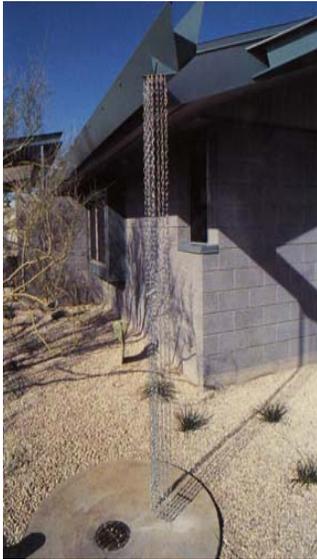




U.S. Department of Energy
Energy Efficiency and Renewable Energy

Permeable Pavements and Rainwater Harvesting





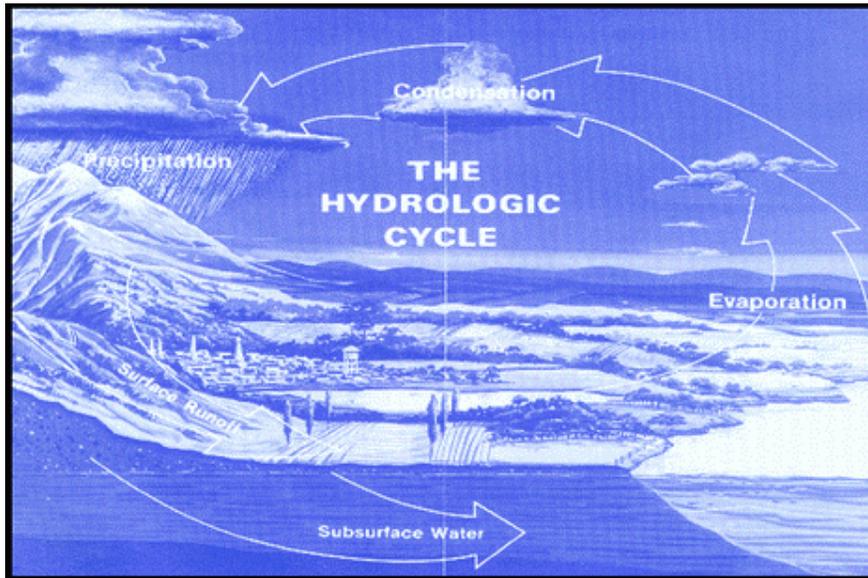
Why are we concerned with implementing these strategies?

- Hydrological Cycle
- Urban Runoff Contaminants
- Natural Drainage System
- LEED™ Certification Points

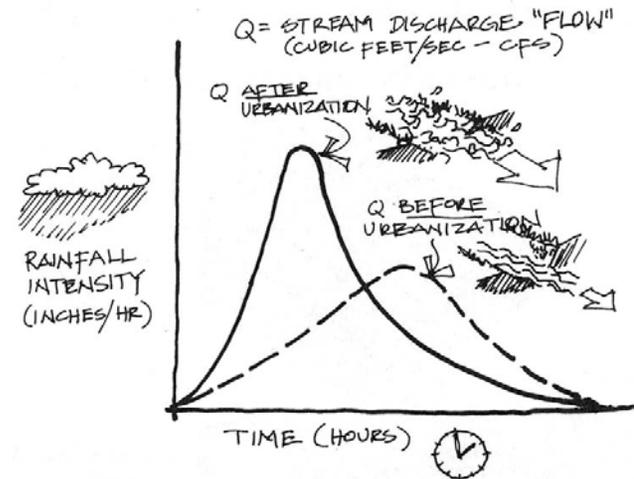




Hydrological Cycle



- Ten Percent Rule





Urban Runoff Contaminants

Urban Surface Runoff vs Raw Domestic Sewage

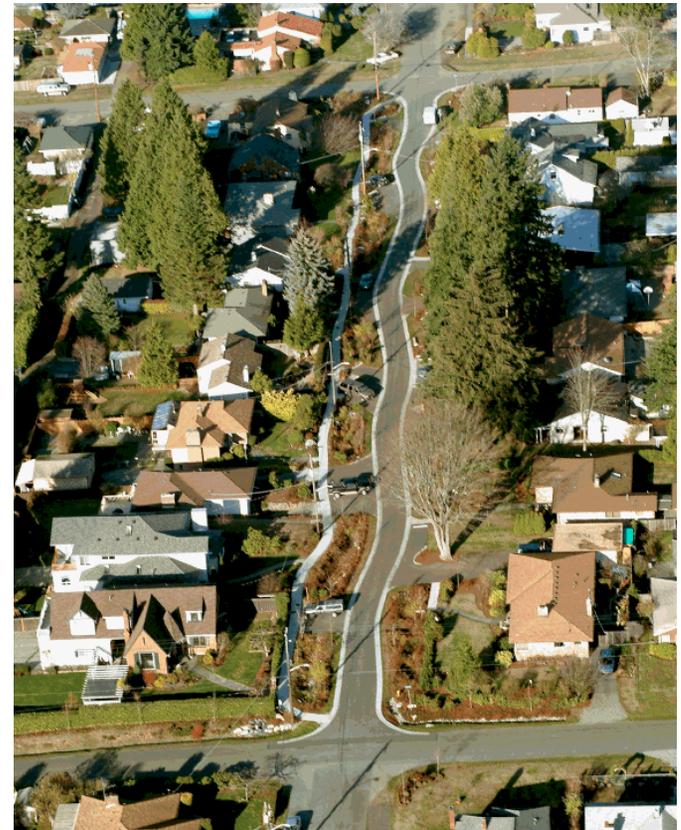
<u>Constituent</u>	<u>Urban Surface Runoff</u>	<u>Raw Domestic Sewage</u>
Suspended Solids	250-300	150-250
BOD No.	10-250	300-350
<u>Nutrients:</u>		
Total Nitrogen	0.5-5.0	25-85
Total Phosphorus	0.5-5.0	2-15
Coliform Bacteria (MPN/100ml)	10^4 - 10^6	10^6 or greater
Chlorides	20-100	15-75
Oil and Grease	Yes	Yes
Heavy Metals	10-100 times Raw conc.	Traces
Pesticides	Yes	Seldom
Other Toxins	Potential exists	Seldom

By the University of Michigan



Natural Drainage System

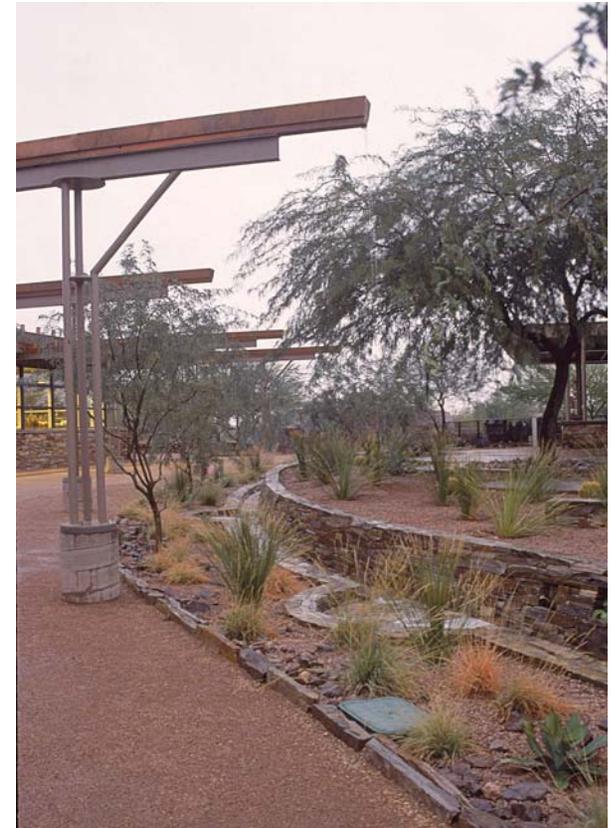
- The City of Seattle's Natural Drainage Systems (NDS) Program
- Low Impact Development





LEED™ Certification Points

- Sustainable Sites
- Water Efficiency
- Energy & Atmosphere
- Materials & Resources
- Indoor Environmental Quality
- Innovation & Design Process



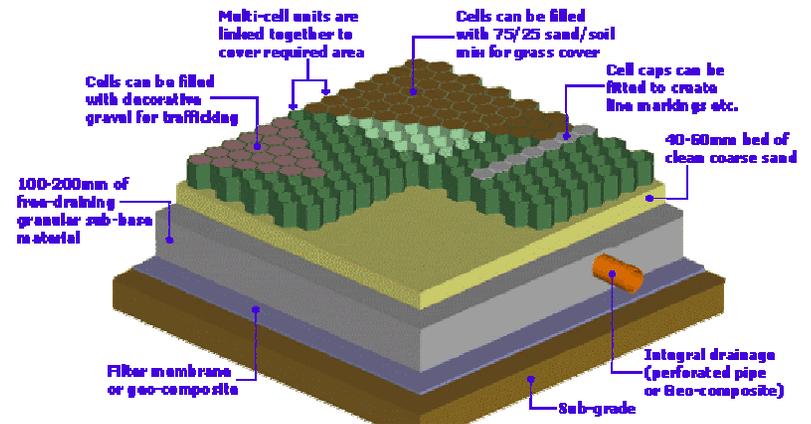
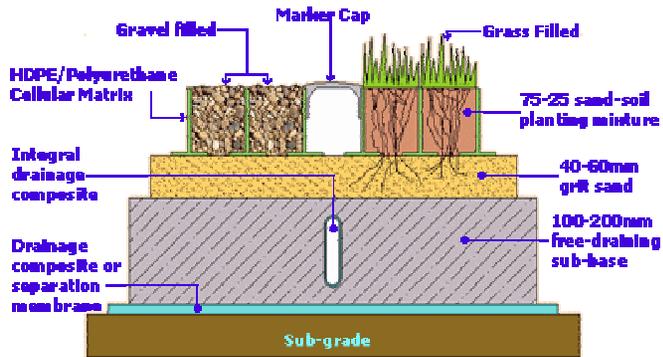
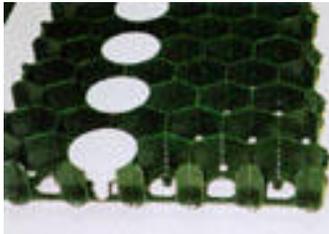


What are Permeable Pavements?

- Unreinforced
- Reinforced
- Protected
- Aggregate
- Turf
- Structural Soil
- Pervious Pavement



Aggregate





Turf



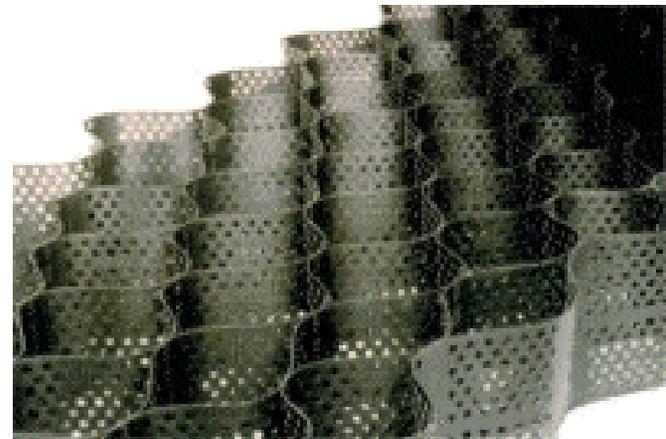
September 10, 2004

Permeable Pavements and Rainwater Harvesting



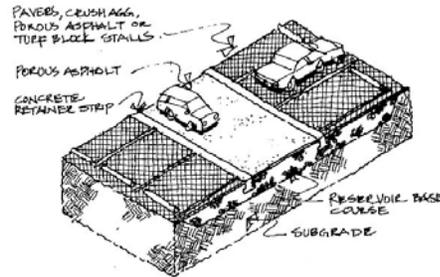
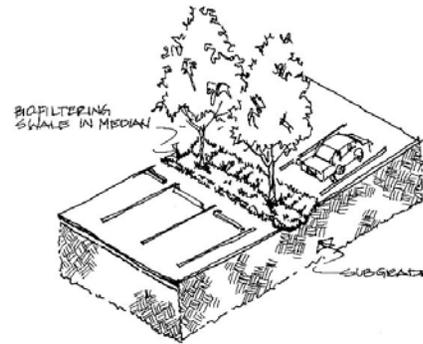
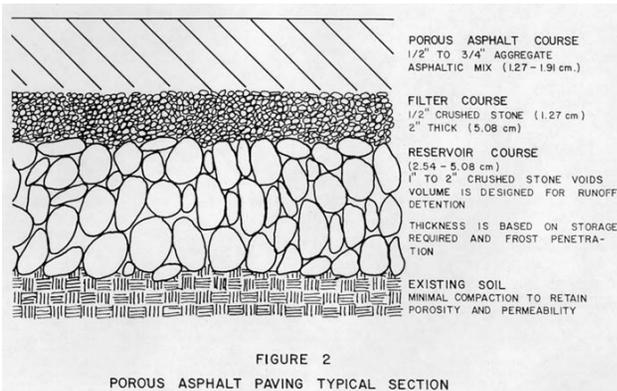
Structural Soil

- Cellular Confinement System
- Slope Stabilization
- Unstable Soils - Sandy
- Infiltration





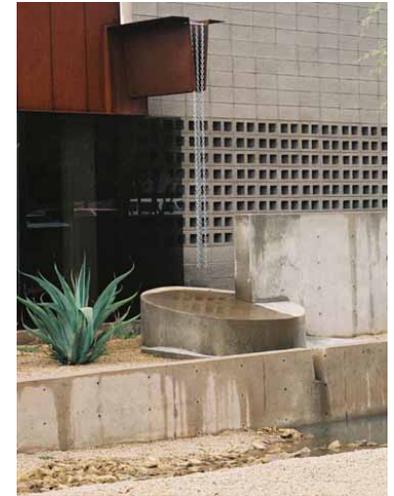
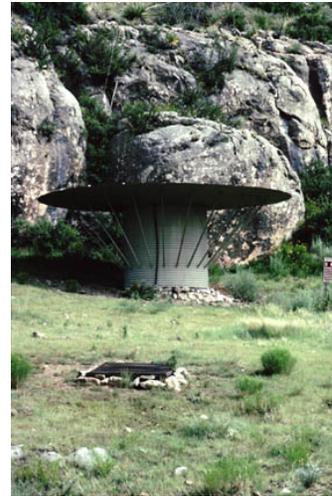
Pervious Pavement

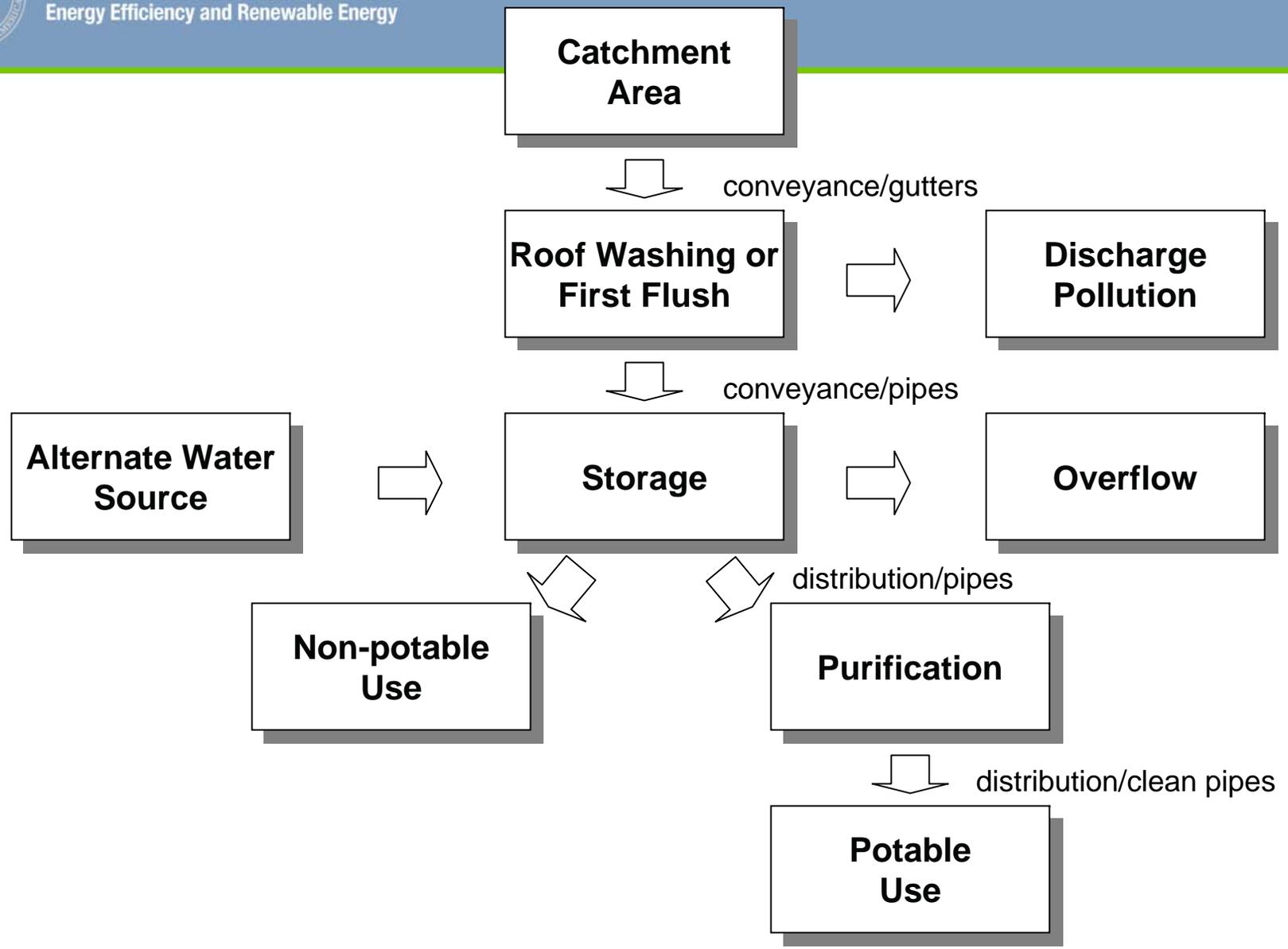




What is Rainwater Harvesting?

- Rooftop or Ground Level
- Passive or Active
- Residential or Commercial
- Individual or Community

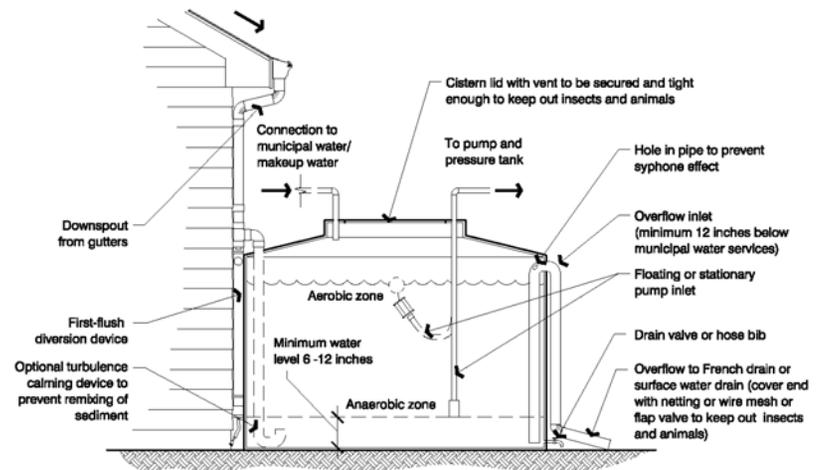






What can the harvested water be used for?

- Landscape Irrigation
- Toilet Flushing
- Cooling Tower Make-up Water
- Vehicle Washing
- Equipment Cooling
- Potable Water Source With Purification

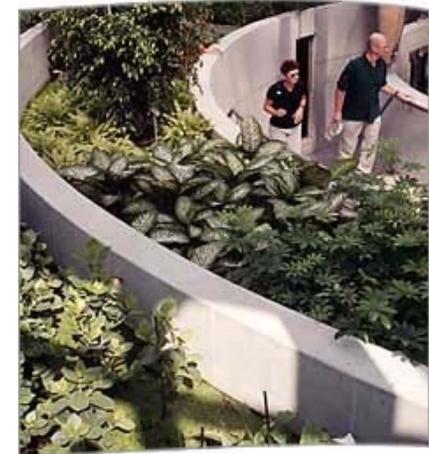
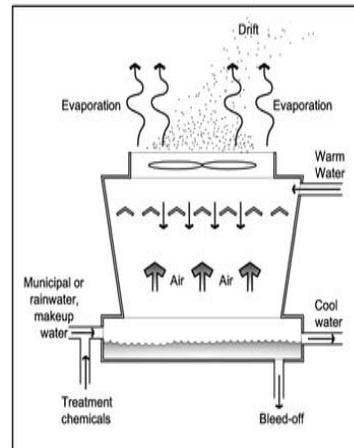


Residential Cistern Detail



Can water be harvested from other sources?

- Bleed-off Water from Cooling Towers
- Potable Wells – System Flushes
- Gray Water
- Flushes From Various Equipment Cooling Processes
- Living Systems





How many LEED™ points can be gained by integrated water conservation strategies?

- A Minimum of 12 Points

Possible Points	Section 1. Sustainable Sites
4	<p>Stormwater Management</p> <p>6.1 • No net increase in the rate or quantity of runoff or reduction of runoff on an existing site.</p> <p>6.2 • Treatment systems designed to remove suspended solids and total phosphorus in runoff.</p>
	<p>Landscape & Exterior Design to Reduce Heat Islands</p> <p>7.1 • Provide shade with in 5 years on at least 30% of non-roof impervious surface or use light-colored/high-albedo materials for 30% of the site's non-roof impervious surfaces or place minimum of 50% of parking spaces underground or use open-grid pavement system for minimum of 50% of a parking lot area.</p> <p>7.2 • Use Energy Star Roof-compliant, high-reflectance and high emissivity roofing for a minimum of 75% of the roof surface or install a "green (vegetated) roof" for at least 50% of the roof area.</p>
5	<p>Section 2. Water Efficiency</p> <p>Water Efficient Landscaping</p> <p>1.1 • Use high efficiency irrigation technology or use captured rainwater to reduce municipal water use for irrigation by 50% over conventional means.</p> <p>1.2 • Use only captured rain or recycle site water for an additional 50% reduction (100% total) of potable water for site irrigation needs or do not install a permanent landscape irrigation system.</p>
	<p>Innovative Wastewater Technologies</p> <p>2.0 • Reduce the use of municipally provided potable water for building sewage conveyance by a minimum of 50% or treat 100% of wastewater on site to tertiary standards.</p>
	<p>Water Use Reduction</p> <p>3.1 • Employ strategies that aggregate use is 20% less water than the baseline calculations.</p> <p>3.2 • Exceed the potable water use reduction by an additional 10%.</p>
1	<p>Section 3. Energy & Atmosphere</p> <p>Measurement and Verification</p> <p>5.0 • Comply with long-term continuous measurement of performance of building functions related to water consumption.</p>
0-4	<p>Section 4. Materials & Resources</p> <p>3.1 & 3.2 Resource Reuse 4.1 & 4.2 Recycled Content</p>
0-1	<p>Section 5. Indoor Environmental Quality</p> <p>8.1 & 8.2 Daylight and Views</p>
2	<p>Section 6. Innovation & Design Process</p> <p>1.1 thru 1.4 Innovation in Design 2.0 LEED Accredited Professional</p>
Min.: 12	<p>Source: U.S.G.B.C. 2004</p> <p>A minimum of 26 points are needed to reach a LEED Certified level, 33 points gain a Silver level, 39 points gain a Gold level, and 52 points gain a Platinum level. The maximum attainable points are 69. See the U.S.G.B.C. for additional information.</p>



Conclusion

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