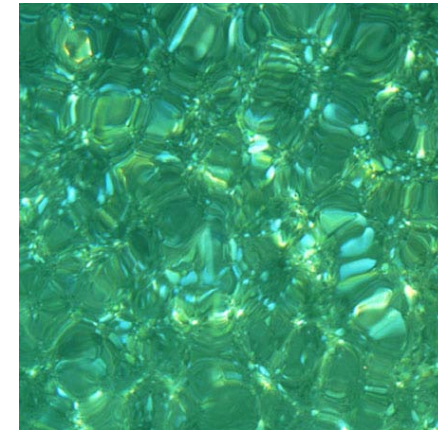


This presentation premiered at WaterSmart Innovations

watersmartinnovations.com



Residential Graywater Reuse – *A Technology Whose Time Has Come?*



Date: Thursday, October 7, 2010
Time: 10:40 - 11:10 AM
Location: Napa B



watersmart2010™
INNOVATIONS

Topics

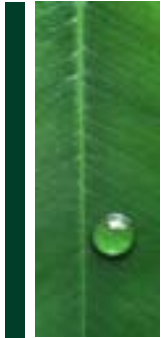
Introduction

Indicators of Greater Acceptance

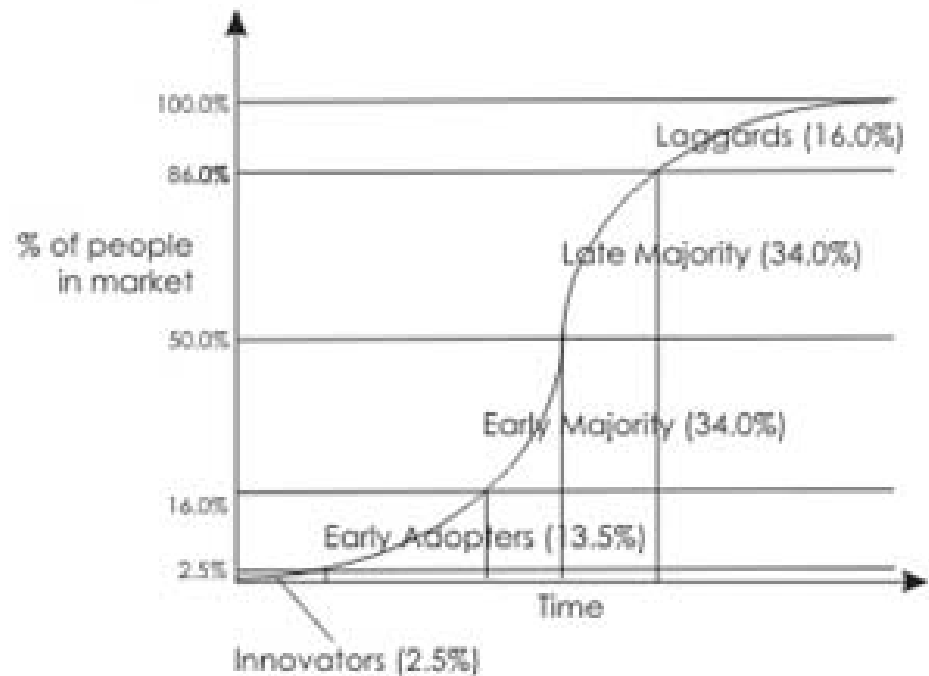
Continuing Impediments

Conclusion and Summary

Graywater Adoption



- Where is graywater on the Rogers Innovation Diffusion Curve?
- What's driving the technology forward?
- What's holding it back?



Introduction

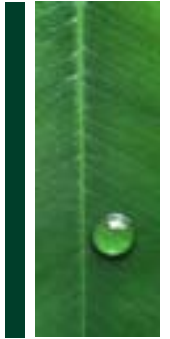
Onsite Graywater Water Systems



- Lightly contaminated wastewater collected from fixtures for reuse.
 - Excludes wastewater containing fecal matter, food waste (blackwater).

- Graywater may be used for many applications (depending on local regulations)
 - Subsurface irrigation (usually untreated)
 - Flushing
 - Irrigation
 - Water features
 - Fire suppression

Grey or Gray?



- IPC: Graywater
- IGCC: Graywater
- ASHRAE 189.1: Gray water
- UPC: Gray water
- NSPC: Graywater
- Canada: Greywater
- Australia: Greywater



- NOT Potable

But...

- NOT Blackwater

Graywater Sources



Specifically Permitted

- Bathtubs
- Showers
- Lavatories
- Clothes Washers
- Laundry Trays

Specifically Prohibited

- Toilets
- Urinals
- Kitchen Sinks
- Dishwashers

Ambiguous

- Drinking fountains
- Floor drains

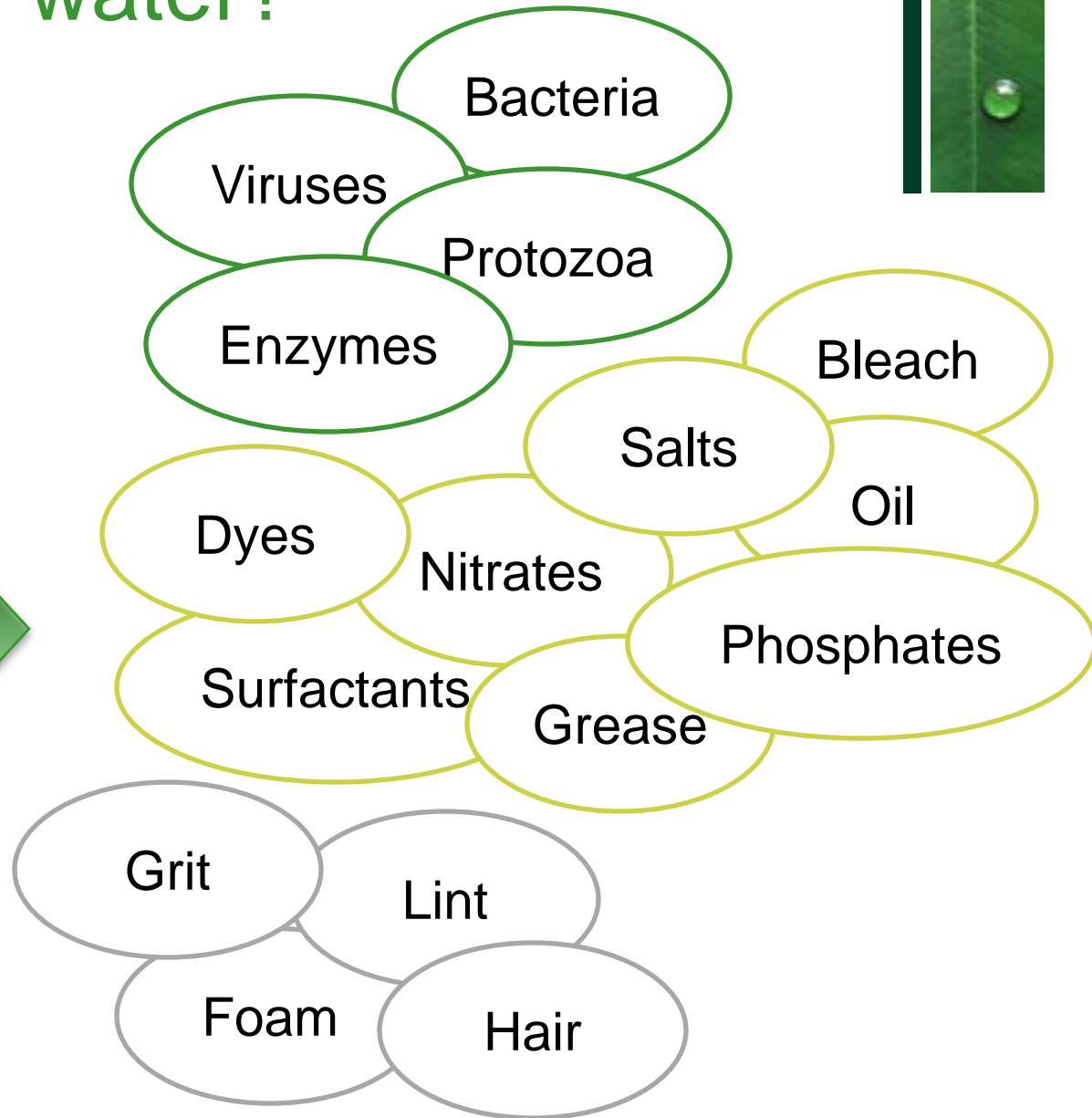
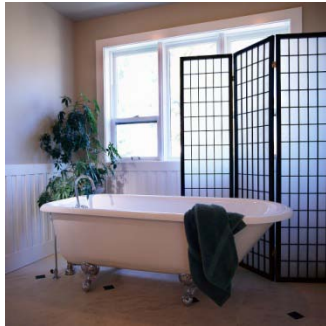
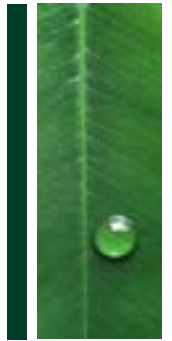


Intermingling – To Mix or Not to Mix?

- Rainwater
- Swimming pool and other filter backwash
- AC Condensate
- Steam/Boiler condensate
- Foundation drainwater
- Municipal reclaimed water



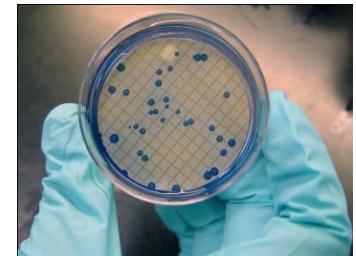
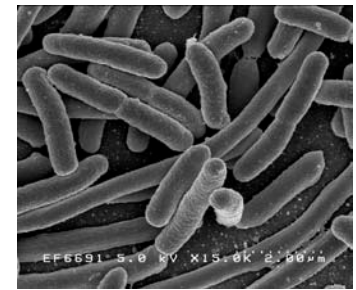
What's in the water?



How does it compare to wastewater?



Parameter	Graywater	Wastewater
Suspended Solids (mg/L)	45-330	100-500
BOD ₅ (mg/L)	90 -290	100-500
pH	6.6-8.7	6.5-8.5
Nitrite (mg/L)	<0.1 – 0.8	1-10
Ammonia (mg/L)	<1.0 – 25.4	10-30
Total Coliform (CFU/100 mL)	10 ² - 10 ⁶	10 ⁶ - 10 ⁸
E. Coli (CFU/100 mL)	10 -10 ⁵	10 ⁶ - 10 ⁸



Canadian Guidelines for Domestic Reclaimed Water, Jan. 2010.

Indicators of Greater Acceptance

Integrated Systems -Packaged Onsite Graywater Systems

- Integrated “appliances” eliminate the need for engineered systems
 - Reduced need for specialized installer skills
 - Control units integrate disinfection, monitoring, alarms/notifications
- Standards under development to address water quality, system features, and maintenance
 - NSF 350 – Residential Wastewater Treatment Systems
 - CSA B128.3 Performance of Non-Potable Treatment Systems



Sloan Aqus

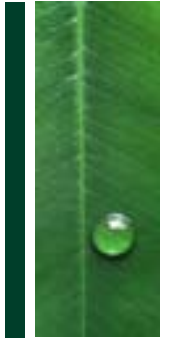


Water Legacy



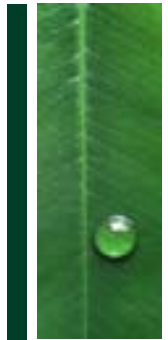
BRAC Systems

NSF 350 – Onsite Residential and Commercial Water Reuse Treatment Systems



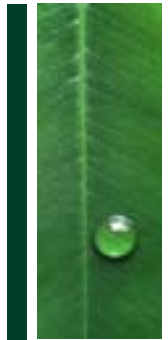
- Scope: Onsite residential and light commercial approx up to 1500 gal/d treatment capacity
 - Specifies different artificial influent challenge water criteria depending on whether single or multiple source is intended.
 - Applications include nonpotable restricted and unrestricted indoors and outdoors (single criteria).
- 26 week testing using standardized artificial challenge water under several loading scenarios.
- Status
 - Ballot released September 21, public comment in Fall 2010
 - Release in early/mid 2011

CSA B128.3 Performance of Non-Potable Water Treatment Systems



- Scope: Onsite residential and light commercial non-potable water treatment systems approx 2650 gal/d treatment capacity or less.
 - Recommends, but does not specify influent criteria. Allows artificial or actual graywater influent. Permits single or multiple source testing.
 - Applications include nonpotable restricted and unrestricted indoors and outdoors (separate criteria)
- 46 week testing using standardized artificial challenge or actual graywater under several loading scenarios.
- Status
 - Ballot with TC in October, no additional public comments
 - Release spring or late summer 2011

Comparison of Effluent Criteria

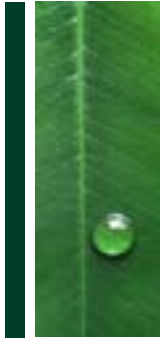


Parameter	NSF 350 Class R		CSA B128.3 Unrestricted		CSA B128.3 Restricted	
	Test Average	Single Sample Maximum	Test Average	Single Sample Maximum	Test Average	Single Sample Maximum
CBOD ₅ (mg/L)	10	25	10	20	10	25
TSS (mg/L)	10	30	10	20	10	25
Turbidity (NTU)	5	10	2	5	2	5
E. Coli (MPN/100 mL)	14	240	Non-detect	200	100	400
Fecal coliforms*			Non-detect	200	100	400
pH (SU)	6.0-9.0	NA				
Total chlorine residual (mg/L)	0.5 – 2.5		0.5 - 2		0.5 - 2	
Color	MR**	NA				
Odor	Non-offensive	NA				
Oily film and foam	Non-detectable	Non-detectable	MR**		MR**	

*CSA B128.3 Allows E.Coli or Fecal Coliforms to be measured. NSF 350 requires only E. Coli

**MR: Measured and Reported

Model Codes and Green Specifications

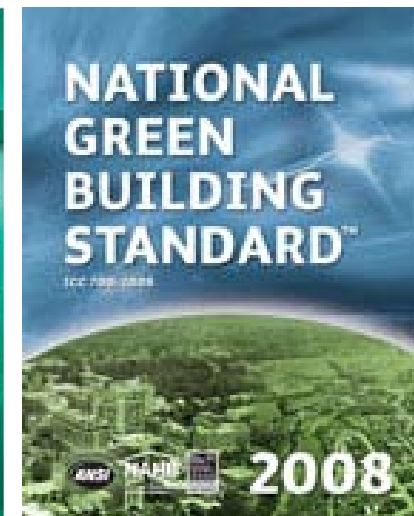
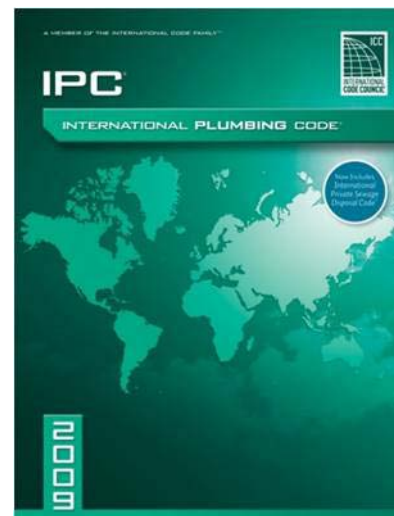


Green Codes/Standards/Specs

- IGCC – Sections 706, 708, 406
- ICC-700
- ASHRAE 189.1, 191
- IAPMO Green Supplement
- USGBC LEED

Model Plumbing Codes

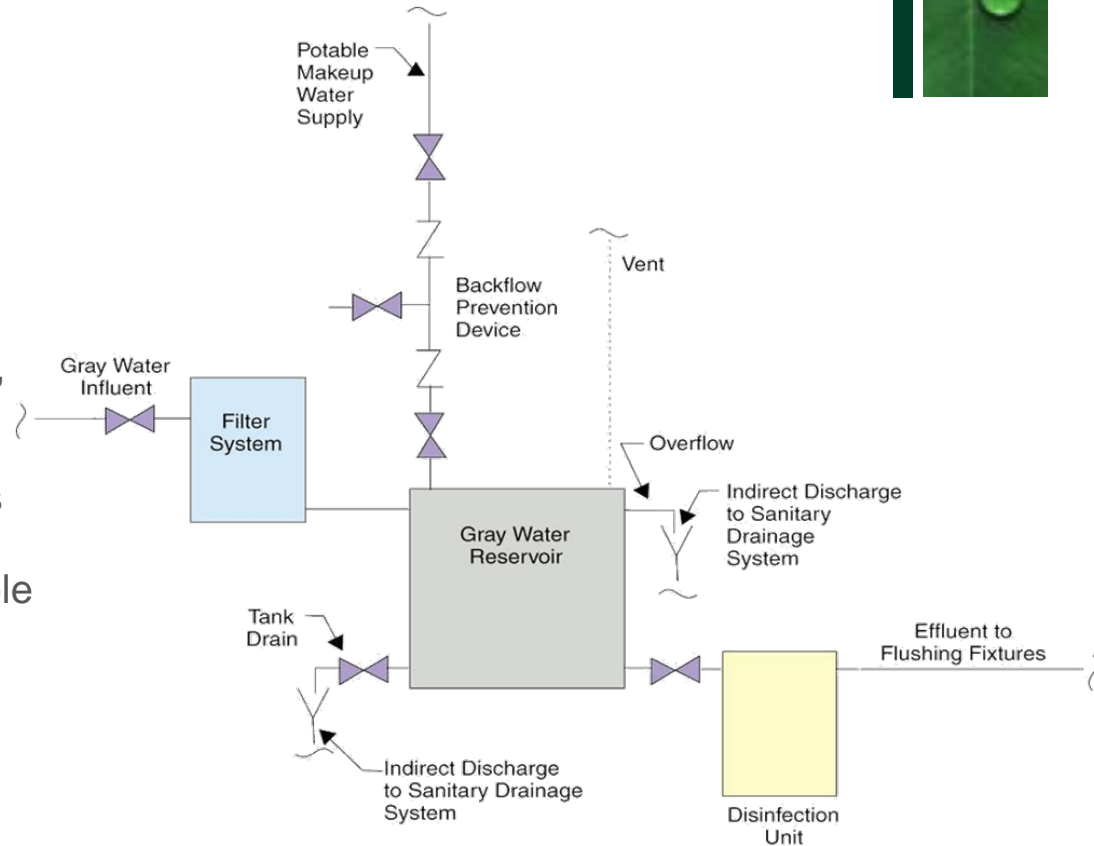
- IPC: Appendix C
- UPC: Chapter 16
- NSPC: Appendix G



Example: IGCC Graywater Reuse Section



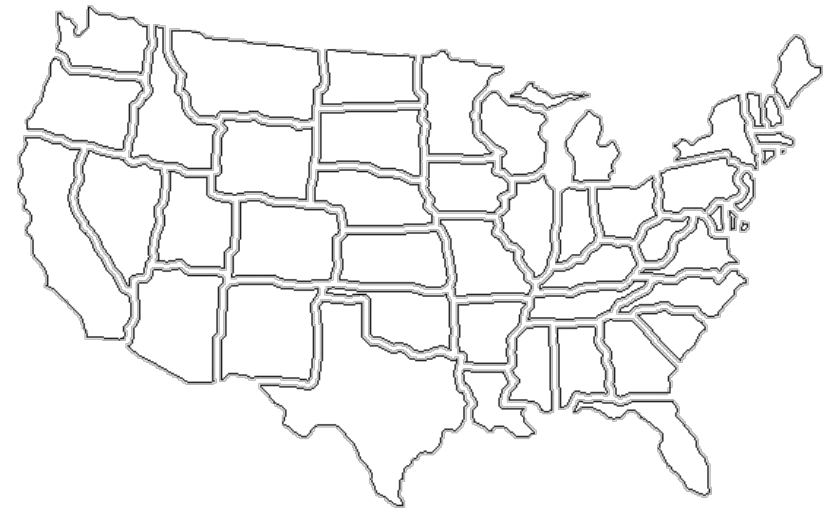
- Removes dye requirement
- Leaves water quality req. to AHJ
- Detailed requirements for tank access and construction, controls, alarms, overflows, makeup water
- Allows wide range of source flows
- Requires labeling and use of purple pipe for distribution
- Provisions for wide range of uses including fountains, trap priming, construction, dust suppression, surface irrigation



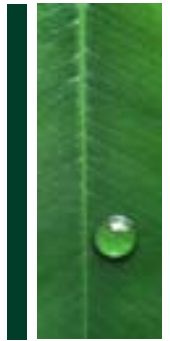
States Modernizing and Updating Graywater Regulations



- Adding permitted uses
- Migration toward wider residential use
- Reducing permit requirements
- Simplification of regulatory structures
- Creation of multiple effluent standard tiers

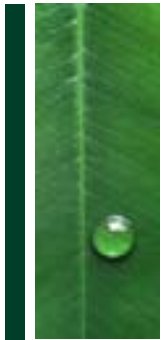


NC Example: Proposed Reclaimed Utilizations



Type	Details	2T Utilization	2U Utilization
Land Applications (Outdoor)	Residential lawns, Golf courses, Cemeteries, Parks, Landscape areas, etc.	Permitted with signage, regular inspection, record keeping.	Permitted for Class B with signage, regular inspection, record keeping.
Indoor Applications	Toilet/Urinal Flushing & Fire Protection	Permitted on case-by-case basis for commercial or industrial (not residential)	Permitted for commercial or industrial (not residential)

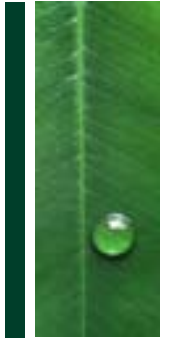
NC Example: Proposed Effluent Criteria



Parameter	2T	2U Class A	2U Class B
BOD ₅	< 10 mg/L monthly, < 15 mg/L daily max	< 5 mg/L monthly, < 10 mg/L daily max	< 10 mg/L monthly, < 15 mg/L daily max
TSS	< 5 mg/L monthly, < 10 mg/L daily max	< 5 mg/L monthly, < 10 mg/L daily max	< 5 mg/L monthly, < 10 mg/L daily max
NH ₃	< 4 mg/L monthly, < 6 mg/L daily max	< 1 mg/L monthly, < 2 mg/L daily max	< 4 mg/L monthly, < 6 mg/L daily max
E. coli	< 14 CFU/100 mL (monthly geo. mean), < 25 CFU/100 mL (daily)	< 3 CFU/100 mL (monthly geo. mean)	< 25 CF U/100 mL (monthly geo. mean)
Coliphage	NR	< 5 CFU/100 mL (monthly geo. mean)	< 25 CF U/100 mL (monthly geo. mean)
Clostridium perfringens	< 10 CFU/100 mL (monthly geo. mean)	< 5 CFU/100 mL (monthly geo. mean)	< 25 CF U/100 mL (monthly geo. mean)
Turbidity	< 10 NTU	< 5 NTU	< 10 NTU



Upcoming Research Studies

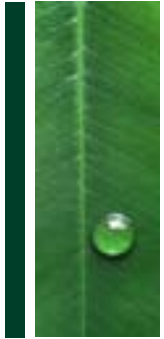


- WERF– “Treatment Public Health and Regulatory Issues Associated with Graywater Reuse”
 - Current treatment technologies – water quality, reliability, lifetimes
 - Survey of existing water quality codes and standards
- PERC Study – “Test Plan Proposal to Investigate Drainline Transport in Buildings”
- Alliance for Water Efficiency – Research Committee

Continuing Impediments

Regulations in North America
Model Codes and Standards

Residential Graywater Issues

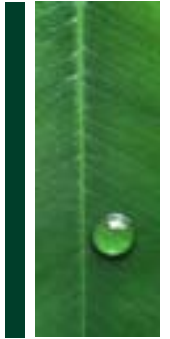


- Differing code requirements
 - Acceptance
 - Water quality, residence time
 - Cross connection control and dyeing
 - Pipe labeling and color
- Personal care products and cleaners constantly changing
- Long-term effects on end use devices, plants and soils unknown
- Homeowner maintenance (filters, decontamination)
- Water quality verification programs difficult to implement
- Effects of reduced volume on drainline function unknown
- Initial cost high and system payback often very long



Brac 450 L Graywater System

Regulations in North America – Highly Fragmented Among States

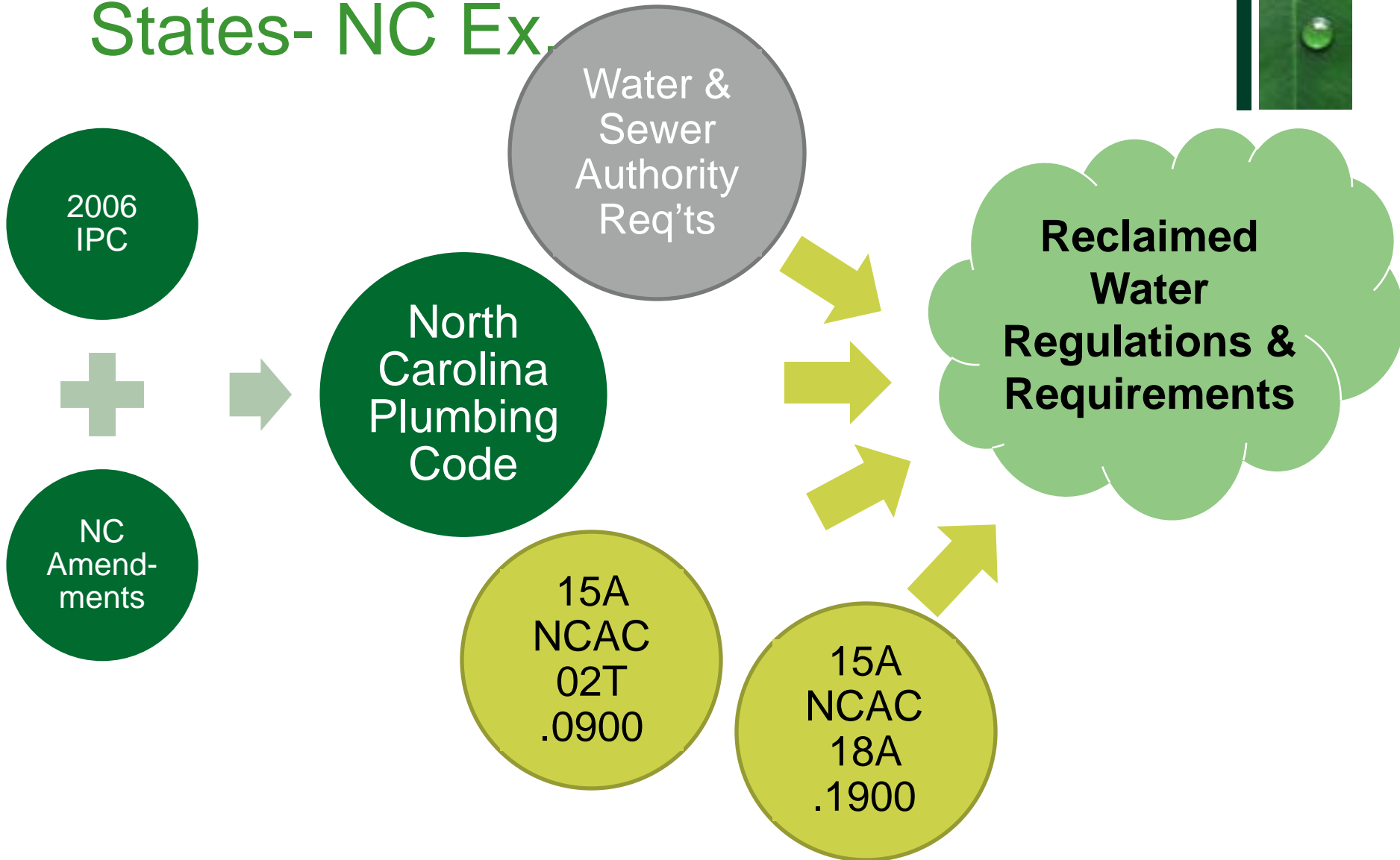
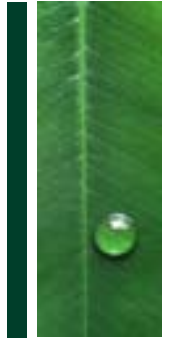


- Utilizations permitted
- Effluent quality standards
- Cross connection control and dyeing
- Pipe labeling and color
- Residence time limits

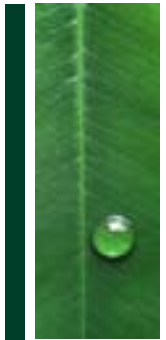


Charlotte Pipe ReUze™ CPVC

Regulatory Fragmentation within States- NC Ex.



Effluent Quality Management Schemes – No Clear Winner



Maintenance Contract Model	Operating Permit Model	Responsible Management Entity Operation Model	Responsible Management Entity Ownership Model
<p>Lower risk of malfunction Lower resource program</p>	<p>Regular reporting</p>	<p>O&M transferred to professional OME who has permit</p>	<p>High level of oversight Reduces owner/RME conflict</p>
<p>Difficult to track/enforce compliance</p>	<p>More regulatory resources & expertise needed</p>	<p>RME right of entry Oversight of RME</p>	<p>Requires RME financial investment May limit competition</p>

Significant Knowledge Gaps



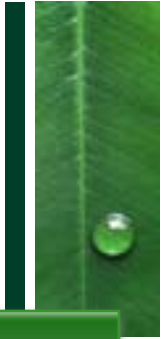
- 2006 WERF/SDA Study – “Long-term Effects of Landscape Irrigation Using Household Graywater”
 - Accumulation of graywater constituents in soil and transport to groundwater
 - Soil chemistry changes
 - Effects on landscape plants
 - Effects on indigenous soil microorganisms
 - Survivability and growth of different indicator organisms and pathogen correlations
- Effect of graywater on flushing system components
- Correlation of indicator organism concentrations to health hazard

Compatibility of Disinfection with End Use Devices



*Graywater: It's Not Black and White, TOTO USA May, 2010.
EPA Regional Science Workshop on Using Treated Graywater*

Pipe Labeling and Coloring – The Conflict Continues



POTABLE

POTABLE

POTABLE

NONPOTABLE

RAIN WATER

NONPOTABLE

GRAY WATER

GRAY WATER

RECLAIMED

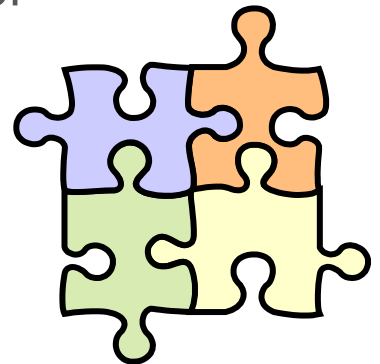
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Conclusion & Summary

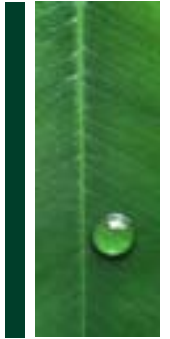
Some pieces are coming together



- States slowly expanding and modernizing graywater regulations and permit processes
- Research and pilot studies will better document health effects, technology implementation issues, system robustness and build our understanding of the risk.
- Standards are nearly complete that will allow for robust product certification.
- Product availability will improve with the completion of standards and updates to regulations



What's Needed for Further Adoption of Graywater?



- Better delineate and coordinate roles of various regulatory agencies.
- Further development of maintenance and inspection programs and infrastructure.
- More education needed to dispel misconceptions and old biases
- Anticipate the addition of graywater (future-proofing) in more new construction
- Research to plug knowledge gaps.
- Change to the basic economics.

The Final Word

- Technological hurdles can be overcome.
- Real problems:
 - Economic
 - Regulatory
 - Perception
- Remaining question:
 - Can graywater be deployed safely on a large scale in residential applications?



Water Legacy WL-55

Acknowledgements

Robert Rubin, PhD. – Chair, NSF 350 Committee

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Michael Vail – Water Legacy



Thanks for your
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