

Cisterns for Rainwater Re-Use



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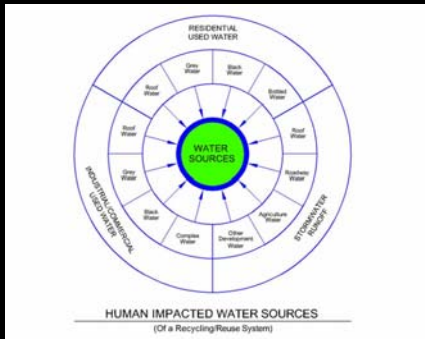
SYSTEMS THINKING

Need to think differently about the problem...

- Whole System Design
 - "Site & Project" Relationships
- Integrated Design
 - "Design" Relationships
- Sustainable Design
 - Materials & Systems (relationships)

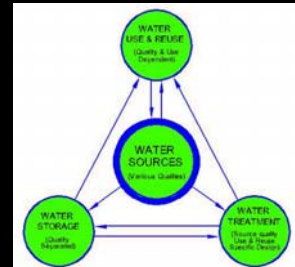
SYSTEMS THINKING

All Water is a Potential Source...



SYSTEMS THINKING

Water Management vs. Water Supply...



SYSTEMS THINKING

Potential Water Sources – Semantics are Important

Water Resources Defined

- Potable Water (Drinking)
- Stormwater (General rainwater run-off from sites)
- "Waste"water (An out-dated term; all types of water are considered resources)
 - Blackwater (Toilet water)
 - Greywater (Sinks, showers, laundry, etc.)
 - Combined Water (Blackwater & greywater)
- Rainwater (Roof run-off)
- Reclaimed Water (Treated water)

LEED

Water Efficiency

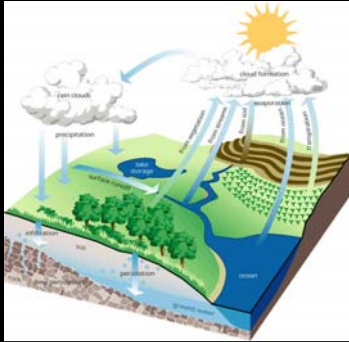
2. Innovative Wastewater Technologies (1)
3. Water Use Reduction (2)



RAINWATER HARVESTING

Introduction

- Rainwater is a clean water source available at the site
- Treatment provided by large scale distillation process
- Storage costs challenge the economics
- Current water rates do not justify much in the way of water conservation
- Utility incentives may be available
- Systems can pay for themselves in some cases



RAINWATER HARVESTING

Introduction

- Not a new idea, been done for centuries
- In many areas rainwater harvesting is commonplace
- Many jurisdictions support or require Rainwater Harvesting
 - States of Texas, California, Hawaii allow rainwater catchment
 - City of Portland, Oregon allows rainwater catchment
 - San Juan County, Washington permits rainwater catchment systems for new construction
 - Bermuda and US Virgin Islands require the use of cisterns in all new construction
 - In rural Australia rainwater catchment is very common

RAINWATER HARVESTING

Introduction

- In this brief talk we are covering two topics with competing needs...
 - Rainwater Re-use cisterns for water conservation (*tries to make tank full*)
 - Stormwater detention cisterns for flow-control during storms (*tries to make tank empty*)
- Hybrid systems are possible, but they require seasonal changes in operation in this climate

RAINWATER HARVESTING

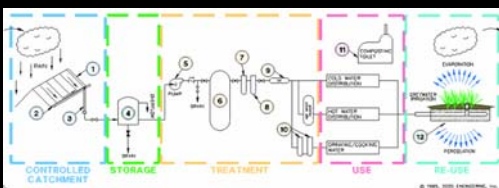
Major System Types

- Irrigation
- Toilet Flushing
- Potable
- Industrial
- Stormwater / CSO Control
- Hybrids of the above
- Each has pros and cons and the cost effectiveness of each type depends on site specific conditions and project goals

RAINWATER HARVESTING

Primary System Components

- Catchment
- Pre-Treatment
- Storage
- Treatment
- Distribution/Use
- Re-Use
- O&M
- Education



RAINWATER HARVESTING

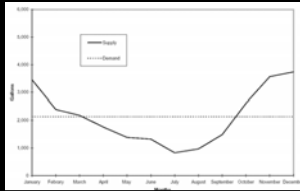
Standards, Guidelines, and Regulations

- California Re-Use Standard (Title 20 of the CA public utilities code)
- New Guidelines from State Building Codes Council (3316.3—PERMISSIVE RAINWATER HARVESTING SYSTEM GUIDELINES FOR NON-RESIDENTIAL OCCUPANCIES)
- WSDOH / WSDOE Re-Use Guidelines
- Texas Guide to rainwater harvesting
- San Juan County, WA
- City of Portland "Code Guide"
- Stormwater charges are reduced a minimum of 10% if rainwater is used (RCW 36.89.080, RCW 86.15.160, etc.)
- A note about Water Rights...

RAINWATER HARVESTING

System Design: Re-Use

- Supply, Demand, and Storage Sizing
 - Catchment Area
 - Storage Volume
 - Seasonal/Daily Supply and Demand
- Treatment
- O&M
- Education



RAINWATER HARVESTING

System Design: Stormwater

- Typically sized for a particular design event, say the 2-year storm
- Seasonal operational changes may be needed
- The design of these small volumes (300-3,000 gallon) can be very sensitive to orifice size
- Design depends location in the basin (i.e. do not detain in the lower reaches)



RAINWATER HARVESTING

Component Design: Catchment and Storage

- Controlled Catchment Area
- Course Pre-Treatment
- Cistern Storage Tank
 - Underground Concrete (CIP, or Pre-Cast)
 - Underground Fiberglass
 - Partial Bury Plastic
 - Above Ground Plastic
 - Above Ground other (recycled stainless steel, etc.)
- Structural Considerations (geotechnical, seismic, etc.)

RAINWATER HARVESTING

Component Design: Catchment and Storage



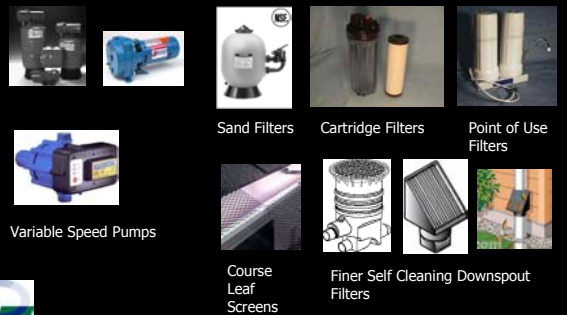
RAINWATER HARVESTING

Component Design: Pumping and Water Quality

- Treatment Depends on Use
- WSDOE / WSDOH Re-Use Guidelines define Class A, B, C, D Reclaimed water (focused on municipal wastewater re-use)
- Filtration (Sand Filter, Cartridge Filter, etc.)
- Disinfection (UV, Ozone, Chlorine)
- Cross-Connection (6" Air-gap or Double Check Valve Reduced Pressure Backflow Prevention Device)

RAINWATER HARVESTING

Component Design: Pumping and Water Quality



RAINWATER HARVESTING

Component Design: Overflow and Release

- Per local stormwater management code
- Re-Use (conservation) system design assumes tank is full and therefore storm is un-detained
- Therefore another retention/detention Best Management Practice (BMP) may be required (same as what would be required of a downspout)
- Prefer Low-Impact Development (LID) BMP's
- Stormwater cisterns are the BMP....

RAINWATER HARVESTING

Example Projects

- Local Public Buildings with Toilet Flush and Irrigation Systems
 - King Street Center (re-use for toilet flushing)
 - Seattle Central Library (re-use for irrigation)
 - Seattle City Hall (retrofit for irrigation and fountain) (under construction)
 - Cascade Eco-Renovation at the Cascade Neighborhood Center and P-Patch (re-use for toilet flushing and irrigation) (*in design*)
 - Portland State University dorm (toilet flushing)
 - Others...

RAINWATER HARVESTING

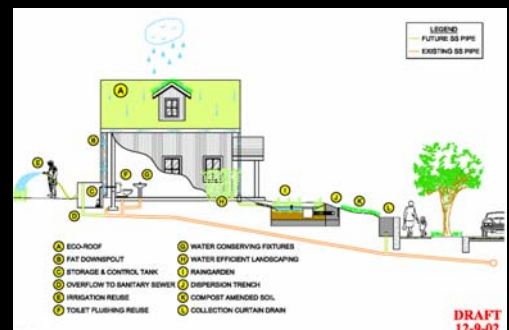
Example Projects

Industrial Re-Use at local composting facilities

- Skagit Soils
 - Eliminated contaminated run-off
 - Eliminated the need for a costly water line extension
- NAS Whidbey Composting Facility
 - Re-used captured roof water in a recycled tank to balance moisture content in in-vessel compost units (conservation)

RAINWATER HARVESTING

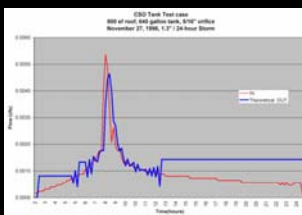
As part of small scale, source control, LID approach



RAINWATER HARVESTING

As possible CSO mitigation strategy

- Large centralized CSO tanks are expensive (~\$5-8/gallon)
- Small decentralized CSO tanks are less expensive (\$0.30 - \$1/gallon)
- Small decentralized allow seasonal re-use for irrigation or other uses
- Maintenance and modeling issues



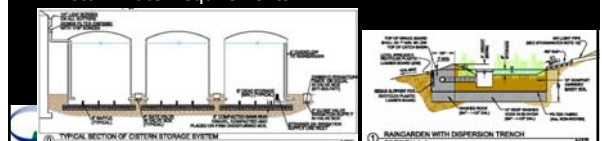
RAINWATER HARVESTING

Residential Hybrid Example Project

Bainbridge Island, WA, *under construction*

Rainwater as source of irrigation water for small market garden

- 1,100 sf roof, 18,000 gal. Storage, 5,000 sf market garden irrigation
- Raingarden Bioretention Area for overflow, meets COBI stormwater requirements



RAINWATER HARVESTING

Commercial Hybrid Example Project

- Bayview Corner Public Restroom Building – Rainwater Collection for toilet flushing
- Serves a Farmers Market and Plant Nursery
- Combines other strategies to be essentially “off the water grid”



RAINWATER HARVESTING

Residential Potable Water Example Project

- Swinomish Indian Reservation, Skagit County, WA, built 1999
- Rainwater as sole source of potable water
- 1,600 sf metal roof, 5,600 gal. Storage, 2 people, 20/5 micron cartridge filtration, 1/0.5 micron carbon at taps, UV disinfection
- Composting toilets & small greywater re-use system



RAINWATER HARVESTING

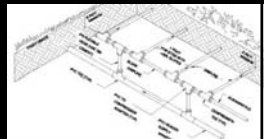
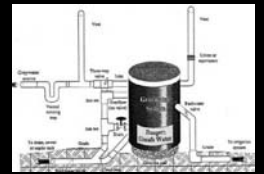
Residential Potable Water Example Project



WATER EFFICIENCY

Ecological “Waste”water Treatment and Re-Use

Subsurface Drip Irrigation



WATER EFFICIENCY

Water Conserving Fixtures



Waterless Urinals



Dual Flush Toilets



Fixtures



Washing Machines



Composting Toilets



Drought Tolerant Landscaping



WATER EFFICIENCY

Commercial Pool Filter Water Re-Use Economics



City of Vancouver Combined Water and Sewer Rate	
	\$0.0036 per gallon (Governmental Rate)
	\$0.0032 per gallon (Commercial Rate)
<u>Estimate of Filter Backwash:</u>	
Leisure Pool =	8,100 Gallons / 7days = 1,157 GPD
Lap Pool =	4,500 Gallons / 7days = 578 GPD
Whirlpool =	1,000 Gallons / 7days = 151 GPD
	1,886 GPD (Average)
	(= 688,000 Gallons Per Year)
<u>Estimate of Daily Savings for Re-Use</u>	
	\$2,473 per year (Governmental rate)
	\$3,572 per year (Commercial Rate)
<u>Capitalization</u>	
	\$38,046 @ 6.5% (Gov. Rate)
	\$56,953 @ 6.5% (Commercial Rate)
<u>20-year Payback</u>	
	\$49,450 (Gov.) or \$71,440 (Commercial)



THANK YOU...

Questions



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