Low Impact Development (LID)

We could go through the technical definitions, but there is a better way to describe LID.

How did we arrive at using LID? Why are we interested in it?
Storm Conveyance

Goals:

• Get runoff off our property!
• Discharge to existing streams & channels.

Uncontrolled Runoff…

Versus

Controlled Runoff…
• But wait...stream erosion is a problem.
Question: Why is stream erosion a problem?

**Answer:** When land is cleared and converted from forest to lawns, houses and streets, then there is a big jump in peak runoff during storm events.

A graphical representation of Increase in runoff resulting from land-use changes.

Q = flowrate
  (cubic ft/sec)
  (gallons/minute)
Visual Representation of Why Change In Land Use, from Forest to Development, Increases Stormwater Runoff

Reduce Peak Flow Rates

- High Flowrates In → Low Flowrates Out
- Implement the principle of Detention
Reduce Peak Flows

- Detention Volume
- 1977 Simplified Method
- 1990, Single Event Hydrograph
- 2000: Continuous Simulation

Pond Volume

Graph showing detention volumes for different methods.

Date:
- 1977: Simplified Method
- 1990: Single Event Hydrograph
- 2000: Continuous Simulation
Detention Pond Examples
Regional Detention Ponds
Representative Pollutants and Constituents of Concern for Water Quality

<table>
<thead>
<tr>
<th>CONSTITUENT</th>
<th>RANGE</th>
<th>MEANS</th>
<th>CONCERN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkali + chlorine</td>
<td>5E-6 – 1E-4</td>
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<td>Minor</td>
</tr>
<tr>
<td>Alkali</td>
<td>8 - 1,273</td>
<td>46 – 56</td>
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<tr>
<td>Antimony</td>
<td>0.01 - 4.3</td>
<td></td>
<td>Major</td>
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<tr>
<td>Benzene</td>
<td>0.0035 - 0.012</td>
<td></td>
<td>Major</td>
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<tr>
<td>BOD₅</td>
<td>1 - 7,799</td>
<td>6 – 31</td>
<td>No</td>
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<tr>
<td>Cadmium</td>
<td>0.00005 - 13.73</td>
<td></td>
<td>Major</td>
</tr>
<tr>
<td>Calcium</td>
<td>0.04 - 2,123</td>
<td>4.8 – 26.5</td>
<td>No</td>
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<tr>
<td>Chromium</td>
<td>0.001 - 23</td>
<td>0.010 – 0.23</td>
<td>Major</td>
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<tr>
<td>Copper</td>
<td>0.00006 – 1.44</td>
<td></td>
<td>Major</td>
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<tr>
<td>Dissolved oxygen</td>
<td>0 – 14</td>
<td>0.0065 – 0.15</td>
<td>Major</td>
</tr>
<tr>
<td>Dissolved solids</td>
<td>76 – 2,792</td>
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<td>Major</td>
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<tr>
<td>DDT</td>
<td>&lt;0.0001</td>
<td></td>
<td>No</td>
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<tr>
<td>Enterococci</td>
<td>3 – 1,406</td>
<td></td>
<td>Major</td>
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<tr>
<td>Fecal coliform</td>
<td>0.2 – 1,500</td>
<td></td>
<td>Major</td>
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<tr>
<td>Hardness</td>
<td>12 – 2,100</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Iron</td>
<td>0.08 – 480</td>
<td>1 – 12</td>
<td>No</td>
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<tr>
<td>Lead</td>
<td>0.00057 – 25</td>
<td>0.02 – 1.56</td>
<td>Major</td>
</tr>
<tr>
<td>Nickel</td>
<td>0.001 – 49</td>
<td></td>
<td>Major</td>
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<tr>
<td>Nitrogen (all forms)</td>
<td>0.07 – 16</td>
<td></td>
<td>Major</td>
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<tr>
<td>Nitrate</td>
<td>0.01 – 1.2</td>
<td></td>
<td>Major</td>
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<tr>
<td>Oil and grease</td>
<td>0.001 – 110</td>
<td></td>
<td>Major</td>
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<tr>
<td>PAH</td>
<td>2.4E-6 – 4.01</td>
<td></td>
<td>Minor</td>
</tr>
<tr>
<td>pH</td>
<td>4.5 – 6.7</td>
<td></td>
<td>Minor</td>
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<tr>
<td>Petroleum hydrocarbons</td>
<td>0.64 – 19.71</td>
<td></td>
<td>Minor</td>
</tr>
<tr>
<td>Phenol</td>
<td>0.003 – 0.01</td>
<td></td>
<td>Minor</td>
</tr>
<tr>
<td>Phosphorus (total)</td>
<td>0.01 – 7.3</td>
<td>0.015 – 0.52</td>
<td>Minor</td>
</tr>
<tr>
<td>Salts</td>
<td>0.06 – 1252</td>
<td></td>
<td>Minor</td>
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<tr>
<td>TSS</td>
<td>1 – 36,200</td>
<td>4 – 1,223</td>
<td>Major</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.0007 – 23</td>
<td>0.017 – 0.58</td>
<td>Major</td>
</tr>
</tbody>
</table>

a. mg/L, except for bacteria which is counts/100 ml.
Water Quality Treatment

- Make use of natural processes to remove pollutants.
- Filter through the soils or wetlands containing plant materials and other organics.

Idea! What if we integrated these natural-looking, (and beneficial), stormwater treatment features into our neighborhood?
Integrated Management Practices (IMP)

Definition of IMP

• Manage stormwater as close to its origin as possible by utilizing small scale, distributed hydrologic controls.
• Create landscape features which “slows storm flows and increases time of concentration.”
• Provide multiple LID flow control measures.
• Integrate LID features & create landscape amenities into a development.

(Source: “LID Technical Guidance Manual for Puget Sound”, 2012, Sec. 1.4.7 – abbreviated)

What does it mean?  Construct several small LID type facilities Instead of A Single Big One.  This approach uses less land & it can beautify the neighborhood!
Examples of LID

Rain Gardens at intersection edge with curb

Linear Rain Garden along roadway edge
Examples of Rain Gardens along roadways
Continuous Inflow Biofiltration Swale along roadway

Brick pavers with infiltration

Vegetated Filter Strip
Constructed Wetland for Treatment

Porous Concrete Sidewalk

Planter Boxes for Roof Runoff
Large Gravel Gallery under parking lot (under construction)

Martin Way Park-n-Ride for WSDOT, Lacey, WA

Media Filter Drain
Single Residential Lot with LID
A Few Points to Remember

Goals: 1) Stormwater Conveyance; 2) Reduce Peak Flowrates; 3) Remove Pollutants for Better Water Quality.

- LID significantly improved performance for **water quality** treatment compared with conventional facilities -- detention ponds and pipes;
- For **detention**, LID typically does not replace conventional detention facilities to **reduce peak flowrates & erosion**, but LID does reduce detention pond size requirements;
- For retrofit projects, the more LID facilities that are constructed the better it will perform, as a whole, within a drainage basin;
- The Information & technology of LID is constantly evolving and the options are expanding.

*When one tugs at a single thing in nature, he finds it attached to the rest of the world.* ~ John Muir
Definition of LID

“Low impact development (LID) is a stormwater and land use management strategy that strives to mimic pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation, and transpiration by emphasizing conservation and use of on-site natural features, site planning, and distributed stormwater management practices that are integrated into a project design.”

(Source: “LID Technical Guidance Manual for Puget Sound”, 2012, Sec. 1.4.1)