Incorporating Low Impact Development and Fluvial Geomorphology for Watershed Protection

2013 Upper Trinity Symposium
September 26, 2013
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Traditional Approach to Stormwater
What is Low Impact Development?

Change in philosophy of stormwater management

**EPA Definition:** “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
- Try to mimic natural hydrology and hydraulics
What is Low Impact Development?
What is Low Impact Development?

Drainage from Lots
How LID Helps Watersheds

- Reduces flooding

Presidential Disaster Declarations
1964-2007
Downstream Assessments

- No adverse impacts downstream
- Take into account flow timing and downstream capacities
- LID helps slow things down
How LID Helps Watersheds

• Reduces erosion
How LID Helps Watersheds

• Helps water quality
How LID Helps Communities

• Key resources are limited:
  – Developable **land**
  – **Water** for community uses
  – **Funding** for capital & operations

• Meet today’s needs while planning sensibly to meet the needs of the future.
How LID Helps Communities

• Uses site’s natural features
• Neighborhoods with character
• Higher property values
• Increased quality of life
LID Economic Effects

Cost Savings

• Decreased pipe/inlet size and quantity
• Reduced concrete
  • Reduced Paving
  • Alternative sidewalks
  • Reduced curb/gutter
• Reduced tree removal and/or replanting
• Increased land value
• Reduced long-term maintenance effort
• Reduction in quantity/size of structural BMPs for treating runoff

Cost Increases

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

Other items to consider: reduced land use, irrigation, improved aesthetics, recreational opportunities, erosion mitigation, and water quality improvements
EPA LID Case Studies

- Cost savings ranged from 15 to 80% (with some exceptions)

Table 2. Summary of Cost Comparisons Between Conventional and LID Approaches

<table>
<thead>
<tr>
<th>Project</th>
<th>Conventional Development Cost</th>
<th>LID Cost</th>
<th>Cost Difference</th>
<th>Percent Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd Avenue SEA Street</td>
<td>$868,803</td>
<td>$651,548</td>
<td>$217,255</td>
<td>25%</td>
</tr>
<tr>
<td>Auburn Hills</td>
<td>$2,350,385</td>
<td>$1,598,969</td>
<td>$761,396</td>
<td>32%</td>
</tr>
<tr>
<td>Bellingham City Hall</td>
<td>$27,600</td>
<td>$5,600</td>
<td>$22,000</td>
<td>80%</td>
</tr>
<tr>
<td>Bellingham Bloedel Donovan Park</td>
<td>$52,800</td>
<td>$12,800</td>
<td>$40,000</td>
<td>76%</td>
</tr>
<tr>
<td>Gap Creek</td>
<td>$4,620,600</td>
<td>$3,942,100</td>
<td>$678,500</td>
<td>15%</td>
</tr>
<tr>
<td>Garden Valley</td>
<td>$324,400</td>
<td>$260,700</td>
<td>$63,700</td>
<td>20%</td>
</tr>
<tr>
<td>Kensington Estates</td>
<td>$765,700</td>
<td>$1,502,900</td>
<td>-$737,200</td>
<td>-96%</td>
</tr>
<tr>
<td>Laurel Springs</td>
<td>$1,654,021</td>
<td>$1,149,562</td>
<td>$504,469</td>
<td>30%</td>
</tr>
<tr>
<td>Mill Creek</td>
<td>$12,510</td>
<td>$9,099</td>
<td>$3,411</td>
<td>27%</td>
</tr>
<tr>
<td>Prairie Glen</td>
<td>$1,004,848</td>
<td>$599,536</td>
<td>$405,312</td>
<td>40%</td>
</tr>
<tr>
<td>Somerset</td>
<td>$2,456,843</td>
<td>$1,671,461</td>
<td>$785,382</td>
<td>32%</td>
</tr>
<tr>
<td>Tellabs Corporate Campus</td>
<td>$3,162,160</td>
<td>$2,700,650</td>
<td>$461,510</td>
<td>15%</td>
</tr>
</tbody>
</table>

- Kensington Estates LID included $824K for rooftop rainwater collection.
LID Resources

http://iswm.nctcog.org

### 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.

<table>
<thead>
<tr>
<th>Planning</th>
<th>4Mb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Quality</td>
<td>.5Mb</td>
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<tr>
<td>Hydrology</td>
<td>3Mb</td>
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<tr>
<td>Hydraulics</td>
<td>6Mb</td>
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<tr>
<td>Site Development Controls</td>
<td>10Mb</td>
</tr>
<tr>
<td>Construction Controls</td>
<td>13Mb</td>
</tr>
<tr>
<td>Landscape</td>
<td>.5Mb</td>
</tr>
</tbody>
</table>
iSWM Site Design Practices

Conservation of Natural Features and Resources

- Natural Drainageway
- Wetland
- Undisturbed Forest
- Conservation Area

Area with erodible soils

“C” and “D” soils should be used for impervious surfaces and buildings

“A” and “B” soils are more porous – preserve undisturbed if possible

Large Impact Area

Small Impact Area

25 foot Stream Buffer

100-year Floodplain
iSWM Site Design Practices

Lower Impact Site Design

[Diagram showing site design practices]

- Roads on ridge lines or upland areas
- Houses located on "brow" of ridge
- Vegetated drainage swales
- Undisturbed vegetation on slopes
- Natural drainageways preserved
iSWM Site Design Practices

Reduction of Impervious Cover
iSWM Site Design Practices

Utilization of Natural Features
Post Construction Controls
What is Fluvial Geomorphology?

- Fluvial = River
- Geo = Relating to the Earth
- Morphology = Study of shape, form, and structure
- Fluvial Geomorphology = The study of river related landforms and assesses the processes/functions that exist in river systems.
Time Scales
Lanes Relationship

- Sediment size: coarse → fine
- Slope: flat ← steep
- Sediment load: erosion → sedimentation
- Discharge: input → output

Diagram showing the balance between sediment size, slope, sediment load, and erosion/sedimentation.
Lanes Relationship
Lanes Relationship
Channel Evolution

TYPE I (h<\(h_0\))
CHANNELIZED

TYPE II (h=\(h_0\))
DEGRADATION

TYPE III (h>\(h_0\))
WIDENING

TYPE IV (h>\(h_0\))
WIDENING AND AGGRADATION

TYPE V (h<\(h_0\))
DYNAMIC EQUILIBRIUM

LONGITUDINAL PROFILE

So...why do you care?

- Stream channels change in response to watershed stressors (i.e. increased runoff from development)

- Adequate planning allows anticipation and control of change

- Where development occurs without sustainable planning, results can be severe and options are limited and expensive
So...why should you care?

Erosion = Sediment

#1 Pollutant of our streams and Rivers (EPA)

- Natural – erosion would account for ~30%
- Impacted – erosion accelerated and accounts for ~70%

$1.1 BILLION DOLLARS

Blackland Prairie of TX (USACE)

$16 BILLION DOLLAR ANNUALLY

in the US

- Maintenance
- Stabilization
So...
So...
Understanding the Before, During, and After
Understanding the Before, During, and After
Understanding the Before, During, and After
Understanding the Before, During, and After
Channel Change???
Understanding the Before, During, and After
One Size Does NOT Fit All
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