

H₂O AND RESIDENTIAL LANDSCAPE IRRIGATION

Philip T. McCreanor*, Douglas M. Doud,
Nand Patel, and Justin Pritchard

*Associate Professor, Director of Engineering Honors Program
mccreanor_pt@mercer.edu
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What is Gray Water?

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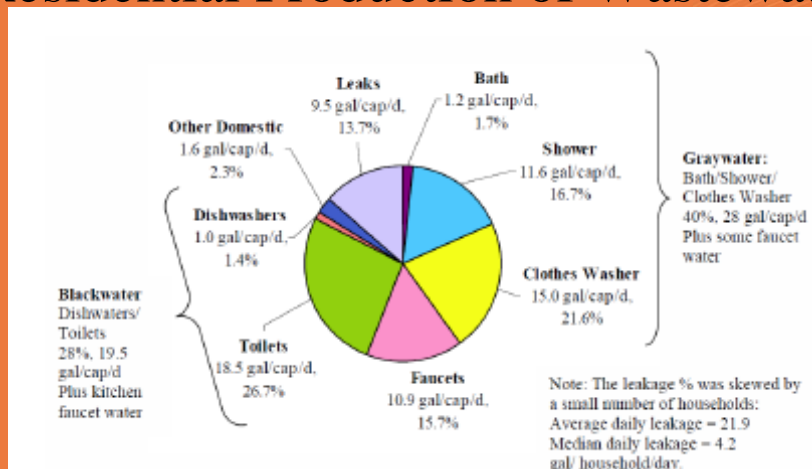
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What is Gray Water?

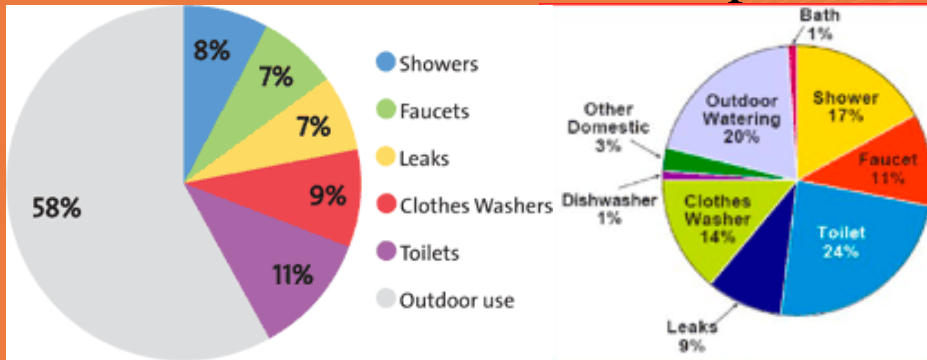
- It is not Reclaimed Water.
- Wastewater from non-septic and low substrate concentration sources.
 - 45 to 70% of residential water usage
 - Potential sources include
 - Bathroom sinks, showers, bath tubs, and washing machines.
 - Typical exclusions include
 - Toilets, urinals, kitchen sinks, and dishwashers.

Residential Production of Wastewater



From :Sheikh, Bahman, White Paper on Graywater, AWWA, 2010

Residential Water Consumption



GRAY WATER PRODUCTION > IRRIGATION DEMAND

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Comparison of Gray and Black Water

Component	Black Water ¹	Gray Water ²
TSS, mg/l	250	120
BOD ₅ , mg/l	250	155
pH	6.5	7.25
Total Coliform, CFU/100 mL	10 ⁹	10 ^{3.7}
Fecal Coliform, CFU/100 mL	10 ⁷	10 ^{2.7} (E.coli)
Ammonium-Nitrogen, mg/l	10	--
Nirate-Nitrogen, mg/l	<1	--
Total Nitrogen, mg/l	60	4
Total Phosphorous, mg/l	10	<1

From: 1-Gross, Mark, Wastewater Characterization, University Curriculum Development for Decentralized Wastewater Management, University of Arkansas, 2004.
2 - NSF International, Onsite Residential and Commercial Water Reuse Treatment Systems, Issue 1, Draft 1.7, Sept. 16, 2010.

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Potential Benefits of Gray Water Re-use for Landscape Irrigation

- Reduced potable water demand for irrigation purposes
- Drought-proofed landscaping
- Decreased wastewater flows to aging sewage systems
 - **But** there will be a higher solids content in flows.
- Reduced carbon footprint → less pumping

Challenges to Implementation of Gray Water Re-use for Landscape Irrigation

- State-level Regulatory Concerns
 - Framed around septic system maintenance requirements and failures
- Municipal-level Regulatory Policies
 - Septic systems not allowed on a lot served by a public sewer system
- Compatibility with Existing Plumbing Codes
- Small Body of Scholarly Studies/Knowledge

Drip Emitter Design Notes

- Irrigation Guideline: ~1"/week (0.09 gpd/sq.ft.)
- Georgia On-site Sewage Management Systems Manual

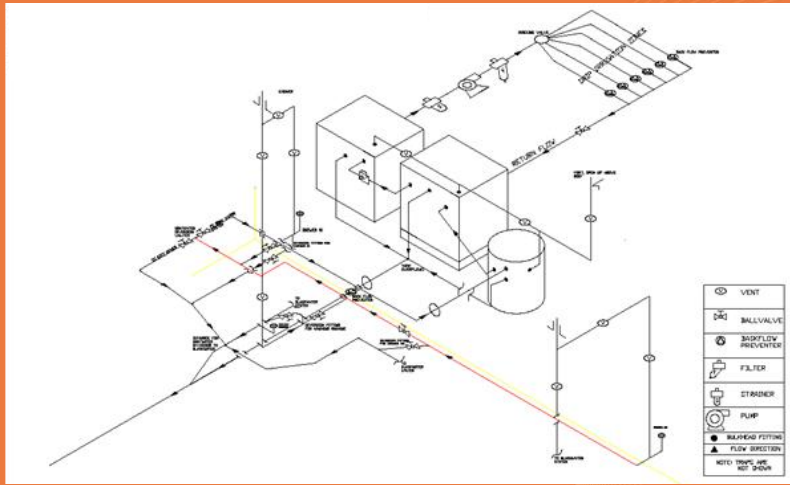
Soil Group	Soil Textural Classes (USDA classification)	Percolation Rate (min./in.)	Maximum Hydraulic Loading Rate (gpd/sq.ft)
I.	Sands (Sand and Loamy Sand)	<10	0.4 to 0.3
II.	Coarse Loams (Sandy Loam and Loam)	10-30	0.3 to 0.15
III.	Fine Loams (Sandy Clay Loam, Silt Loam, Clay Loam, Silty Clay Loam, Silt)	30-60	0.15 to 0.1
IV.	Clays (Sandy Clay, Silty Clay, Clay)	>60	0.1 to 0.04

- Class I Effluent: ≤ 25 mg/l BOD₅, ≤ 30 mg/l SS

Mercer Gray Water Irrigation System

- Filters at baths and laundry sources
- Separate gray water and black water plumbing flows
 - Main diversion valves
 - Diversion valves at each source
- Lift Tank (55 gallon drum with sump pump)
- Treatment Tank (225 gallon water tote with bristle filter)
- Fitting for septic chlorine tabs
- Dosing Tank (225 gallon water tote)
- 420 μ m mesh strainer, 100 μ m mesh Wye-filter with cleaning flush
- Indexing valve, drip zones

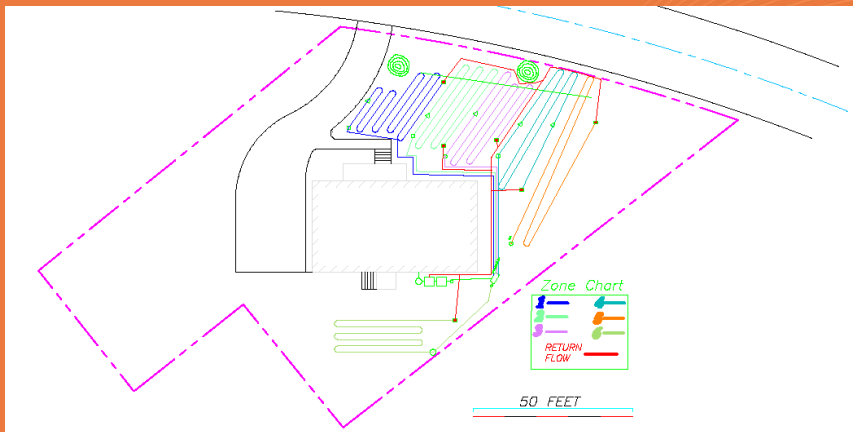
Macon Area Habitat Home System



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Macon Area Habitat Home System



OPERATING SINCE
MARCH 2011

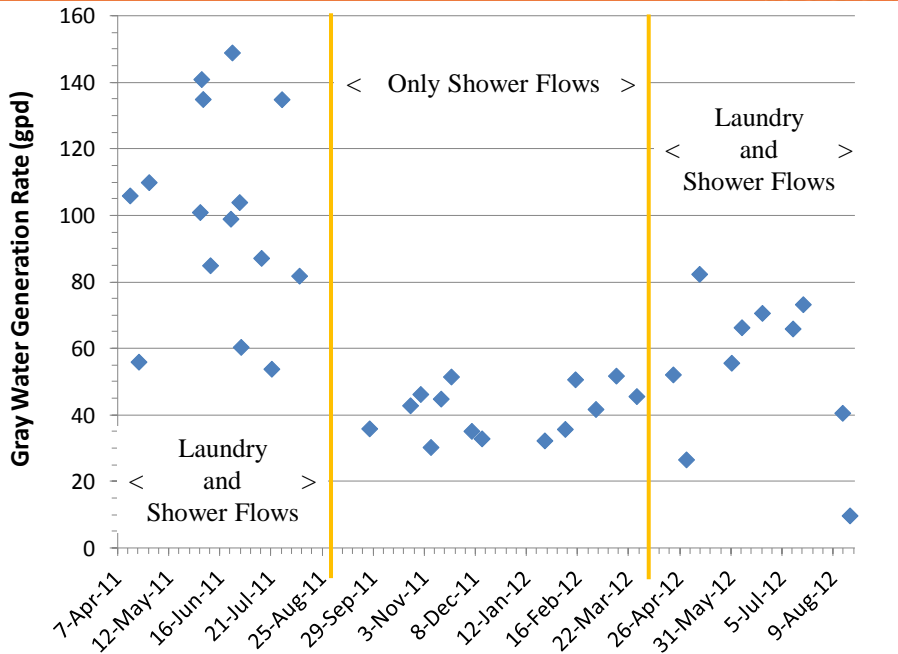
PHOTOS TAKEN
JUNE 2011



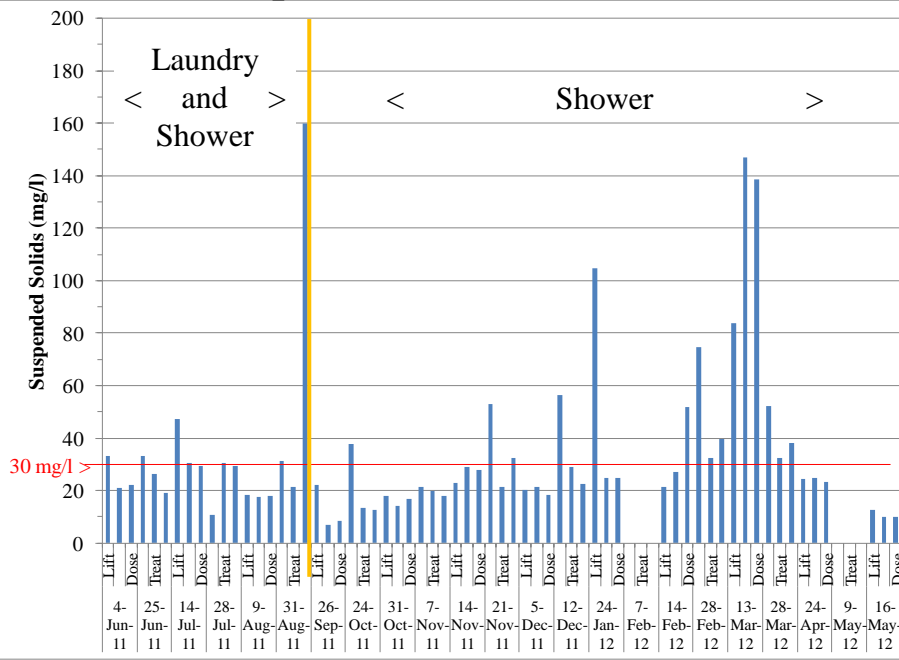
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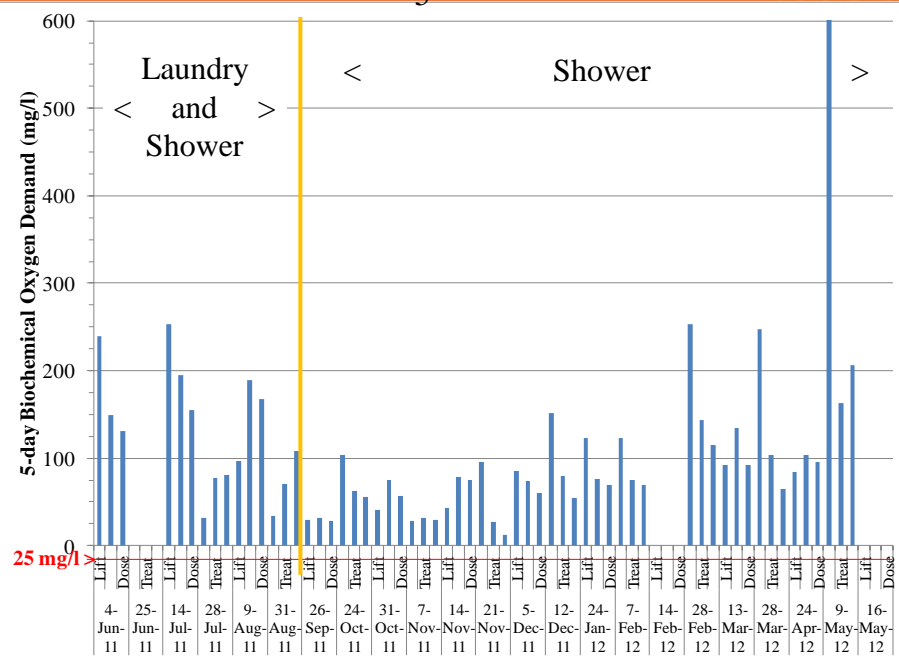
Gray Water Production



Suspended Solids Results

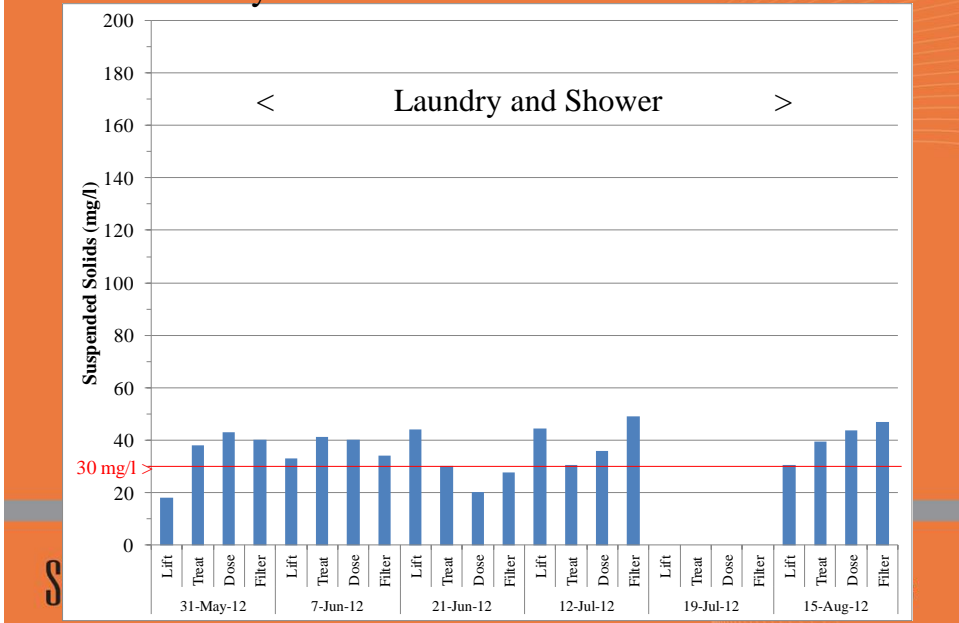


BOD₅ Results



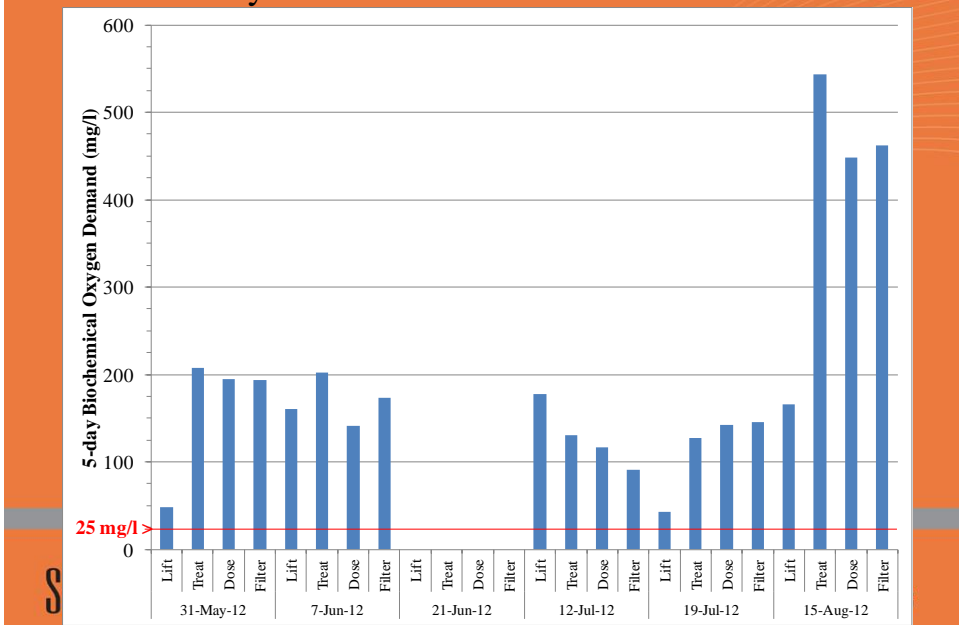
Suspended Solids Results

with laundry flow and vortex filter with constant flush



BOD₅ Results

with laundry flow and vortex filter with constant flush



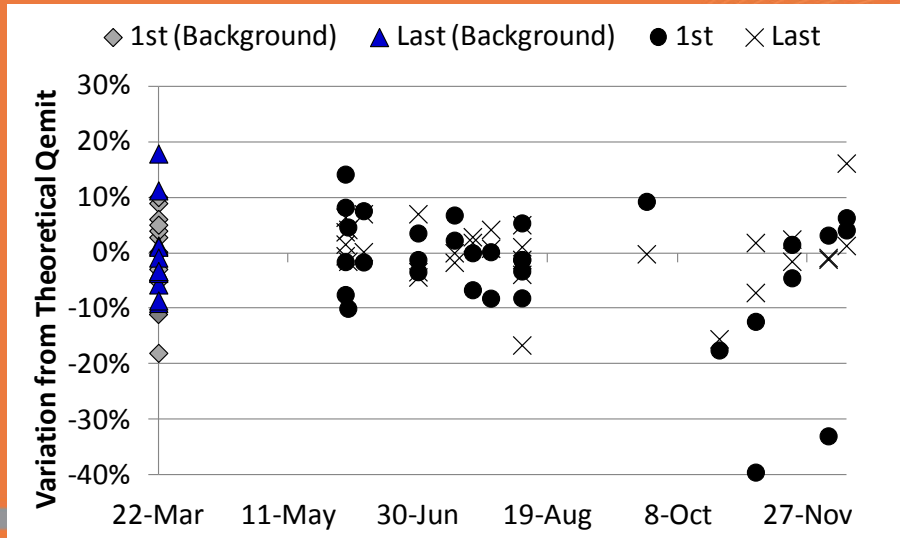
Drip Emitter Performance

Date	Zone	Pressures (psi)			Emitter Drip Rate (gph)		
		Inlet	Outlet	Drop	First	Last	Average
2-Jun	2A	30	24	5.8	1.65	1.33	1.49
	2B	31.5	25	5.8	1.46	1.39	1.43
	3A	30.5	25	5.8	1.35	1.33	1.34
	3B	32	26	5.8	1.62	1.33	1.47
3-Jun	4A	31	26	5	1.54	1.39	1.47
	4B	30	26.5	3.5	1.30	1.33	1.32
9-Jun	5A	29	28	1	1.39	1.39	1.39
	5B	30	28	2	1.55	1.49	1.52
29-Jun	1	30.3	28.7	1.6	1.44	1.41	1.42
14-Jul	2A	31	26	5	1.57	1.32	1.44
	2B	33	NR	---	1.55	NR	---
21-Jul	3A	32	26	6	1.39	1.36	1.38
	3B	ND	25.5	---	1.55	1.36	1.46
28-Jul	4A	33	26	7	1.52	1.39	1.46
	4B	33	26.5	6.5	1.39	1.36	1.38

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Drip Emitter Performance



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Key Findings to Date

- Laundering process produces a lot of lint
 - Filtrol® 160 lint filter at washing machine needs to be cleaned or replaced about every 4 loads
 - Washing machines may not be an ideal source
- BOD₅
 - Georgia Drip Emitter Treatment Standard = 25 mg/l
 - Laundry+Shower Flow: Influent = 256 mg/l Effluent = 325 mg/l
 - Shower Flow: Influent = 157 mg/l Effluent = 81 mg/l
- Total Suspended Solids
 - Georgia Drip Emitter Treatment Standard = 30 mg/l
 - Laundry+Shower Flow: Influent = 29 mg/l Effluent = 46 mg/l
 - Shower Flow: Influent = 42 mg/l Effluent = 32 mg/l

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COMMENTS AND DISCUSSIONS



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Consumptive Use Concerns and the Energy-Water Nexus

- Pumping water to and sewage from a residence requires energy.
- The production of energy requires a significant amount of clean water.
- The production of clean water requires a significant amount of energy.