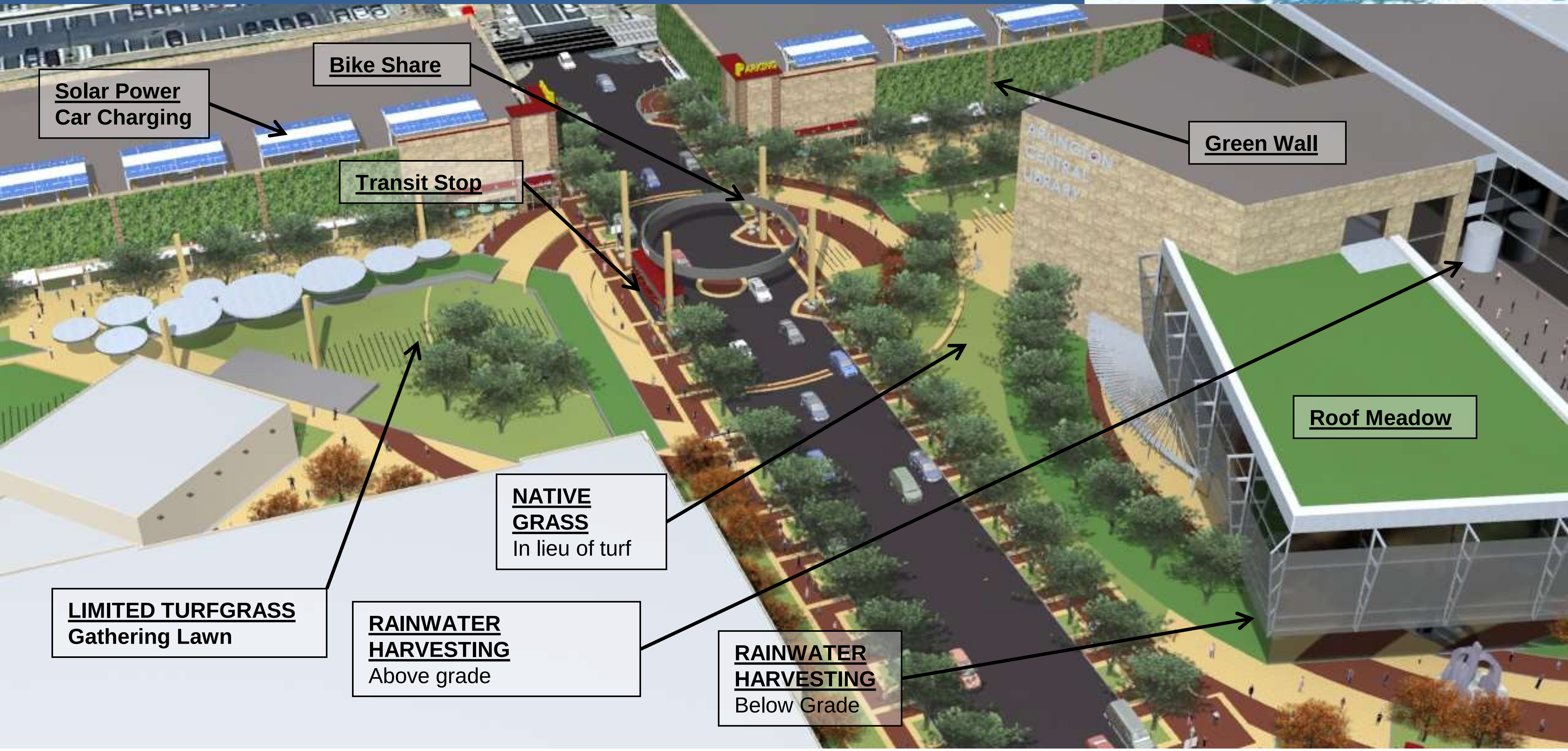
Intersection of Center & Main

The Old Mineral Well

WATER was at the core of the city center

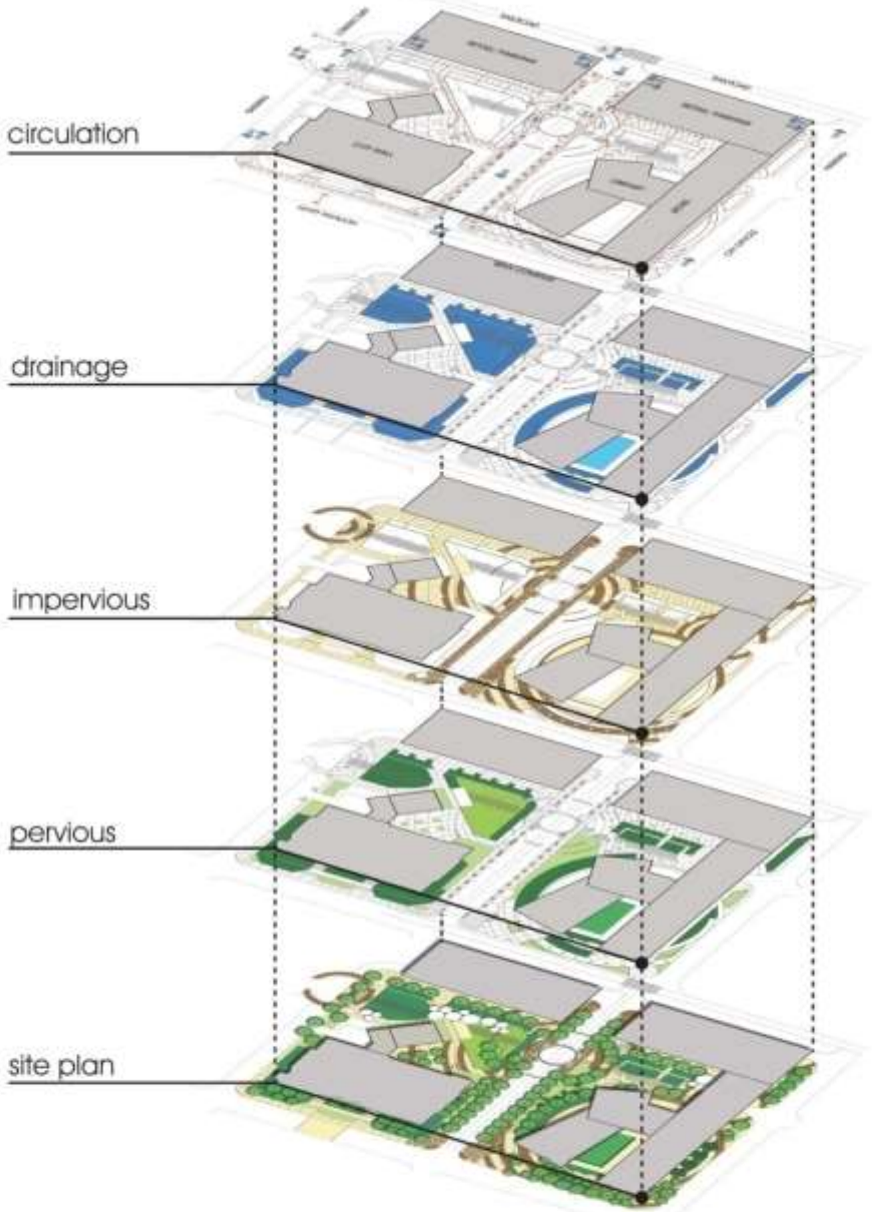
This plan proposes to return WATER to the heart of the civic center through LID practices that serve as a site amenity for a downtown urban village

iSWM



FACT: HVAC condensate reaches peak levels when plants need more irrigation.

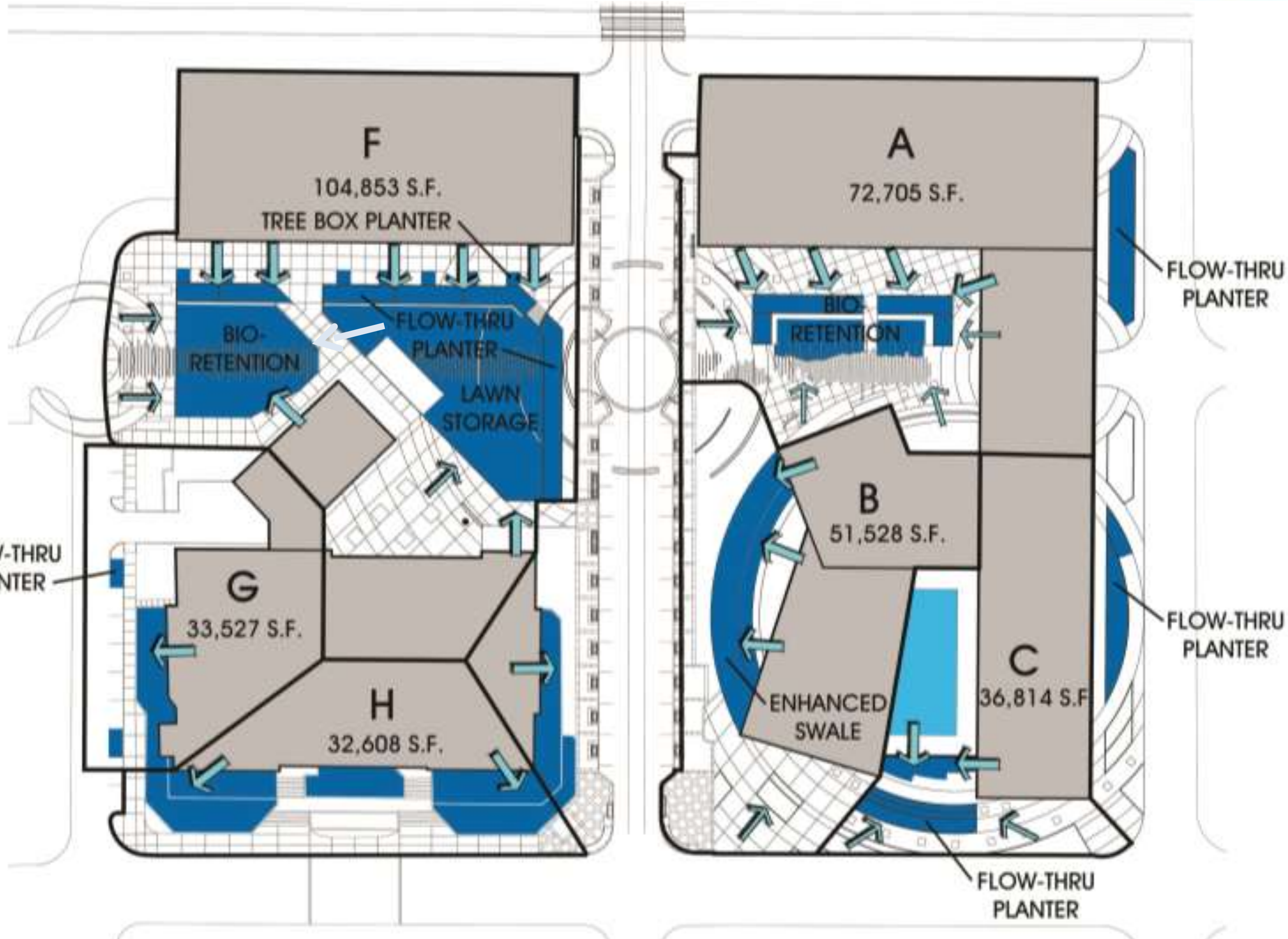
LID SUCCESS STRATEGY:
INTEGRATE LID FEATURES INTO URBAN SPACES



Low Impact Development strategies will be layered with functional and aesthetic features to create strong civic spaces.

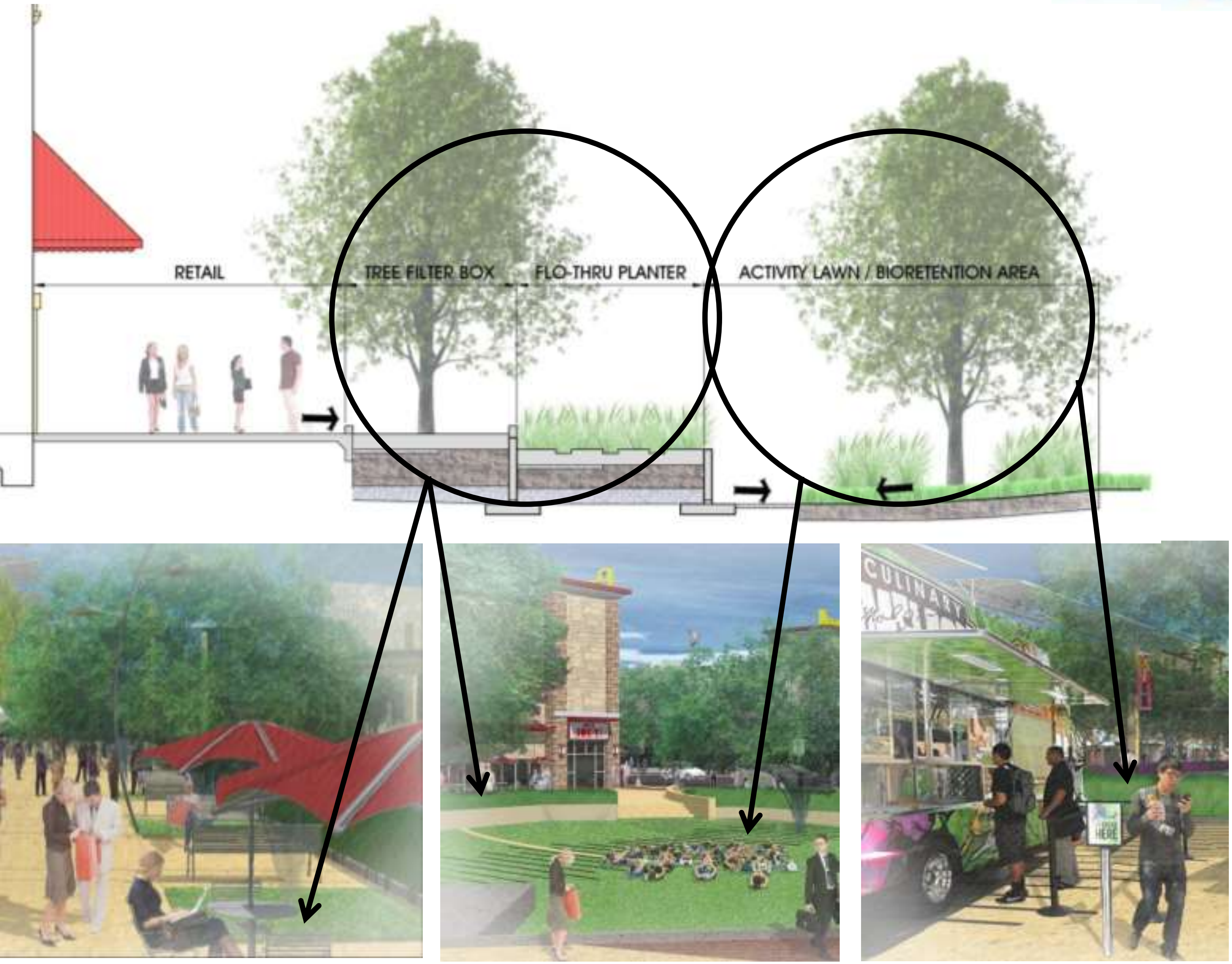
iSWM

LID Success Strategy:
Blend Blue & Green



iSWM

LID Success Strategy:
Make it an Amenity

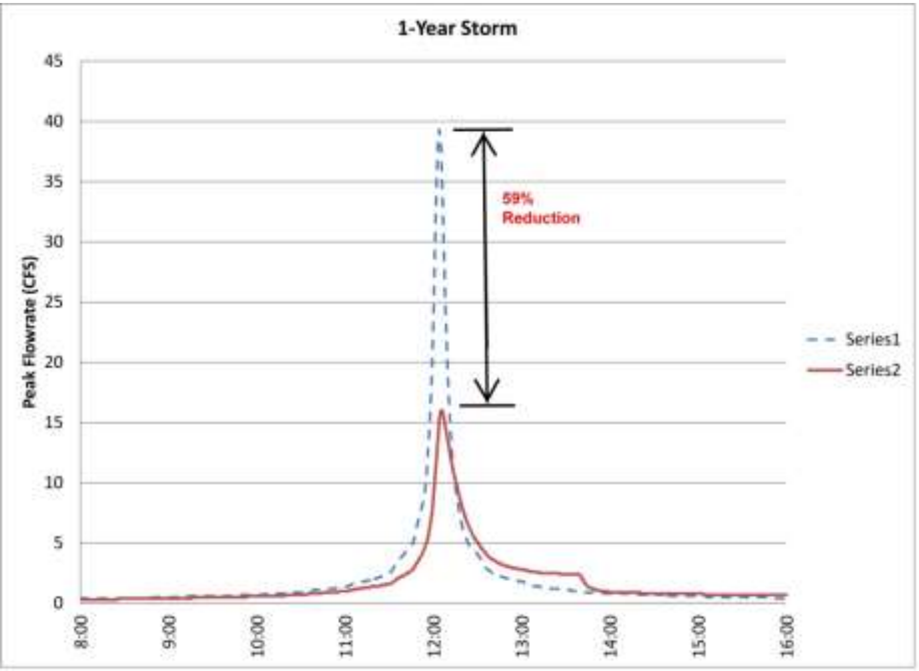


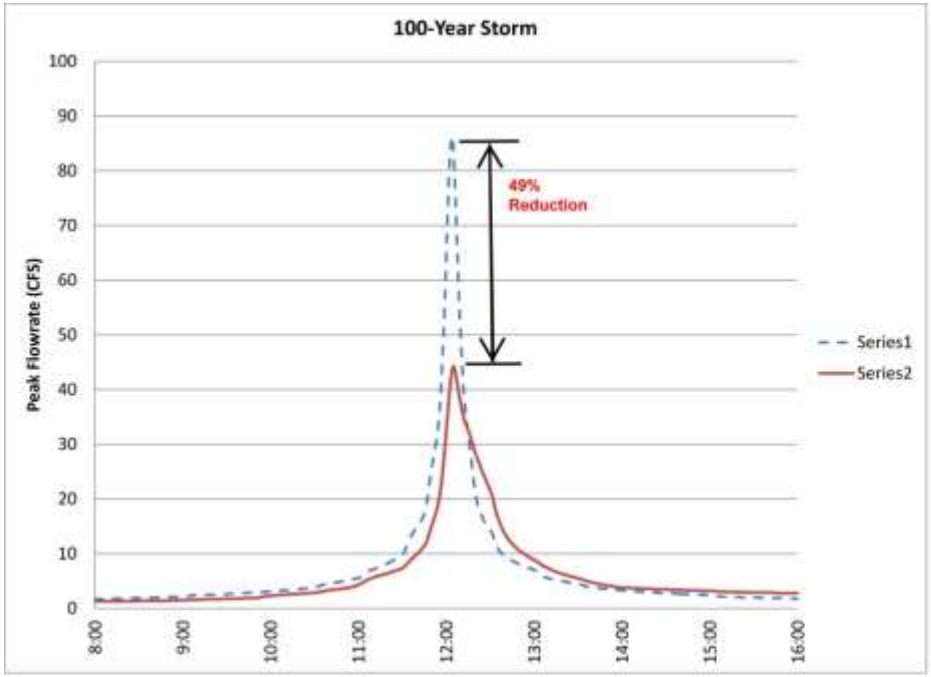
LID Success Strategy:
Think Outside the Pipe

LID Design

Conventional Design

LID Success Strategy:
Quantify your BMP's





LID Success Conclusion:

For People to Be Good Stewards of The Environment They Must be Connected To Natural Processes

PROCESS OF CREATING AN LID SITE PLAN: EXAMPLES FROM LID COMPETITION

Cedars West (Dallas)

Winning design by:

- Halff Associates, Inc.
- Jea-Javier Espinoza Architect
- Texas Agrilife Extension
- Ecosystem Design Group, Lady Bird Johnson Wildflower Center
- Caye Cook and Associates, Inc.
- Sustainable Best Practices

Overview of North Texas LID Competition

Urban Mixed-Use Development – Cedars West, Dallas

- 60 acres of vacant land
- Southwest of downtown Dallas between Cedars neighborhood and Trinity River

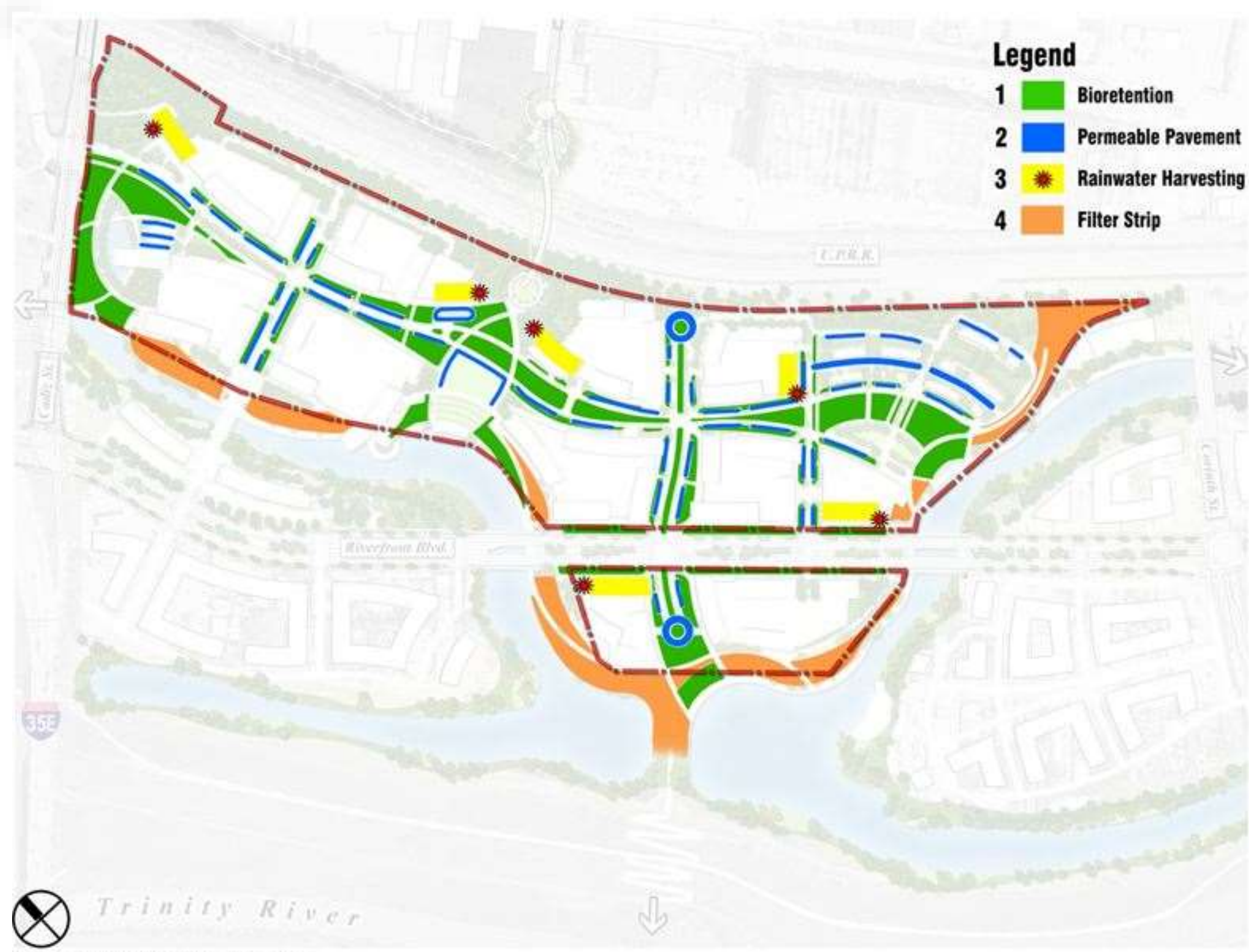
CHALLENGE: Design a new "green" mixed-use development and interior roadway system that incorporates LID Techniques:

- Reduces impervious cover
- Promotes infiltration
- Reduces stormwater pollution through biofiltration or other means
- Reduces long-term maintenance costs

iSWM

Process of Creating an LID Site Plan: Examples from LID Competition

Cedars West (Dallas)



Overall LID Strategies

Process of Creating an LID Site Plan: Examples from LID Competition

Northern Crossing (Fort Worth)

Winning design by:

- Michael Baker Jr., Inc
- Dewberry
- Craig Design Group
- Brown & Gay

OVERVIEW OF NORTH TEXAS LID COMPETITION

Mixed-Use Development – Northern Crossing, Fort Worth

- 115 acre site
  - 56 acres undeveloped
  - 20 acres reserved for wetland mitigation and detention
- Located in Fossil Creek drainage area
- Required the following:

CHALLENGE: Design a new "green" mixed-use development and interior bike/pedestrian system that incorporates LID techniques

iSWM

Process of Creating an LID Site Plan: Examples from LID Competition

Northern Crossing (Fort Worth)

Approach:

"Overall, the available land was much larger than what was needed for the project. Even with the parking we were able to incorporate substantial green space."

- Common area green space
- Provides amenity
- Creates buffer between residential/non-residential
- Provides room for LID features

Existing Features:

- Site had been cleared previously so no true natural condition existed
- Considered historic pre-development land use
- Incorporated the restoration of native prairie vegetation

Disciplines involved:

- Civil engineer (site design)
- Stormwater engineer (stormwater controls/LID)
- Landscape Architect
- Land Planner
- Architect

PROCESS OF CREATING AN LID SITE PLAN: EXAMPLES FROM LID COMPETITION

Northern Crossing (Fort Worth)

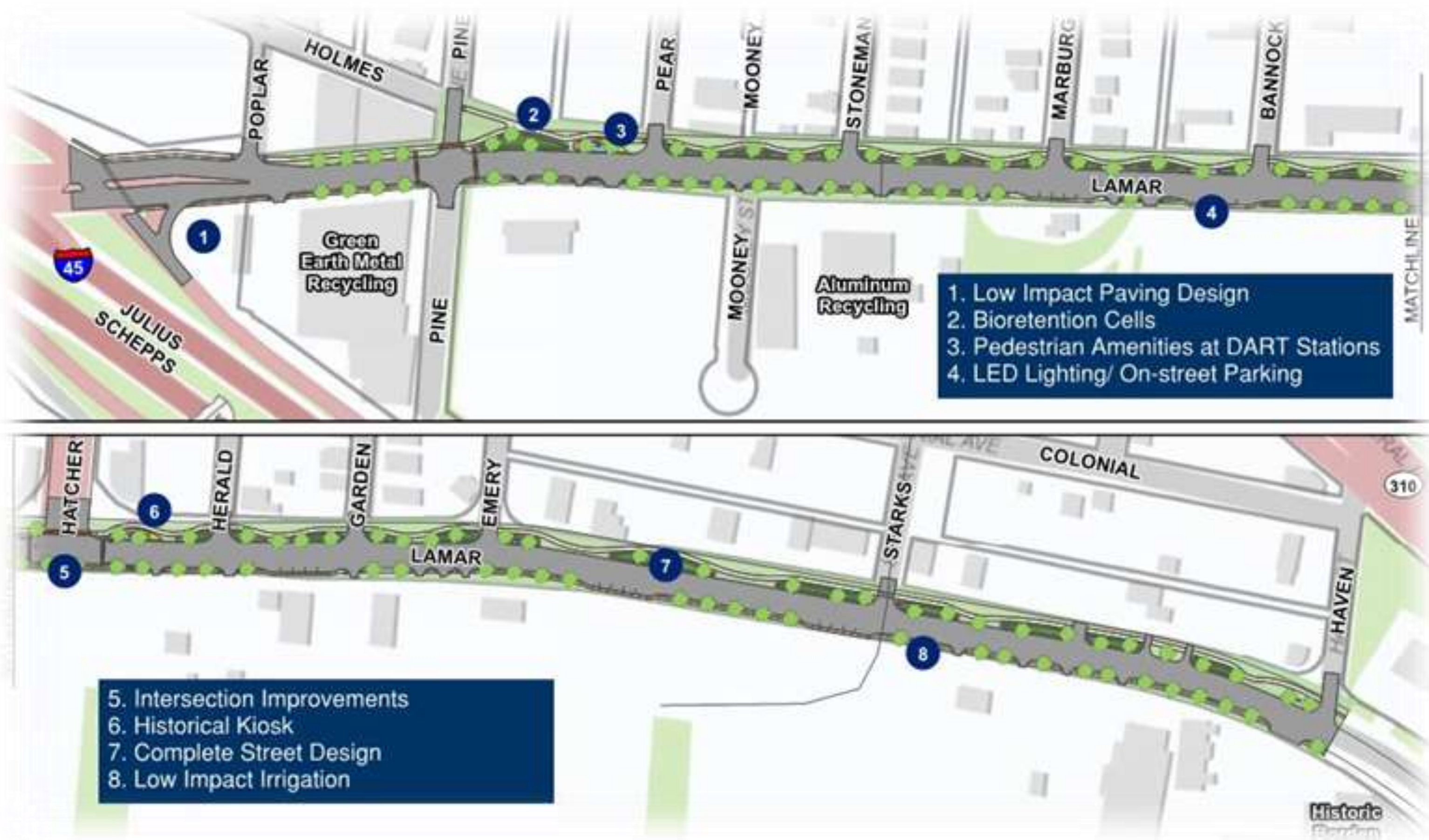
Lessons Learned:

- *"…LID provides an economical and effective way to develop"*
- *"…our pre-conceived notions that LID will not work in our part of the world (primarily due to clay soils) could be overcome with some ingenuity and engineering."*
- *"We learned that LID designs should be focused – there may be a tendency to throw every potential LID measure into a project."*
- ***"A few years ago, I could have described myself as a "LID Scoffer". While I had started to evolve a bit prior to this competition, working through the actual exercise, and conducting the research necessary to support the design and analysis really opened my eyes. It changed my opinion and belief in a big way, and I think this was one of the primary goals of the LID Competition."***

Comments from Burton Johnson, P.E. of Michael Baker Corporation

Process of Creating an LID Site Plan: Examples from LID Competition

South Lamar Street (Dallas)



Winning design by
Freese and Nichols, Inc.

Overview of North Texas LID Competition

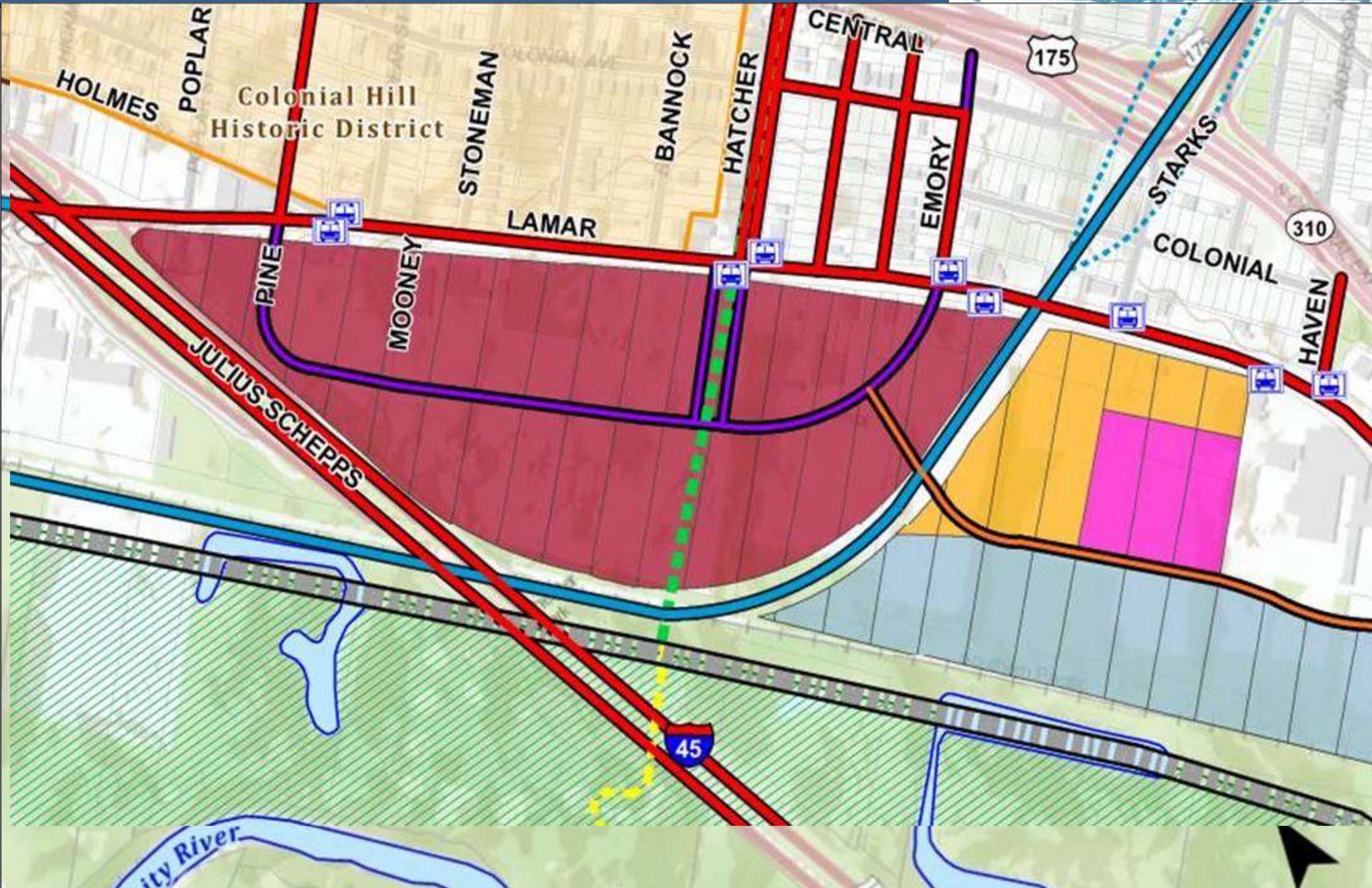
Green Roadway – South Lamar

- One mile stretch of existing South Lamar
- Residential on north side with industrial/commercial on south.
- Drains directly to the Trinity River

CHALLENGE: Design a new "green" roadway section that incorporates LID techniques:

- Reduced impervious cover
- Promotes infiltration
- Reduces pollution by biofiltration or other means
- Reduces long-term maintenance costs

Process of Creating an LID Site Plan: Examples from LID Competition



Process of Creating an LID Site Plan: Examples from LID Competition

Offset Road in ROW

Remove striped median

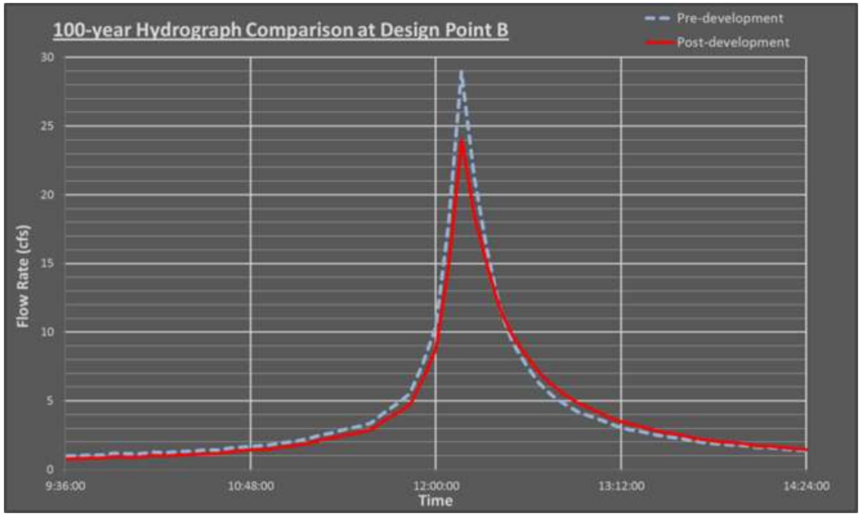
Green space opens up on the north side of road

24% Reduction in Impervious Surface

iSWM

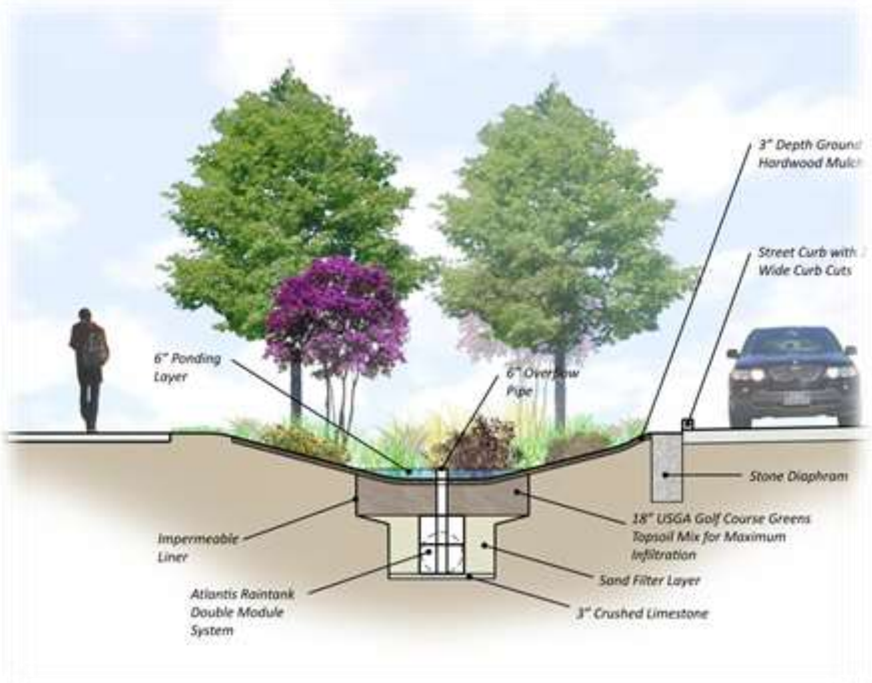
PROCESS OF CREATING AN LID SITE PLAN: EXAMPLES FROM LID COMPETITION

- What are the benefits of reducing impervious area?
  - Up to **17% decrease** in **PEAK FLOW** for runoff within ROW
  - Total of **28% reduction** in Water Quality Volume (WQ_v)



Process of Creating an LID Site Plan: Examples from LID Competition

- What type of BMPs should be used?
  - Many BMPs meet 80% TSS requirement
  - SELECTED: Bioretention
    - Exceed required treatment level
    - Provide method to decentralize drainage
    - Aesthetically pleasing (if properly maintained)



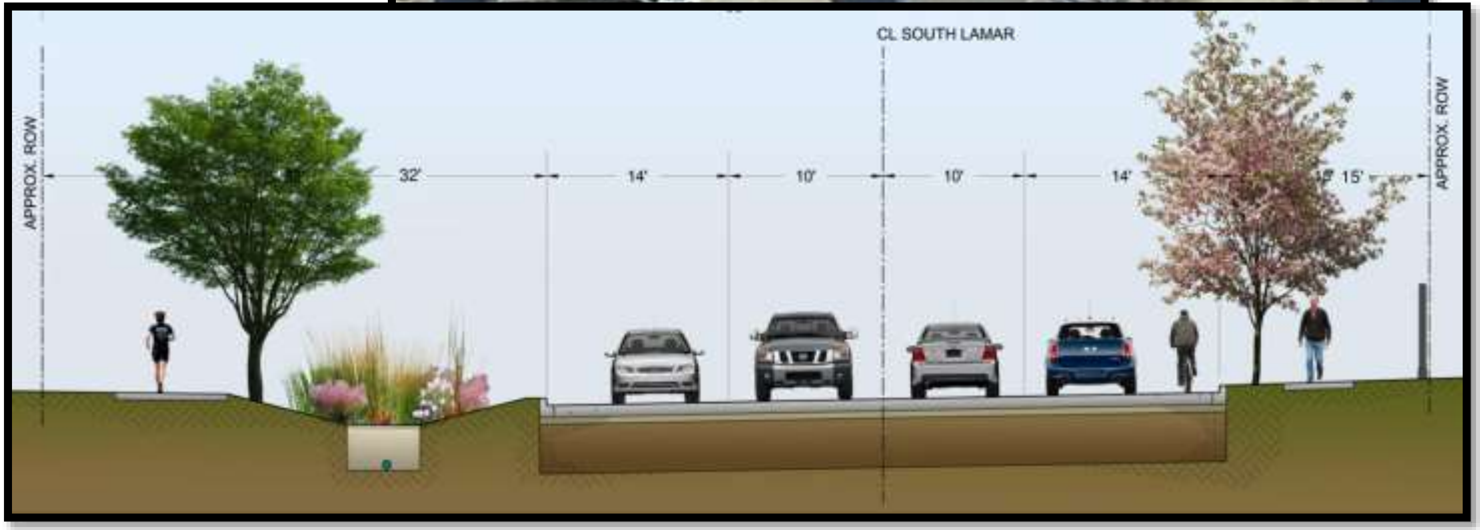
iSWM

Process of Creating an LID Site Plan: Examples from LID Competition

- Determine amount of bioretention required to treat first 1.5” of runoff

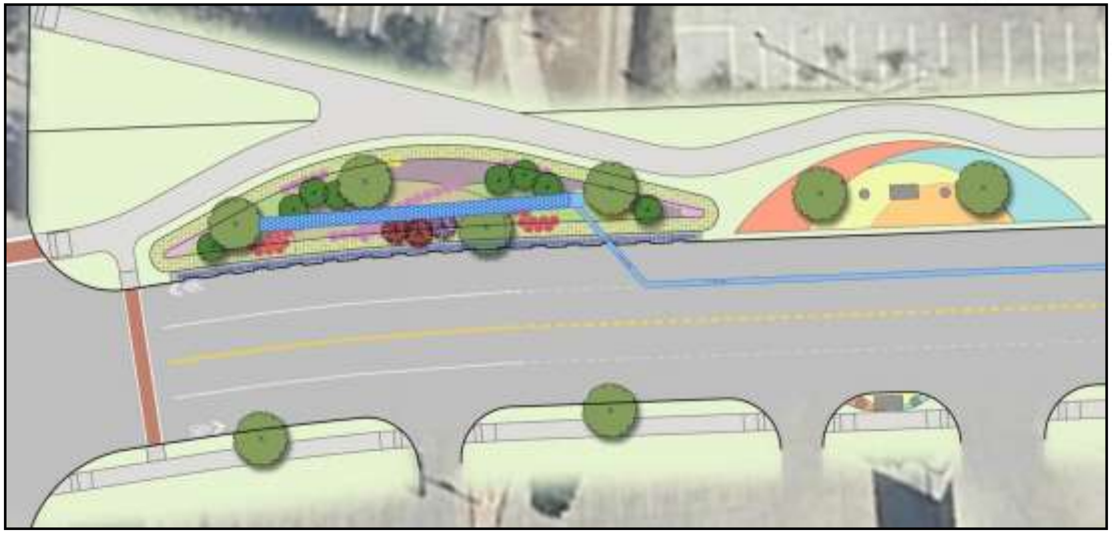
Process of Creating an LID Site Plan: Examples from LID Competition

- Determine site layout and road cross section



PROCESS OF CREATING AN LID SITE PLAN: EXAMPLES FROM LID COMPETITION

- **Specifics of Bioretention**
  - Determine bioretention location and configuration
  - Develop a layout and scheme for the underdrain / overflow pipe
  - Ensure bioretention is designed to not exceed maximum ponding depth and drain time



iSWM

Process of Creating an LID Site Plan: Examples from LID Competition

- **Specifics of Bioretention**
  - Plant selection: Drought/inundation tolerant and native species
  - Sight triangles for roadway applications













Process of Creating an LID Site Plan: Examples from LID Competition

BEFORE

Process of Creating an LID Site Plan: Examples from LID Competition

AFTER

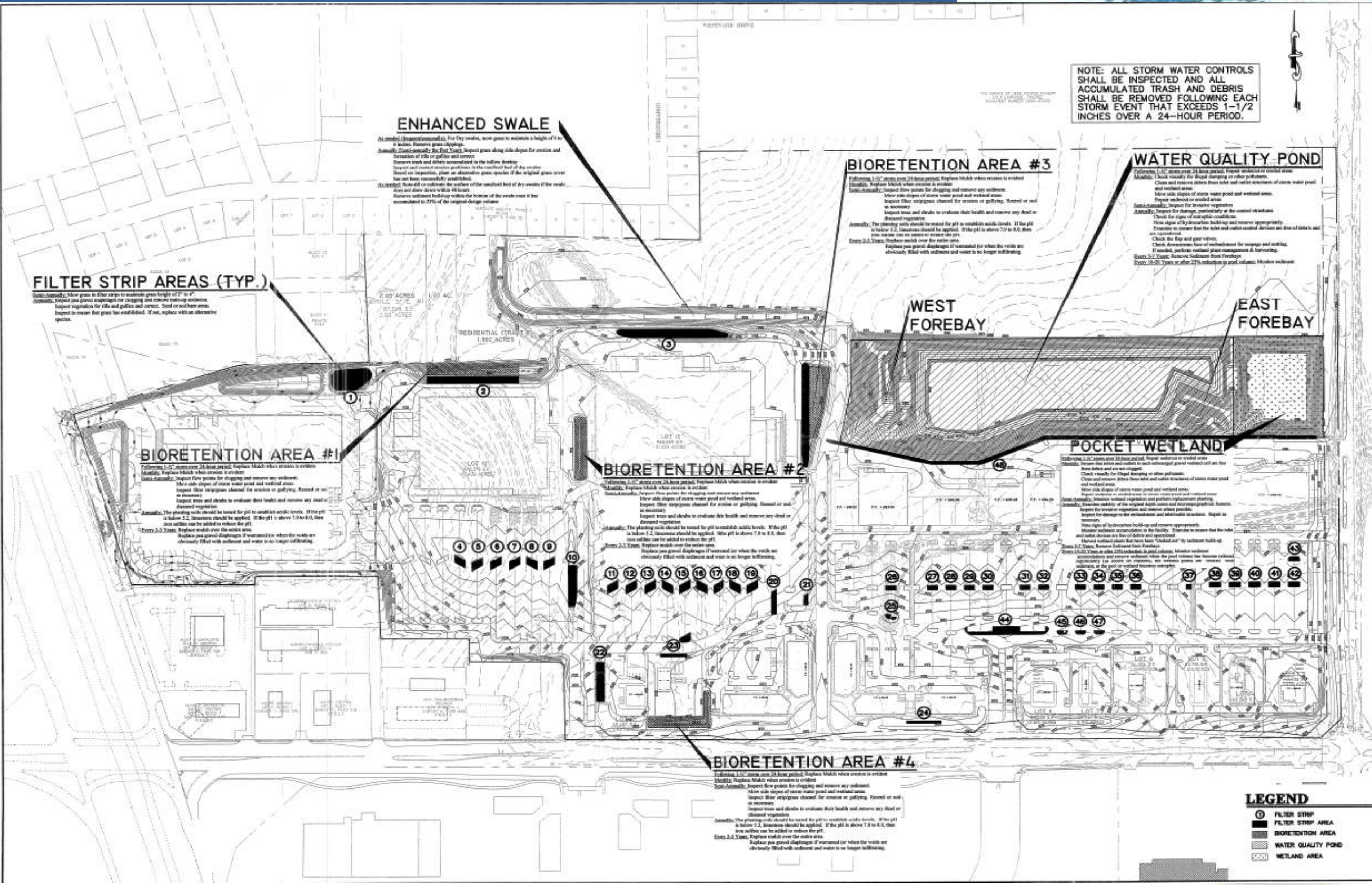
Process of Creating an LID Site Plan

Regional Examples

North Central Texas
Council of Governments

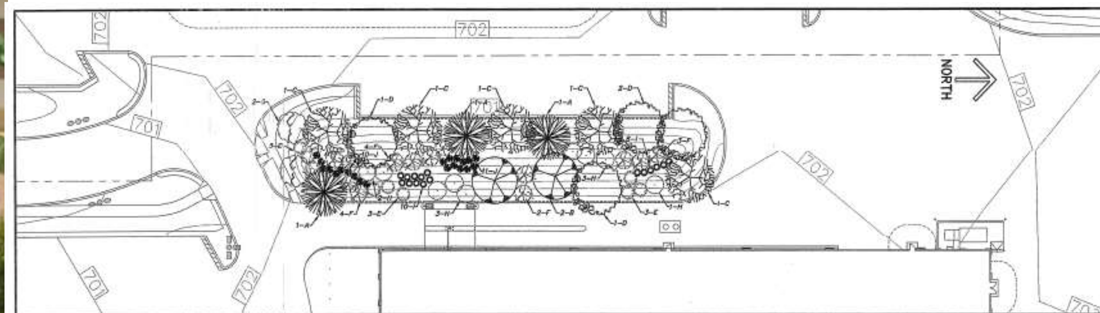
Rayzor Ranch Commercial Development

Denton, TX



Rayzor Ranch Commercial Development

Denton, TX



WAL-MART / SAM'S CLUB BIORETENTION BASIN

PLANT MATERIAL LIST — FULLY ROOT NEWLY STEPPED PLANTS NOT ACCEPTABLE — THIS CHART IS FOR REFERENCE ONLY. CONTRACTOR SHOULD VERIFY QUANTITIES AS SHOWN ON PLAN.

SYMBOL	KEY	COMMON/SCIENTIFIC NAME	QUANTITY	CALIPER	HEIGHT	SPREAD	ROOT	REMARKS
	A.	BALD CYPRESS *Taxodium distichum*	13	2"	9'–12'	4'–6'	CONTAINER	SINGLE TRUNK
	B.	RED OAK *Quercus shumardii*	20	2"	9'–12'	4'–7'	CONTAINER	SINGLE OR MULTI TRUNK
	C.	CEDAR ELM *Ulmus crassifolia*	26	2"	9'–12'	4'–7'	CONTAINER	SINGLE OR MULTI TRUNK
	D	BUR OAK *Quercus macrocarpa*	16	2"	9'–12'	4'–7'	CONTAINER	SINGLE TRUNK
	E	FALSE INDIGO *Amorpha fruticosa*	71	N/A	2'–4'	2'–3'	* 5 gal.	
	F	WAX MYRTLE *Myrica cerifera*	65	N/A	3'–6'	4'–6'	CONTAINER	MULTI TRUNK
	G	RED BUD *Cercis canadensis*	19	1"–2"	6'–8'	4'–5'	CONTAINER	SINGLE OR MULTI TRUNK
	H	BUTTONBUSH *Cephalanthus occidentalis*	32	N/A	N/A	N/A	* 5 GAL.	
	I	BUSHY BLUESTEM *Andropogon glomeratus*	194	N/A	N/A	N/A	* 1 GAL.	
	J	SWITCHGRASS *Panicum virgatum*	224	N/A	N/A	N/A	* 1 GAL.	
	K	GRASS (See note below)	–					

* Size substitutions will be permitted based on availability

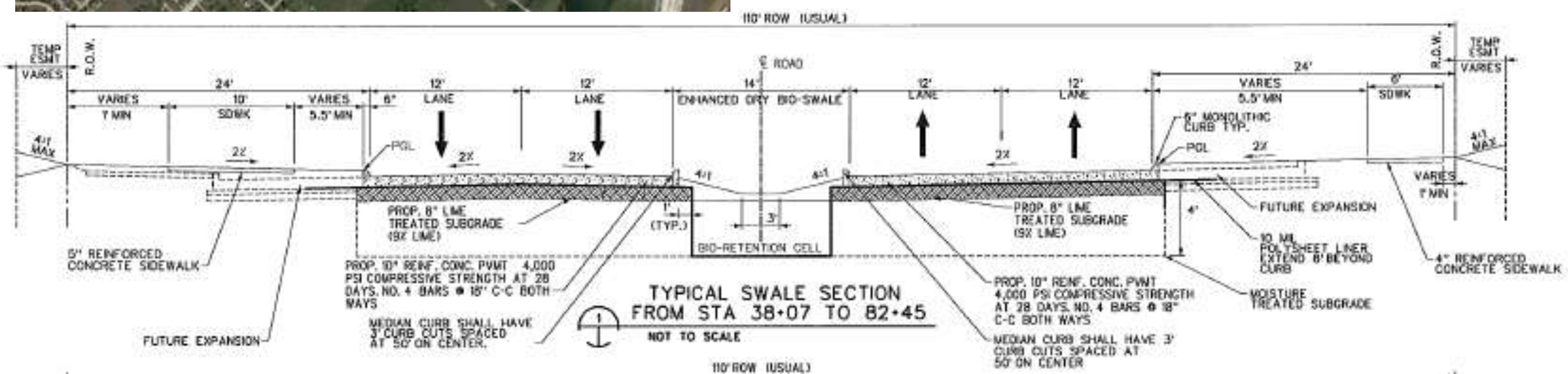
Grassing Note: Entire bioretention basin shall be grassed with Bamert Seed Company (www.bamertseed.com) "Deluxe Prairie Blend" seed at a rate of 20 lbs/acre. Prior to seed application the bioretention basin shall be mulched with shredded hardwood mulch 3 inches thick.

Rayzor Ranch Commercial Development
Denton, TX

Merritt Road

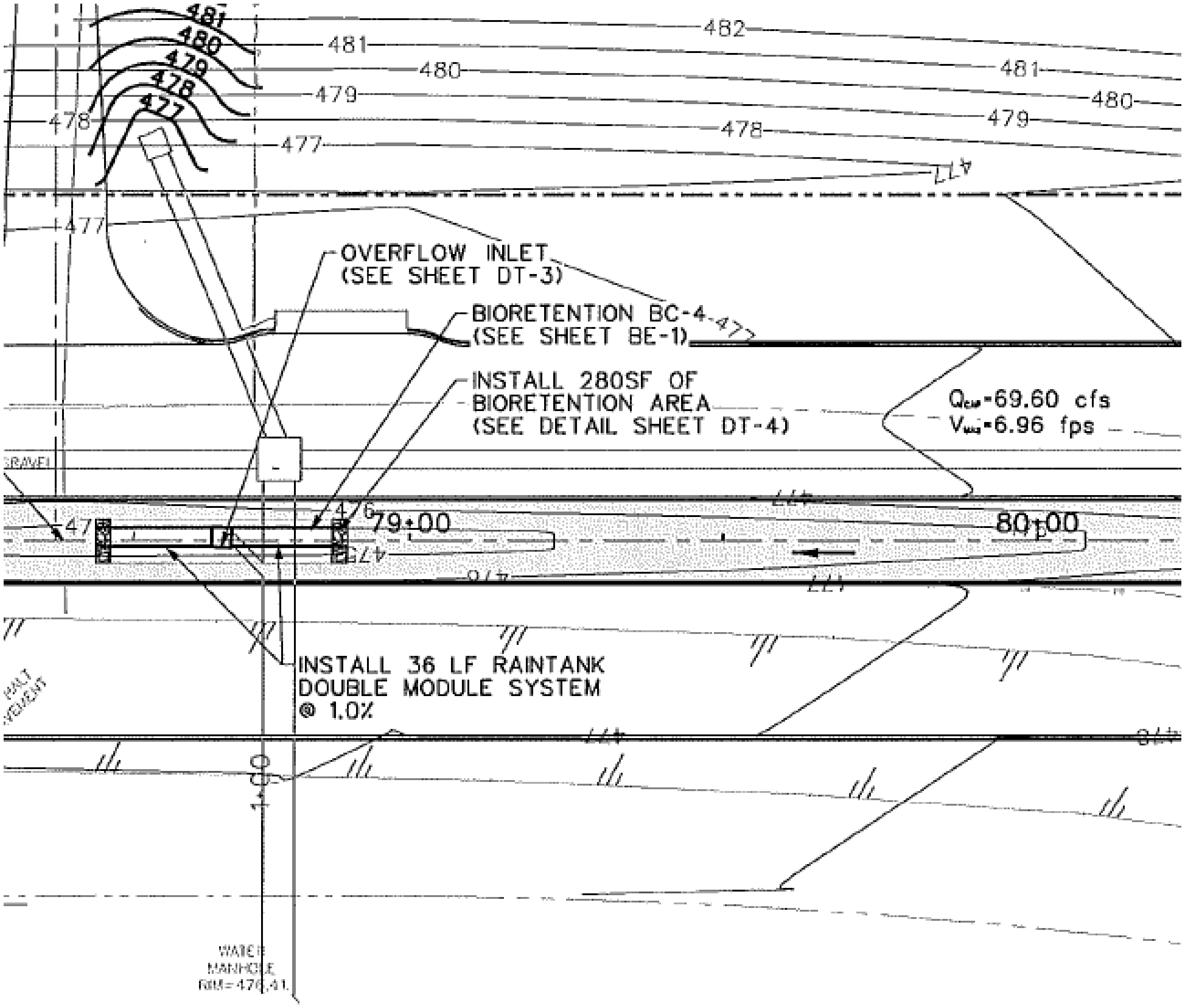
Rowlett, TX

- Approx. 9,070 foot roadway project
- Approx. 3,600 feet of bioretention swales
- Between Liberty Grove Road and Pleasant Valley Road
- Currently under construction (bioretention recently installed)



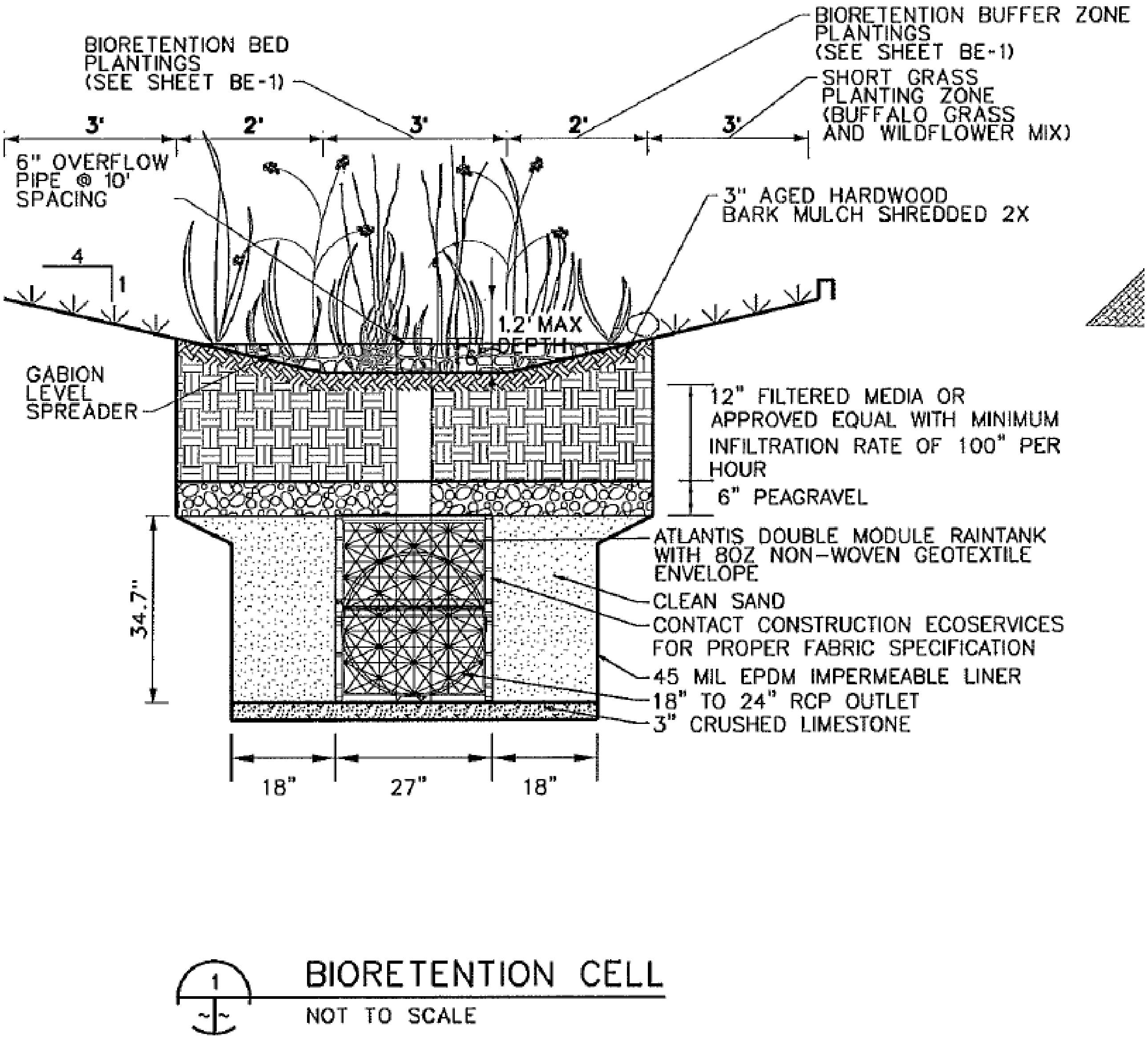
Merritt Road

Rowlett, TX



Merritt Road

Rowlett, TX



Merritt Road

Rowlett, TX

Merritt Road

Rowlett, TX

Process of Creating an LID Site Plan

EPA Case Studies

North Central Texas
Council of Governments

Process of Creating an LID Site Plan: EPA Case Studies

EPA Study: "Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices"

- Report comparing projected or known costs of LID practices with conventional approaches
- Summarizes 17 case studies of various types of developments
- In most cases, LID project costs "were shown to be both fiscally and environmentally beneficial to communities"
- Pilot Project for Seattle's Street Edge Alternatives (SEA) program

NOTE: Cost comparison will be shown in next section of the presentation

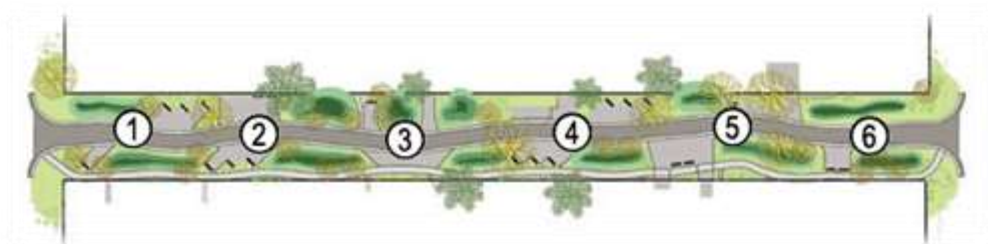
Reference for data and images:
EPA 841-F-07-006. United States Environmental Protection Agency – Nonpoint Source Control Branch (4503T)

Process of Creating an LID Site Plan: EPA Case Studies

2nd Avenue SEA Street (Seattle, WA)

Pilot Project for Seattle's Street Edge Alternatives (SEA) program

- Redesign a 660-foot block with various LID techniques
- GOALS:
  - Reduce runoff
  - Provide a more "livable" community
- Components:
  - Replaced curb and gutter with bioswales in ROW on both sides of street
  - Street width reduced from 25 to 14 feet
  - Added 100 evergreen trees and 1,100 shrubs
  - Significant amount of community outreach to raise level of community acceptance



Reference for data and images:
www.seattle.gov – Street Edge Alternatives (SEA)
EPA 841-F-07-006 - "Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices

iSWM

Process of Creating an LID Site Plan: EPA Case Studies

2nd Avenue SEA Street (Seattle, WA)

Pilot Project for Seattle's Street Edge Alternatives (SEA) program

- More closely mimics natural landscape prior to development by using Natural Drainage Systems (NDS) approach
- 18% Reduction in impervious surface from traditional street
- Hydrologic monitoring indicates a 99% reduction in total potential surface runoff
- At time of report, no runoff was recorded from the site since December 2002 (including the highest-ever 24-hour recorded rainfall)
- Retaining more than original design of 0.75 inches

Reference for data and images:
www.seattle.gov – Street Edge Alternatives (SEA)
EPA 841-F-07-006 - "Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices

Process of Creating an LID Site Plan: EPA Case Studies

Prairie Crossing Subdivisions (Grayslake, IL)

Mixed-Use Conservation Development

- 678 acre site with 470 acres of open space
- Consists of:
  - 362 residential units
  - 73 acres of commercial property
  - Schools, community center, biking trails, lakefront beach, farm
- Along with maintaining significant open space, site uses bioretention and vegetated swales to manage stormwater
- Used alternative materials other than concrete for sidewalks in some locations

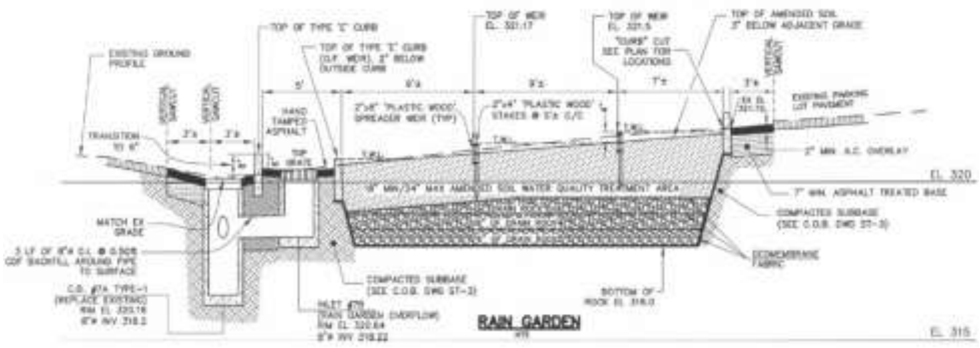
Reference for data and images:
http://www.prairiecrossing.com
EPA 841-F-07-006 - "Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices

PROCESS OF CREATING AN LID SITE PLAN: EPA CASE STUDIES

Parking Lot Retrofits (Bellingham, WA)

Rain Garden Case Study:

- Retrofitted two parking lots at City facilities with rain gardens rather than underground vaults
- City Hall (Site 1): 3 out of 60 parking spaces used for rain gardens.
- Park (Site 2): 550-sf area converted to rain garden
- Both required:
  - Excavation
  - Geotextile fabric
  - Drain rock
  - Soil amendments
  - Native plants
  - Overflow systems for heavy rains



Reference for data and images:

1. Puget Sound Action Team, Reining in the Rain: A Case Study of the City of Bellingham's Use of Rain Gardens to Manage Stormwater (Puget Sound Action Team, 2004), www.psat.wa.gov/Publications/Rain_Garden_book.pdf (accessed September 11, 2007).
2. EPA 841-F-07-006 - "Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices

Process of Creating an LID Site Plan: Summary

Summary of LID Planning

- Two components of Low Impact Development:
  1. Site Planning – Reduce imperviousness and conserve resources
  2. Treat and manage runoff with LID Stormwater Controls
- LID is a change in philosophy and approach to stormwater management.
- Developer and City should communicate on requirements and approaches early in the development process
- Not every site is the same. Every development should be evaluated to determine the most feasible approach to limit the development's impact.

FREESE AND NICHOLS

Construction Cost Comparison Between LID and Traditional Designs

North Central Texas Council of Governments

iSWM

Construction Cost of LID vs. Traditional Design

What is "Traditional Design"?

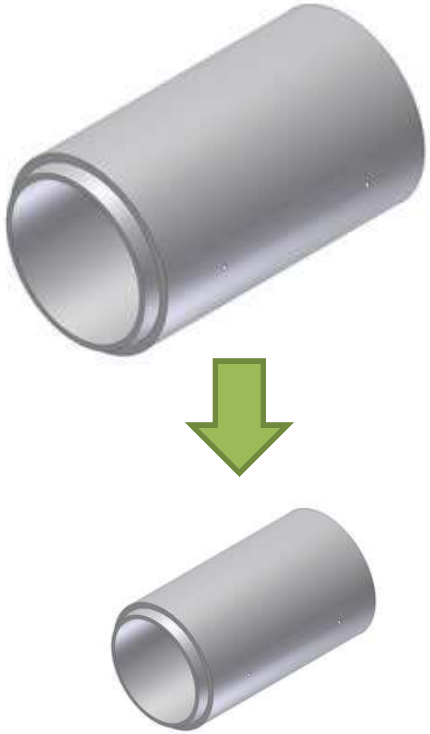
Typical Examples:

- Clear cut and grade
- Curb and gutter draining runoff across impervious surface into storm drain
- Lack of attention to conserving natural resources and pervious area
- Excessive paving turns permeable sites into impervious with high percentage of rainfall becoming runoff
- Often requires detention (excavation, outfalls, loss of space for development)

Construction Cost of LID vs. Traditional Design

What cost savings are found with LID?

- Reduction in pipe/inlet size and quantity
- Concrete:
  - Reduced Paving
  - Alternative sidewalks
  - Reduced curb/gutter
- Reduction in tree removal and/or replanting
- Increased land value
- Reduction in long-term maintenance effort
- Effective site planning provides reduction in quantity/size of stormwater controls for treating runoff



Construction Cost of LID vs. Traditional Design

What cost increases are found with LID?

- Landscaping of additional area
- Construction of LID features
  - Additional excavation
  - Import of engineered soil
  - Construction techniques are not yet widely known
- Preliminary study usually involved to determine feasibility
- Design effort for site design can cost more up front
- Some controls can be very expensive (green roofs, permeable pavers)

Construction Cost of LID vs. Traditional Design

Difficulty Quantifying Savings and Costs of LID

- Reduction in buildable area
- LID can result in higher property value
- Improved aesthetics
- More recreational opportunities
- Erosion mitigation
- Water quality impacts
- Irrigation

CONSTRUCTION COST OF LID VS. TRADITIONAL DESIGN

North Texas LID Competition

Cost Estimates

Figures from Section 2.0 of iSWM Planning Technical Manual

Construction Cost of LID vs. Traditional Design

Arlington Central Library

1st Place Design

Construction Cost of LID vs. Traditional Design

Arlington Central Library

BID ITEM DESCRIPTION	WINNING TEAM ESTIMATES			
	TRADITIONAL	LID	DIFFERENCE	% DIFFERENCE
DRAINAGE				
Grate Inlets	$5,600	$0	-$5,600	-100%
6" RCP	$19,800	$2,400	-$17,400	-88%
8" RCP	$6,000	$7,400	$1,400	23%
12" RCP	$34,500	$8,400	-$26,100	-76%
18" RCP	$24,800	$0	-$24,800	-100%
21" RCP	$7,000	$0	-$7,000	-100%
Outlet Structure	$0	$1,000	$1,000	-
Connection to Existing Inlets	$1,500	$2,000	$500	100%
CIVIL SUBTOTAL	**$99,200**	**$21,200**	**-$78,000**	**-79%**
LANDSCAPING				
Cistern/Pumps/Filtration	$35,000	$35,000	-	-
5" Concrete Sidewalk	$426,160	$426,160	-	-
Miscellaneous Landscape Planting	$232,898	$179,974	-$52,924	-23%
LANDSCAPE SUBTOTAL	**$694,058**	**$641,134**	**-$52,924**	**-8%**
TOTAL	**$793,258**	**$662,334**	**-$130,924**	**-17%**

17% SAVINGS

Construction Cost of LID vs. Traditional Design

Cedars West

Construction Cost of LID vs. Traditional Design

Cedars West

4% SAVINGS

BID ITEM DESCRIPTION	WINNING TEAM ESTIMATES			
	TRADITIONAL	LID	DIFFERENCE	% DIFFERENCE
CIVIL				
Site Preparation and Earthwork	$1,060,000	$851,000	-$209,000	-20%
Drainage	$1,881,000	$558,000	-$1,323,000	-70%
Bridge Structure			-	-
Subgrade and Paving	$1,870,500	$1,716,300	-$154,200	-8%
Traffic Control	$50,000	$50,000	-	-
Signing and Striping	$18,000	$18,000	-	-
Traffic Signal	$150,000	$150,000	-	-
SWPPP	$120,000	$95,000	-$25,000	-21%
Utilities	$1,837,900	$1,837,900	-	-
Extra Work Items				
CIVIL SUBTOTAL	**$6,987,400**	**$5,276,200**	**-$1,711,200**	**-24%**
LANDSCAPE				
Subtotal for Site Preparation and Earthwork	$0	$0	$0	-
Best Management Practices (Bioswales, Water Harvesting	$0	$1,120,000	$1,120,000	100%
Hardscapes (Sidewalks, Porous Pavement, Patios, Etc.)	$4,819,800	$4,819,800	$0	0%
Miscellaneous Landscape Planting	$2,939,500	$2,939,500	$0	0%
Miscellaneous Warranty and Maintenance	$0	$0	$0	-
Extra Work Items	$0	$0	$0	-
LANDSCAPE SUBTOTAL	**$7,759,300**	**$8,879,300**	**$1,120,000**	**14%**
TOTAL	**$14,746,700**	**$14,155,500**	**-$591,200**	**-4%**

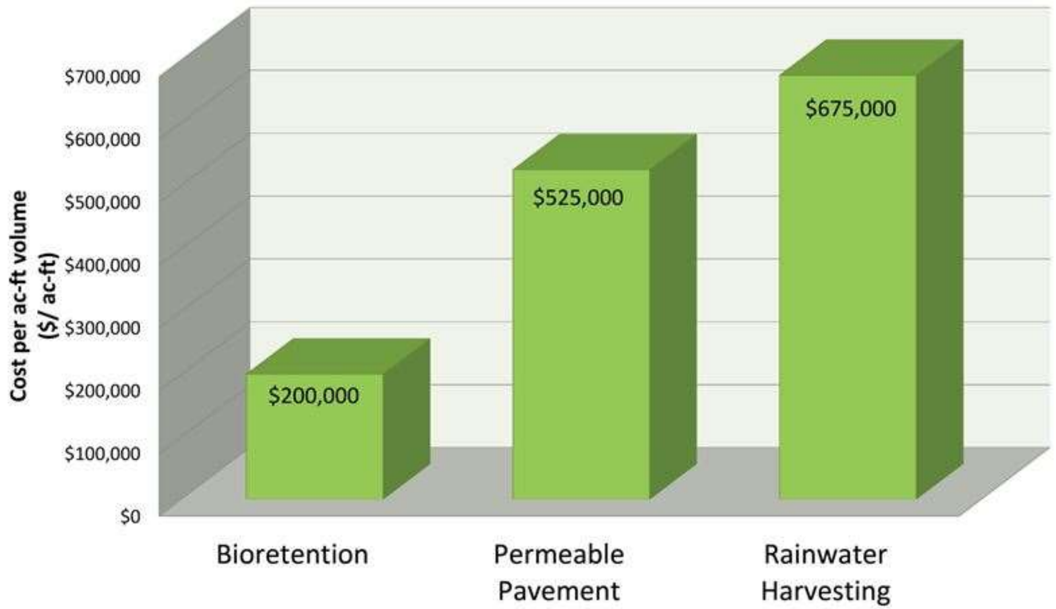
Construction Cost of LID vs. Traditional Design

Cedars West

Economic Analysis of BMPs:

- Bioretention is most cost effective of the BMPs selected for this project

- Permeable pavement and rainwater harvesting were selecting in areas where the runoff volumes were so large that there was not enough area to use bioretention



LID Feature Cost Per Acre-Ft of Storage

Construction Cost of LID vs. Traditional Design

Northern Crossing

Construction Cost of LID vs. Traditional Design

Northern Crossing

7% INCREASE

BID ITEM DESCRIPTION	WINNING TEAM ESTIMATES			
	TRADITIONAL	LID	DIFFERENCE	% DIFFERENCE
Site Preparation and Earthwork	$794,000	$330,000	-$464,000	-58%
Drainage	$1,140,895	$1,461,100	$320,205	28%
Subgrade and Paving	$4,287,500	$2,621,500	-$1,666,000	-39%
Signing and Striping	$14,500	$14,500	-	-
SWPPP	$364,600	$90,900	-$273,700	-75%
Utilities	$313,100	$313,100	-	-
CIVIL SUBTOTAL	**$6,914,595**	**$4,831,100**	**-$2,083,495**	
Best Management Practices (Bioswales, Water Harvesting	$0	$1,844,300	$1,844,300	100%
Hardscapes (Sidewalks, Porous Pavement, Patios, Etc.)	$0	$884,000	$884,000	100%
Miscellaneous Landscape Planting	$109,000	$323,000	$214,000	196%
Miscellaneous Warranty and Maintenance	$200,000	$0	-$200,000	-100%
Extra Work Items	$120,000	$0	-$120,000	-100%
LANDSCAPE SUBTOTAL	**$429,000**	**$3,051,300**	**$2,622,300**	
TOTAL	**$7,343,595**	**$7,882,400**	**$538,805**	**7%**

CONSTRUCTION COST OF LID VS. TRADITIONAL DESIGN

South Lamar – Dallas, TX

iSWM

Construction Cost of LID vs. Traditional Design

South Lamar – Dallas, TX

8% SAVINGS

BID ITEM DESCRIPTION	WINNING TEAM ESTIMATES			
	TRADITIONAL	LID	DIFFERENCE	% DIFFERENCE
Site Preparation and Earthwork	$1,092,259	$1,085,259	-$7,000	-1%
Drainage	$370,384	$225,150	-$145,234	-39%
Bridge Structure			-	-
Subgrade and Paving	$3,529,668	$3,326,601	-$203,067	-6%
Traffic Control	$45,000	$45,000	-	-
Signing and Striping	$20,172	$20,172	-	-
Traffic Signal	$112,000	$243,200	$131,200	117%
SWPPP	$15,000	$15,000	-	-
Utilities			-	-
Extra Work Items				
CIVIL SUBTOTAL	**$5,184,483**	**$4,960,382**	**-$224,101**	
Subtotal for Site Preparation and Earthwork	$208,384	$113,750	-$94,634	-45%
Best Management Practices (Bioswales, Water Harvesting	$0	$123,484	$123,484	100%
Hardscapes (Sidewalks, Porous Pavement, Patios, Etc.)	$383,235	$508,559	$125,324	33%
Miscellaneous Landscape Planting	$599,111	$183,021	-$416,090	-69%
Miscellaneous Warranty and Maintenance	$0	$0	$0	-
Extra Work Items	$0	$0	$0	-
LANDSCAPE SUBTOTAL	**$1,190,730**	**$928,814**	**-$261,916**	
TOTAL	**$6,375,213**	**$5,889,196**	**-$486,017**	**-8%**

Construction Cost of LID vs. Traditional Design

EPA Case Studies

Cost Estimates

Figures from Section 2.0 of iSWM Planning Technical Manual

Construction Cost of LID vs. Traditional Design

2nd Avenue SEA Street (Seattle, WA)

Cost Increases:

- Site preparation *(+35%)*
- Landscaping *(+44%)*

Cost Decreases:

- Stormwater Management *(-29%)*
    - Reduced infrastructure
- Site paving and sidewalks *(-49%)*
    - Reduction in street width and sidewalks
- Miscellaneous (mobilization, etc.) *(-40%)*

Reference for data and images:
www.seattle.gov – Street Edge Alternatives (SEA)
EPA 841-F-07-006 - "Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices

iSWM

Construction Cost of LID vs. Traditional Design

2nd Avenue SEA Street (Seattle, WA)

Item	Conventional Development Cost	SEA Street Cost	Cost Savings*	Percent Savings*	Percent of Total Savings*
Site preparation	$65,084	$88,173	–$23,089	–35%	–11%
Stormwater management	$372,988	$264,212	$108,776	29%	50%
Site paving and sidewalks	$287,646	$147,368	$140,278	49%	65%
Landscaping	$78,729	$113,034	–$34,305	–44%	–16%
Misc. (mobilization, etc.)	$64,356	$38,761	$25,595	40%	12%
Total	**$868,803**	**$651,548**	**$217,255**	—	—

* Negative values denote increased cost for the LID design over conventional development costs.

Reference for data and images:
www.seattle.gov – Street Edge Alternatives (SEA)
EPA 841-F-07-006 - "Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices

Construction Cost of LID vs. Traditional Design

Prairie Crossing Subdivisions (Grayslake, IL)

Item	Cost Savings	Percent Savings
Reduced Road Width	$178,000	13%
Stormwater Management	$210,000	15%
Decreased Sidewalks	$648,000	47%
Reduced Curb and Gutter	$339,000	25%
Total	**$1,375,000**	—

Main Factors:

- Preserved Open Space:
  - Less paving, curb and gutters, sidewalks
- Use alternative materials for sidewalks
- Reduced need/cost for conventional stormwater system
  - Alternative street edges
  - Vegetated swales
  - Bioretention
  - Preservation of pervious area

$1.4 Million in Savings

=

$4,000/Lot

Reference for data and images:
http://www.prairiecrossing.com
EPA 841-F-07-006 - "Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices

Construction Cost of LID vs. Traditional Design

Parking Lot Retrofits (Bellingham, WA)

- **Method:** Use of rain gardens instead of underground vaults
- Based on similar projects, used $12.00/cf of storage to estimate cost of vaults

City Hall Project

Conventional Vault Cost: $27,600
Rain Garden Cost: $5,600
Cost Savings: $22,000

80% Percent Savings

Park Project

Conventional Vault Cost: $52,800
Rain Garden Cost: $12,800
Cost Savings: $40,000

76% Percent Savings

Reference for data and images:

1. Puget Sound Action Team, Reining in the Rain: A Case Study of the City of Bellingham's Use of Rain Gardens to Manage Stormwater (Puget Sound Action Team, 2004), www.psat.wa.gov/Publications/Rain_Garden_book.pdf (accessed September 11, 2007).
2. EPA 841-F-07-006 - "Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices

iSWM

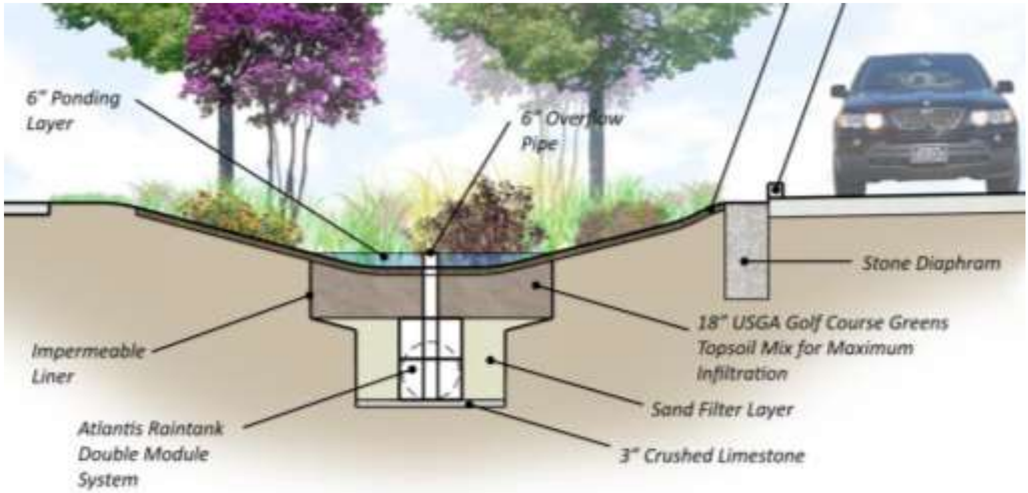
Cost of Typical Bioretention

Opinions From Various Sources

COST OF TYPICAL BMPS: BIORETENTION

Typical Cost Elements for Bioretention:

- Excavation
- Grading
- Filter media (amended soil mix)
- Drainage pipe
- Erosion control materials
- Landscape edging
- Seed
- Live plants
- Compost
- Mulch
- Concrete Work



iSWM

Cost of Typical BMPs: Bioretention

Study: Brown and Schueler (1997)

- Developed a cost equation for bioretention:

$$C = 7.30V^{0.99}$$

Where,

C = Construction, design, and permitting cost ($)

V = Volume of water treated by the facility (ft^3)

Approximately $6.80 per cubic foot of water storage

- Additional considerations:
  - Bioretention replaces an area that would have been landscaped in traditional design
  - Bioretention may reduce need for other BMPs that require significant amounts of land
  - Land requirement is typically about 5% of drainage area

Reference for data:

1. http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=72
2. Brown, W. and T. Schueler. 1997. The Economics of Stormwater BMPs in the Mid-Atlantic Region. Prepared for: Chesapeake Research Consortium. Edgewater, MD. Center for Watershed Protection. Ellicott City, MD

Cost of Typical BMPs: BIORETENTION

City of Omaha: Bioretention Design Manual

- Cost measured per square foot:
  - Between $7.00 and $12.00 per square foot to build
  - Can be as low as $4.00 or as high as $15.00

- Cost measured by drainage area treated
  - Average cost is $11,000/acre (Olsson Associates, 2007)
  - Treatment using BMPs is often 6-7% of total cost of conventional infrastructure construction (can be variable based on design parameters)

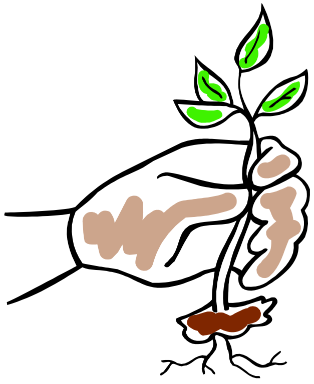
Reference for data:

1. Cuday, Kessler and Ulrich. A Green Gardens Project – A Manual for Contractors in the Omaha Region to Design and Install Bioretention Gardens. Prepared by: The City of Omaha, Nebraska through a grant from the Nebraska Department of Environmental Quality.

Cost of Typical BMPs: BIORETENTION

City of Omaha: Bioretention Design Manual

- What are the most significant costs related to bioretention?
  - Modified / amended soil materials: Costs are continually showing decreases as innovations in design reduce the amount of soil needed for infiltration
  - Use of live plants instead of seeds: It is suggested to work closely with a nursery or horticulturist to reduce the cost of plantings
  - Size of live plants affect final construction cost: deep cell-plugs, seedlings, quart-sized plants, or gallon-sized plants.



NOTE: As stormwater BMPs become more common practice, the cost of design and construction is likely to decrease

Cost of Typical BMPs: BIORETENTION

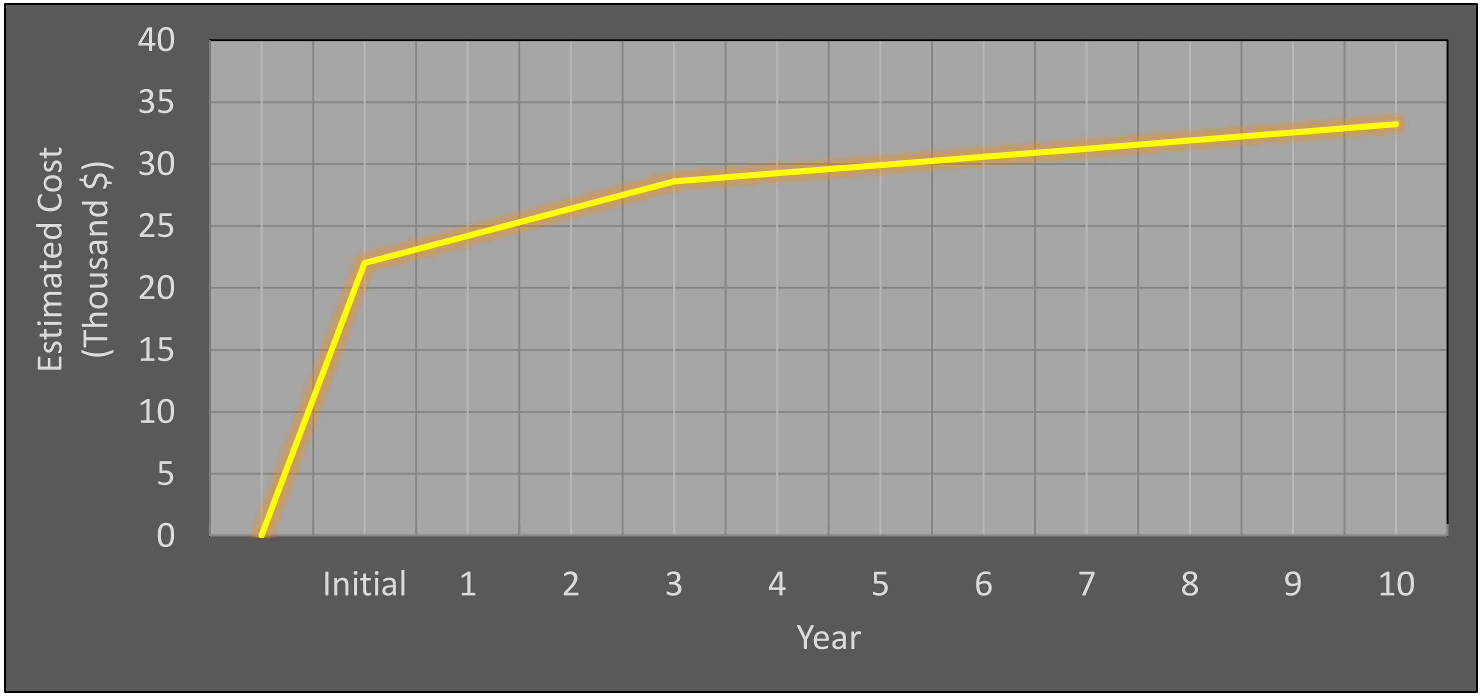
City of Omaha: Bioretention Design Manual

- Cost of Maintenance:
  - Most intensive maintenance during first 2-3 years of operation while plants establish
  - Bioretention becomes more self-sustaining over time
  - Many studies estimate approximately **10%** of construction cost needed for first 2-3 years.
  - After establishment period, annual maintenance costs drop to **< 5%** of original construction cost.

A Note on Maintenance:
In many cases, bioretention or other BMPs are installed in locations that would have also been landscaped under a traditional design. Maintenance for bioretention is comparable to typical landscaping maintenance. In fact, after the establishment period, bioretention usually requires less maintenance than traditional landscaping due to reduced irrigation needs.

COST OF TYPICAL BMPS: BIORETENTION

- <u>Assumptions:</u>
  - 2 acre lot
  - $11,000/acre to treat runoff
  - 10% for first 3 years of maintenance
  - 3% for long-term maintenance after establishment
- <u>Costs:</u>
  - $22,000 initial construction cost
  - $2,200/year for first 3 years for maintenance
  - $660/year for remainder of life cycle for long-term maintenance



"Roadblocks" in Existing Manuals and Ordinances that Inhibit LID

North Central Texas
Council of Governments

Roadblocks to LID

Overcoming Inertia

Development Process Obstacles

Design Obstacles

Ordinance Obstacles

Constructability Concerns

Maintenance and Inspection Concerns

iSWM

Roadblocks to LID

Overcoming Inertia

- ~~This is going to cost too much~~
  - LID approaches can save money through a variety of methods including reducing concrete and stormwater infrastructure
- ~~It won't work in this region~~
  - It already has! LID features are being implemented all over Texas and in areas with similar climates and soils
- ~~Will scare off developers~~
  - Cities with LID requirements are seen as innovative and desirable communities. Think Austin, Seattle, Portland, and recently Houston. People want to live where natural resources are a priority and developers will go where the people are.

iSWM

Roadblocks to LID

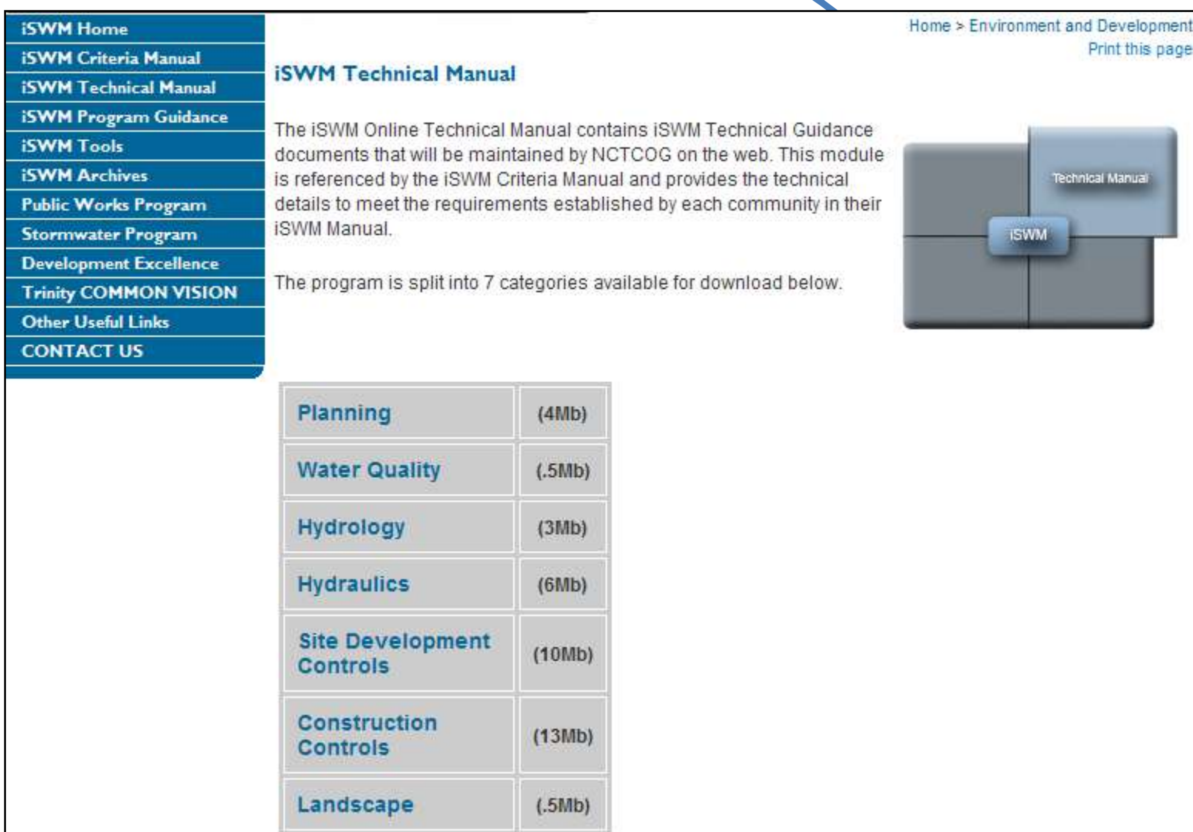
Development Process Obstacles

- ~~Stormwater is an afterthought to developers~~
  - Stormwater needs to be mentioned as early in the development process as possible. Clearly state the City's goals and expectations
- ~~Development is fully planned before the City gets a chance to provide input~~
  - Talk about stormwater plans at the pre-development meetings. An engineer doesn't have to be involved.
- ~~City staff is too overwhelmed with reviewing as is, can't add on any more~~
  - Additional effort can be minimized. Simply state the LID methods that the City promotes and allows.

Roadblocks to LID

Design Obstacles

- ~~No technical information out there to design Structural Controls~~



iSWM Home
iSWM Criteria Manual
iSWM Technical Manual
iSWM Program Guidance
iSWM Tools
iSWM Archives
Public Works Program
Stormwater Program
Development Excellence
Trinity COMMON VISION
Other Useful Links
CONTACT US

Home > Environment and Development
Print this page

iSWM Technical Manual

The iSWM Online Technical Manual contains iSWM Technical Guidance documents that will be maintained by NCTCOG on the web. This module is referenced by the iSWM Criteria Manual and provides the technical details to meet the requirements established by each community in their iSWM Manual.

The program is split into 7 categories available for download below.

Planning	(4Mb)
Water Quality	(.5Mb)
Hydrology	(3Mb)
Hydraulics	(6Mb)
Site Development Controls	(10Mb)
Construction Controls	(13Mb)
Landscape	(.5Mb)

iSWM

Roadblocks to LID

Ordinance Obstacles

- Existing ordinances have un-intentioned blocks to LID
  - Landscaping Ordinance
  - Subdivision Ordinance
  - Zoning Ordinance
- Process of updating ordinances can be time consuming
- Developers won't do LID if they have to get a variance

Roadblocks to LID

Ordinance Obstacles

- Examples of ordinance blocks to LID
  - Curb requirements around landscaped islands
  - Minimum road width requirements
  - Minimum setback requirements
- Can ease into changes by making them part of a PUD

Roadblocks to LID

Constructability Concerns

- No standard specs or details
  - Certain specs and details can be found in other manuals
- Success of structural controls relies heavily on correct construction
  - This is true, inspections should be performed through out the construction process
- No one knows how to construct the controls so they will increase bid prices
  - Several examples are being built in the region and there are several grant opportunities for cost sharing

Roadblocks to LID

Maintenance and Inspection Concerns

- City can't afford to maintain and inspect new features
  - Cities don't have to, there are examples of maintenance and inspection requirements on the iSWM website
- Owners don't know how to maintain or inspect features
  - Require maintenance and operation plans. Several example checklists are available at the Center for Watershed Protection
- Citizens will complain about "natural" look
  - LID practices have been shown to increase property values and can be maintained in an aesthetic manner

Roadblocks to LID

LID is being implemented and working all around the country despite those saying it can't be done.

Case studies have shown reductions in volume as high as 99% and pollutant removal rates as high as 90%.

For more information please visit these sites:
www.iswm.nctcog.org
www.cwp.org
www.lid-stormwater.net
www.lowimpactdevelopment.org
http://water.epa.gov/polwaste/green/

College Park Phased Development
University of Texas Arlington

Schrickel, Rollins and Associates, Inc.

North Central Texas
Council of Governments

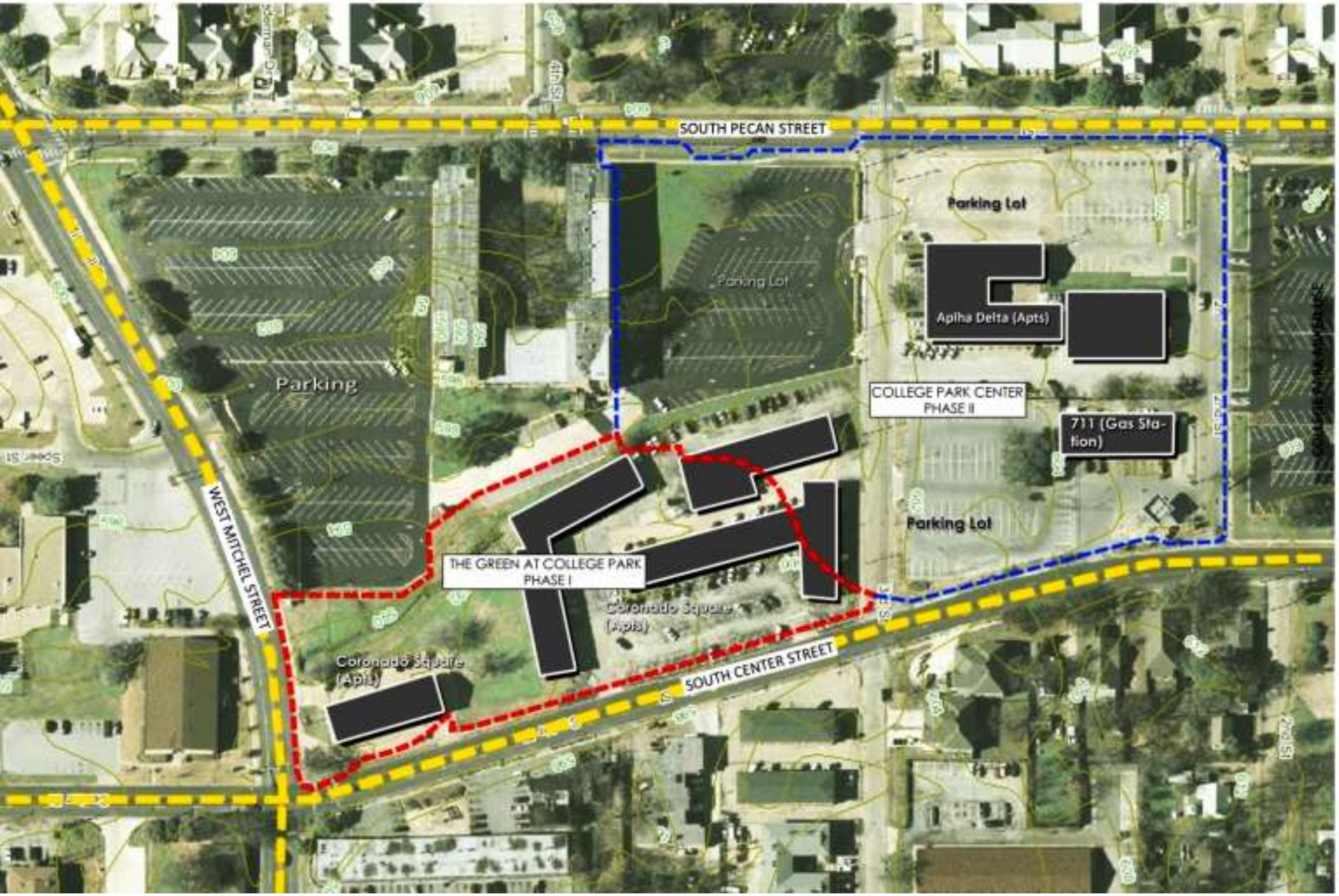
College Park Phased Development

The Green at College Park

University of Texas Arlington

- SITES 1-Star
- LEED Gold
- Texas ASLA Honor Award

Existing Conditions

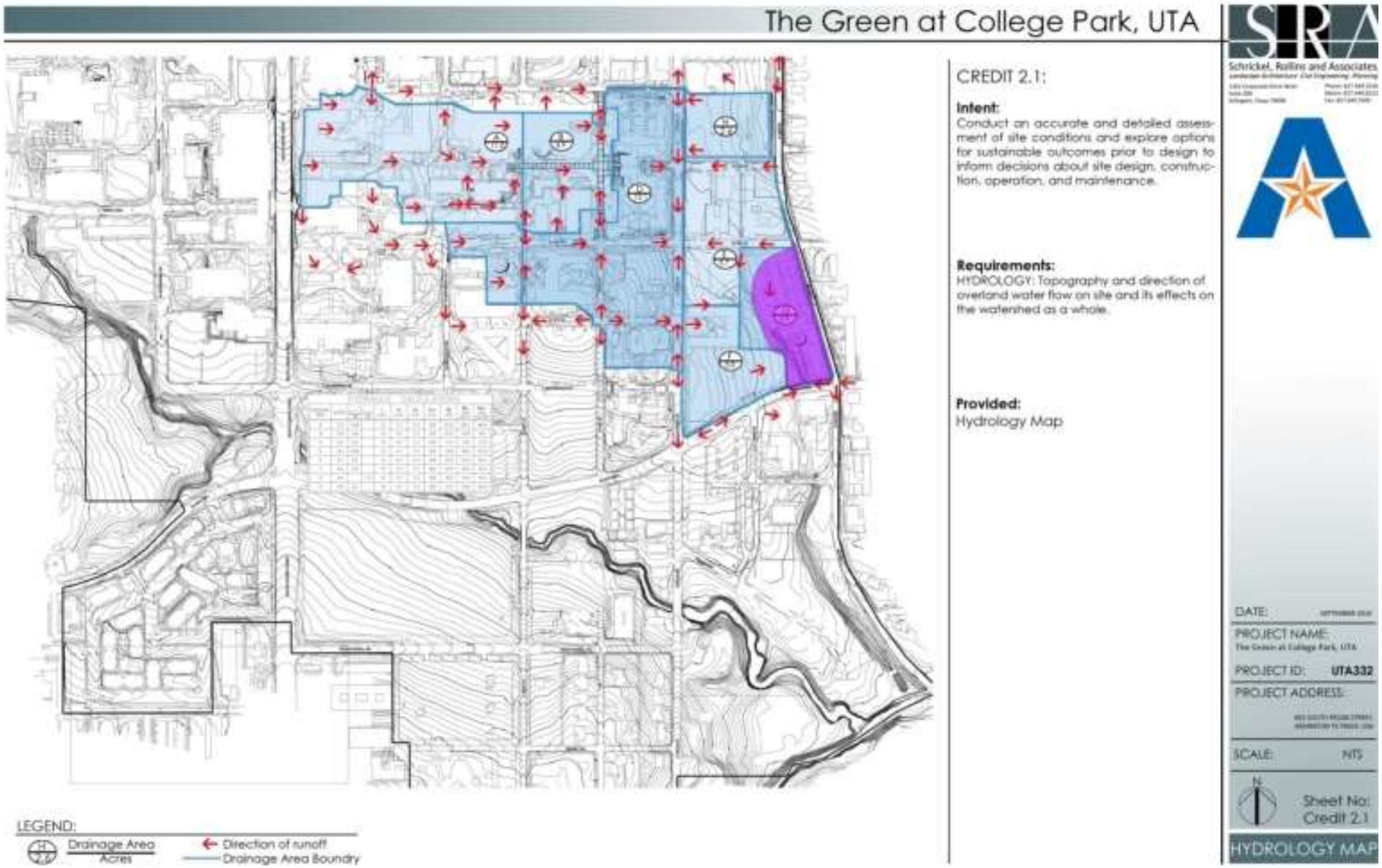


EXISTING CONDITIONS

•8.5 Acres
•82% Impervious

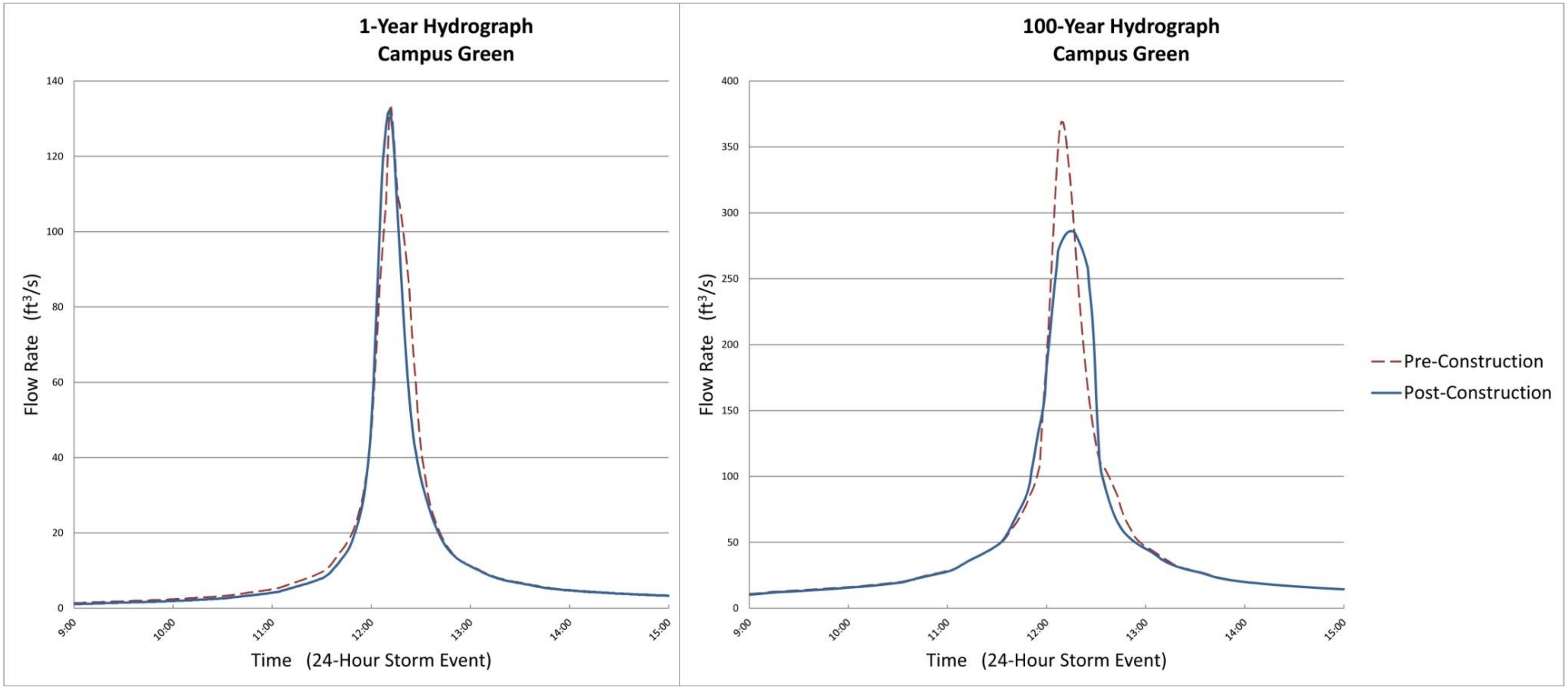
Existing Conditions

DRAINAGE AREA MAP



iSWM

Hydrograph



1-Year Hydrograph
Campus Green
140
120
100
80
60
40
20
0
Flow Rate (ft³/s)
9:00
10:00
11:00
12:00
13:00
14:00
15:00
Time (24-Hour Storm Event)
100-Year Hydrograph
Campus Green
400
350
300
250
200
150
100
50
0
Flow Rate (ft³/s)
9:00
10:00
11:00
12:00
13:00
14:00
15:00
Time (24-Hour Storm Event)
Pre-Construction
Post-Construction

Hierarchy of Storm Water Management

- **Priority One – Design the site to be a green sponge**
  - Encourage infiltration of storm water into the soil
  - Drain storm water from grey to green
  - Sheet flow storm water across the landscape
  - Reduce impervious surfaces
  - Slow down the flow of water
  - Create micro-depressions in the landscape to capture storm water
  - Amend soil with organic matter to encourage soil to function more like pre-development infiltration rates

Hierarchy of Storm Water Management

- **Priority Two – Improve quality of storm water**
  - Filter water through vegetated areas
  - Filter water through soil
  - Slow down flow of water to allow sediment to settle
  - Select plants that break down pollutants in water
  - Slow down the flow of water
  - Provide a highly organic soil so microorganisms can break down pollutants

IDENTIFY APPROPRIATE BMP'S

Expected Pollutants:

- Sediment,
- heavy metals and
- Petroleum compounds from adjacent parking

BMP's

BMP's:

Rain Planters:

- Designed to store and convey run-off and filter contaminants

Biofilters:

- Located between parking areas and rain garden
- Saw tooth curb added to allow stormwater to drain through biofilters
- biofilters contain native vegetation

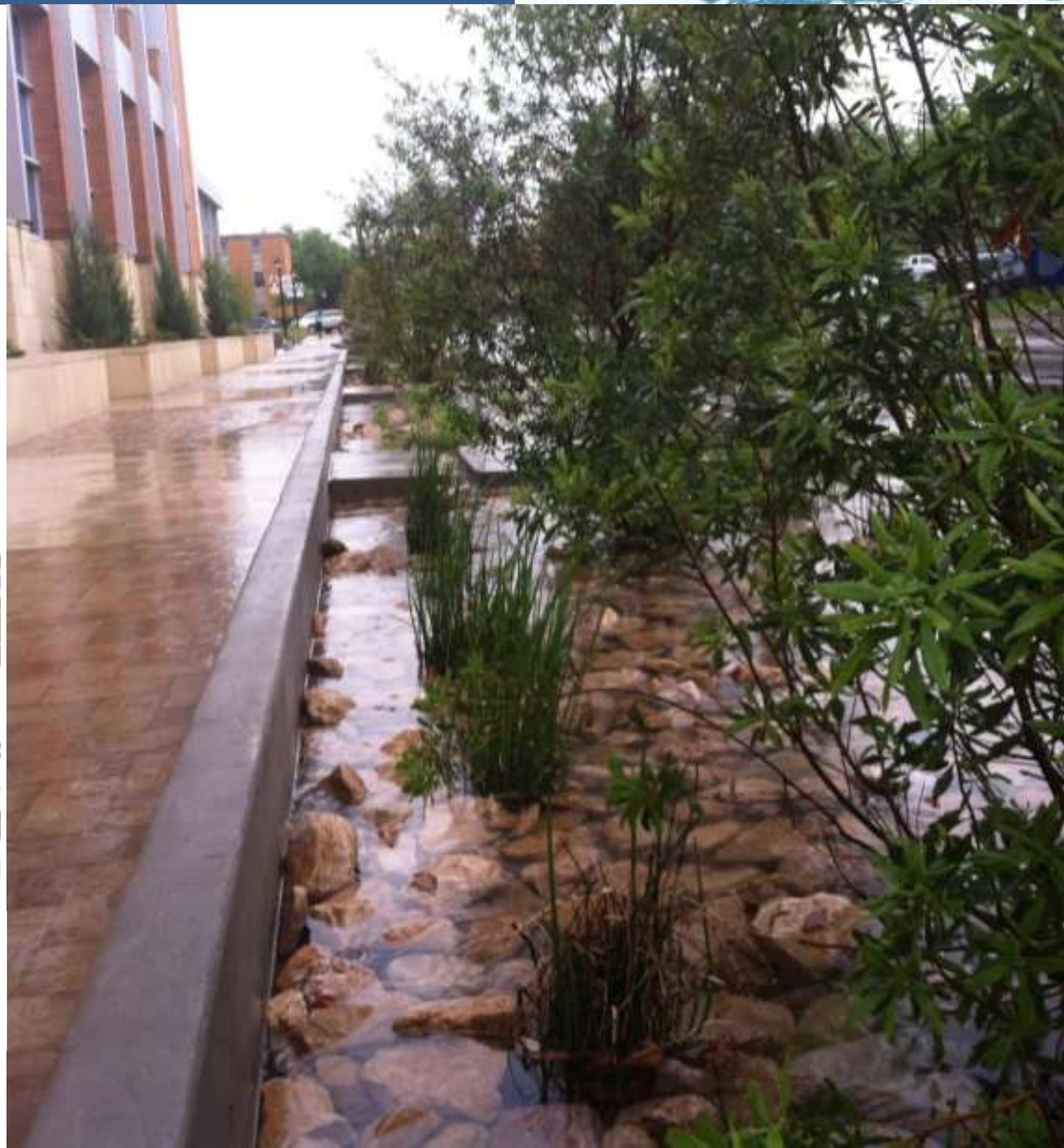
Rain Garden:

- connects and flows into the Rain Garden.
- Water infiltrated into the rich planting media in the rain planters flows through the soil into the rain garden.

Oval Lawn:

- During large storm events run-off backs up and is stored in the oval lawn area.
- Drainage across the lawn sheet flows into the Rain Garden.

Flow-Thru Planter



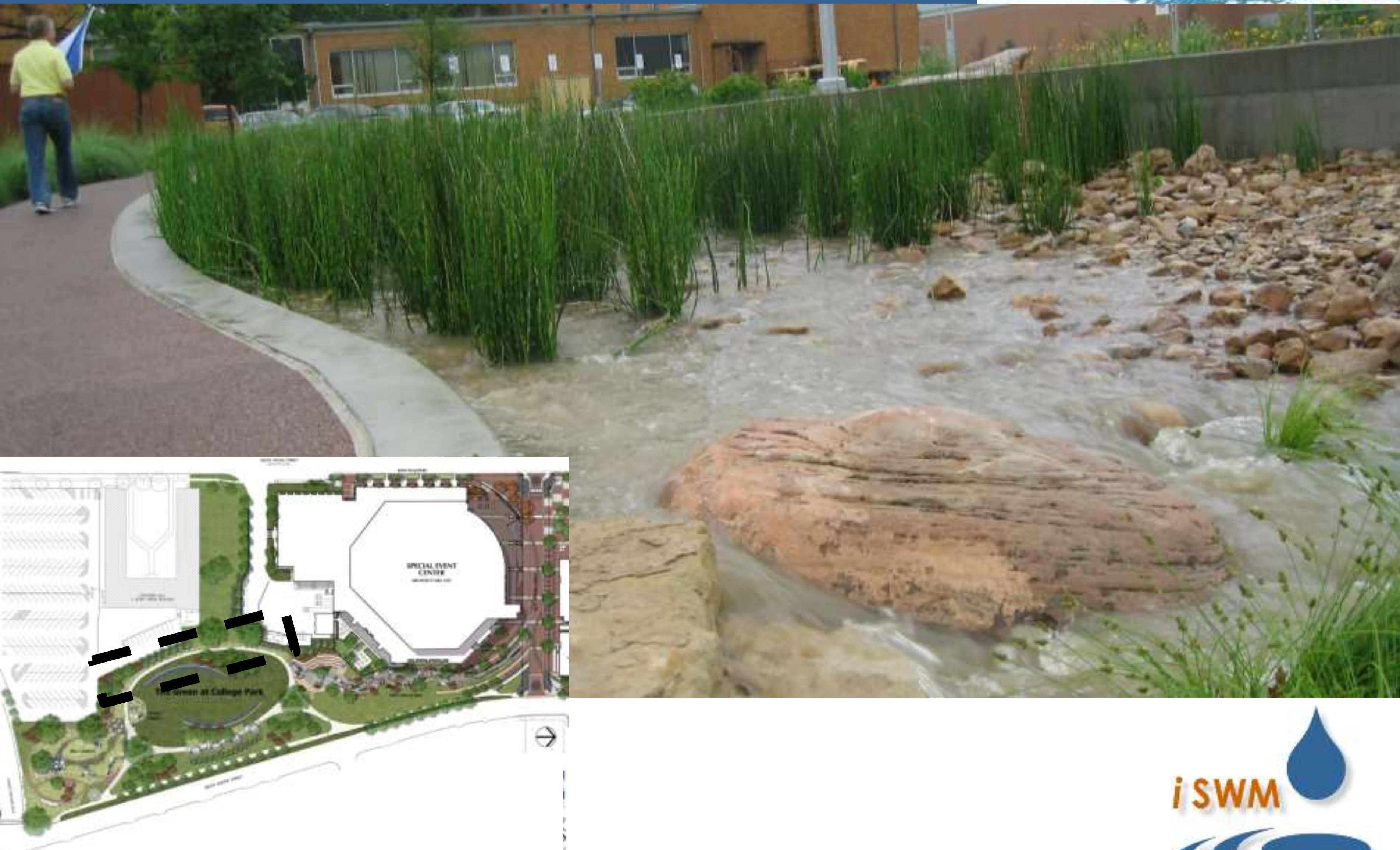
Condensate Fountain

Dry Stream Bed

Rain Garden


COLLEGE PARK
CENTER
SPECIAL EVENT
CENTER
The Green at College Park

Rain Channel



iSWM

Rain garden

Rain Garden

Detention Lawn

Vegetated Strip / Pervious Paving

Over Flow

WATER WISE

A GREEN SOLUTION TO WATER POLLUTION

A **College Park Center Drainage** consists of surface runoff, storm water from roof drains and condensate from the air conditioning system.

B The **Rain Channel** is a conveyance system that consists of a porous soil structure protected by a layer of rock mulch. This channel increases infiltration of runoff into the soil and filters total suspended solids.

C The **Storm Spring** relieves pressure from the underground campus storm drainage system. During large storm events, it functions as a reverse inlet, allowing storm drainage from underground pipes to overflow into the oval lawn area for detention.

D The **Detention Lawn** temporarily holds water during large storm events and gradually allows it to drain into the Rill Garden.

E The **Rill Garden** is a complex system of vegetation that thrives in drought and flood conditions. Below the surface layer of the rock mulch is a porous soil structure that increases infiltration. The soil system, rock mulch and vegetation work together to remove pollutants from storm run-off. This garden replaces an eroded drainage channel,)or rill) that existed on the site.

F The **Check Dam** helps to filter storm water and encourages infiltration by reducing velocity and increasing the amount of time storm water is detained on site.

G The **Overflow Structure** controls the amount of water that leaves the garden and drains to Johnson Creek. The controlled release also alleviates potential flooding of adjacent streets.

H The **Biofilter** is a vegetated system that removes total suspended solids from parking lot run-off before eventually draining into the rill garden.

I The **Microdepressions** are shallow depressions in the landscape that are sculpted to retain irrigation and storm runoff. Below the depressions are large rock sumps that store water and release it into the soil to be used by surrounding vegetation. Planted in the shallow areas are native plants that grow in wet soil conditions.

ADDITIONAL INFORMATION:

QUESTIONS

iSWM

LID Resources

- iSWM Technical Manual – www.iswm.nctcog.org
- Texas Land/Water Sustainability Forum – www.texaslid.org
- EPA LID Information: http://water.epa.gov/polwaste/green
  - LID Fact Sheets
  - National Menu of Stormwater BMPs
  - Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices
- National Low Impact Development Center – www.lowimpactdevelopment.org
- Center for Watershed Protection – www.cwp.org

QUESTIONS?

Lesley Brooks, PE, CFM
lmb@freese.com
214-217-2248

Ben McWhorter, EIT, CFM
bam@freese.com
214-217-2273

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

Jack Tidwell
JTidwell@nctcog.org
817-695-9220

iswm.nctcog.org