Eco-Sense Grey Water Course Notes

Introduction:
Grey water is not a waste, it is a resource and as such is becoming very popular for those those interested in resource recovery, water conservation, permaculture, and local resiliency. The present building codes have not caught up with this necessity, so despite the existence of leading edge policies in many jurisdictions throughout North America that already allow grey water to be reused, BC is lagging WAY behind. This said, it is only a matter of time before its inclusion the BC Building Code, perhaps in the next updated version there will be an allowance for reuse of light Grey Water. So, just to be clear, the grey water resource recovery options being discussed today are NOT currently code approved, but can be used in addition to code approved systems.

This course is designed for people interested in simple do-it yourself Grey water to get started with a basic understanding of the concepts, design considerations, equipment, safety rules, and some applications. We hope to whet your appetite to learn more and put into practice what you will learn. This booklet is not complete and is designed as a supplement to the hands on grey water course. Making additional notes is encouraged.

Black Water

Blackwater is waste water that is derived from flush toilets and urinals.

Grey Water

Grey water is waste water that is derived from clothes washing machines, sinks, showers, bathtubs and dishwashers.

- **Light Grey**
  Water from all fixtures that have limited food particles entering, like bathroom sinks and showers, clothes washers.
- **Dark Grey**
  Water from kitchen sinks and dishwashers.

Although grey water contains less than 10% of nitrogen found in blackwater, greywater has a higher level of un-reacted organic material readily available to micro-organisms and therefore decomposes much faster than blackwater. Blackwater, by contrast, contains material already exposed to one of nature's most efficient "treatment plants": the digestive tract of the human body, which means further decomposition will proceed much more slowly. The high decomposition rate of greywater allows it to quickly achieve chemical stability through organic reactions in the soil, but this rapid decomposition rate also requires greywater to be treated within 1-2 days of its production. (Clivus Multrum: http://www.clivusmultrum.com/science-technology.php)

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The 3 Basic Rules

1. Do Not Store for longer than 24 hours - Greywater should not be stored in holding tanks as it will quickly use up available dissolved oxygen and begin to decompose anaerobically, producing an offensive odor, and become highly pathogenic.

2. Do Not Apply to FOOD Crops to be eaten raw - As greywater will contain pathogens, it should not be applied to any vegetable gardens or food crops wherein the food may not be totally cooked. But, there is a possible exception to this rule for tree or shrub food crops as these have a woody stem and a different type of vascular tissue. For example grey water may be used to safely irrigate fruit trees, some berry bushes, and some woody herbs. This may still be considered controversial by some and it is your risk if you choose to use grey water for food crops.

3. Do Not Apply Above Ground - Always irrigate subsurface. This way children or pets can not drink or play in the water that has potential pathogens. Ideally the water should be dispersed within 15-30 cm below the surface.

Different Grey Water Systems. All systems very much site specific

1. **Branched Drain**
   Branched drain irrigation is the most simple, low maintenance irrigation system beside using a bucket under the sink. Water flows are collected at the source and transported to mulch basins in the desired location...if gravity allows. Flows are split via **flow splitters**, to even out the distribution volumes to the different targets. **Mulch basins** are leaf/straw filled depressions around trees; the exit of the irrigation pipe sits below the surface of the leaves, grey water drops down into the mulch and particles are then eaten, digested, composted by the critters within the mulch.

   Advantages:
   1. No filtration is required. Because greywater has solidifying components like fats and soaps, the system must be designed to easily maintain it, with inspection ports and clean outs, and ability to flush the deposited solids out into the soil.
   2. Simple to maintain
   3. No dousing required (lots of water at once)

   Design considerations: Must use gravity to direct water to flows, must maintain proper slope when laying out the irrigation piping. May require lots of digging and trenching.

Eco-Sense Example: Clothes Washer and hazelnut/plums on west side of the house. Chicken Coop gardens: This grey water comes from the septic tanks where we aerate the contents to keep it aerobic.

2. **Filtered Drip irrigation**

If the greywater is well filtered, and you have sufficient gravity to create enough pressure, greywater can be used with a simple drip irrigation system. The filter must be serviceable, and function as a surge tank, grease trap and particle filter. We use our worm bin for this. From here the water flows down hill to where it has about 8 psi. We use a standard old rubber hose, and have installed drip irrigation lines into it.

The drip irrigation lines do not have valves (they have been removed to avoid clogging), and are distributed sub surface via insertion into a 1/2" piece of tubing that is inserted into the ground into a mulch basin.

Advantages:

1. Better utilization of grey water
2. Filtering with a Worm filter produces - WORM CASTINGS (see below)

Design considerations: Regular upkeep, and system checking. Greater water pressure required.

Eco-Sense example: Apple orchard at the bottom of the hill.

3. **Infiltration beds**

Infiltration is notoriously a maintenance problem with greywater. The concept is that grey water is distributed to a perforated pipe that is buried sub surface within the root zone of plants. The reality of grey water is that eventually materials build up inside the pipes with solids, worms, and roots, and the pipe will become quickly blocked and need to be removed and cleaned...thus disturbing your plants. It's a very unpleasant job.

Design Considerations: Greywater that is used for an infiltration dispersal system must be well filtered, or very clean from its source, as well as irrigating a crop that requires periodic uprooting and digging.

Eco-Sense Example: our raspberry bed. The clothes washer (very light grey) feeds this area. The infiltration pipe is a length of (recycled) 4" PVC; this has about thirty 2" holes drilled into a ten foot length; the pipe is wrapped with a thick filter cloth material which acts as a root and worm barrier, as well as an saturation pad, wherein the material becomes easily saturated, and disperses moisture to the soil along the length of the pipe. We use Armtec 400 for this, but three layers of burlap covered by two layers of filter cloth would perform the same function.

4. **Constructed Wetland**

A constructed wetland is a confined pondlike area created to pass grey water through a series of aggregates and root zones of wetland plants. The idea is that the plants help oxygenate the water as it passes by, while allowing for an environment for bacteria and other micro-organism, plants, and chemical degradation to treat the water.

Usually multiple separate wetlands are used in series. Sizing of wetlands:

- In our colder climate (comparatively speaking about Arizona or California), we should size a wetland wherein there is $3ft^2$ of surface area/gallon/day, or in metric $1m^2$/4 l/day (Take your total usage in litres and divide by 4... this will tell you how many meters of area is required). Depth will depend on the types of wetland plants you use and their roots system, but generally 2 ft (60 cm) is normal. The length should be twice that of the width to allow for flow.

Generally some form of settlement tank or prefilter is used prior to the disbursement into the wetland... highly recommend using an ROWP for designing such complex system. Constructed wetlands can often be approved “Waste Disposal Systems” and are generally only cost effective on larger scales.

5. **Tertiary Treated-re-use**

Not covered in this course - This is a system designed to treat greywater to a high degree so it can be reused for the flushing of toilets. Generally these systems are complex and expensive, requiring settlement tanks, aeration, and circulation through large filters, then treatment before reuse.

Worm Biofilter (worm bin)

The idea behind a worm bin is to filter out particulates from greywater, trap grease and soap residue, and provide some degree of surge capacity so that grey water can be used in applications such as the drip irrigation system or as a prefilter for a constructed wetland. Even if one doesn’t reuse grey water, a worm filter could be installed for the sole benefit of producing worm castings.

Filters require awareness. Every application will require different maintenance schedules, and will require close attention to what products are used (or banned) within the household. Toxic cleaning products or high use of friendly products will kill your worms.

Three functions: Filter, Surge Tank, Grease Trap

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General Concept: Collected water travels into the leaf mulch/worm rich 1st stage, wherein particulates and grease are trapped and eaten; the water then migrates through a series of screens to an area with pumice acting as the final filter medium before exiting. Several times a year (depending on use) the leaf mulch needs to be harvested and composted, to allow for complete pathogen death, and after the one year period the compost/worm castings are a resource for the garden.

Worm Bin 1 - Original Design
Components - see supplied diagram

Worm Bin 2 - improved Design
HDPE water tank - source at a marine supply store

4	small rust resistant hinges
2	2" Bulk Head fittings - (Sourced at Corix, Andrew Sherret, Van Isle Water)
3	2" Male Thread to Glue Joint ABS coupler
1	6 foot section of 2" ABS pipe
1	2" 90 degree elbow ABS
1	2" Wye ABS
1	2" 45 degree ABS
1	2" Clean Out ABS

Attachment to existing plumbing can be done via glue joint couplers or rubber couplers.

Eco-Sense Example: Worm Bin out front.

<u>Soaps And Chemicals</u>

1. Use fully biodegradable soaps, detergents, and other products. NO nasty chemicals like bleach, etc
    - Watch out for chemical preservatives and fragrances...these are generally BAD
    - Even some eco brands have nasty preservatives in them.
    - look up ingredients. see http://www.cosmeticsdatabase.com/
2. Always use the minimum amount required to do the job.
3. Ideally plants prefer and even like soap/detergents that are based on potassium based salts…most are sodium based and the sodium can build up in the soil and eventually cause plant distress. We are lucky living here on the wetcoast as we get lots of rain in the winter to leach out excess salts that may build up in the summer through grey water irrigation.

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Common Materials

Pipe

- ABS - commonly used in DWV (drain/waste/vent) applications; common size is 1 1/2 “; used in the collection system at the house, commonly used in all parts of the distribution system; not UV stable, and expands/contracts large amounts with changes in temperature thus to be used in buried application. The flow splitters are also made of ABS.
- HDPE municipal line - thick wall piping that comes in a roll, is UV stable, and extremely durable and somewhat flexible; used as the upper part of the distribution system; more expensive but can save considerable time and money by not requiring fittings.
- PE polyethylene - thin wall black tubing that is used for the lower portion of the distribution system; kinks easily though is flexible; common use is within irrigation systems.

Pipe Fittings

- Reducer Bushing - used to reduce from a larger pipe diameter to a smaller pipe diameter; bushings, due to their blunt change in size, create an area at reduction for particles and goo to collect.
- Reducer Coupling - used to reduce from a larger pipe diameter to a smaller pipe diameter; due to its tapered design there are no blunt edges at joints and thus create less opportunity for goo build up.
- Coupling - joins two pipes of the same diameter; couplers can come with several combinations of ends on them, most common is glue joints, but you can have glue to male thread, glue to female thread, male thread to female thread, and rubber couplers that use hose clamp (easy to use).
- 22 1/2^{o} elbow
- 45^{o} elbow
- 90^{o} elbow
- 90^{o} long sweep - similar to the above elbow but with a longer radius, thus less prone to clogging

Valves

- Ball valves - used in situations where grey water is filtered; prone to jamming with sand and grit - can be purchased from any plumbing supply store.
- Gate valves - used in situations where water contains unfiltered fluids - can be purchased from Van Isle water and pool supply stores
- Three way CPVC valves - used in areas where diversion is required - can be purchased from Van Isle Water or pool & spa supply stores.

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Installation Tips

Slope of all plumbing should be at least 2% - this is a 1” drop over a 4 foot span

Flow splitters need to be level for flows to be equally split

Always design with maintenance in mind, providing many opportunities to remove valve for cleaning or to have clean-outs just up from major plumbing junctions.

Bevel the upward ends of all pipes - the fluids will run smoother and easier if the leading inside edge of the pipe is beveled, thus lending to less obstacle for goo to collect.

HDPE municipal line can be stretched out in the sun to obtain a functional product... also a small propane torch can be used to warm the pipe at areas where a tighter radius is required.

Immediately after each flow splitter, there should be a drop in elevation to allow flow to speed up and limit debris build up on the joints.

Resources

Create an Oasis with Greywater by Art Ludwig (web is: http://oasisdesign.net/)

Urban Raincatcher Gazette - (website: http://www.urbanraincatchersgazette.ca/)

Flush Toilet Ready - link: http://www.islandnet.com/~anngord/downloads/eco-sense-flush_toilet_ready_draft_policy-091215.pdf

Van Isle water products catalogue - link: http://www.vanislewater.com/images/dlfiles/Catalogues/wsc_10.pdf