Georgia Gray Water Recycling Systems Guidelines

In accordance with Appendix C 'Gray Water Recycling Systems' of the 2009 amendments to the 2006 International Plumbing Code

2009

PREFACE

The Georgia Gray Water Recycling Systems Guidelines are intended to assist all parties involved in the design, construction, inspection and maintenance of gray water recycle systems and to help successfully comply with Appendix C-'Gray Water Recycling Systems' of the 2009 Georgia Amendments to the 2006 International Plumbing Code (IPC). The parties mentioned above include owners, building officials, design professionals and contractors. This consensus document is the product of the parties listed below:

Guideline Committee Members:

Frances Carpenter, co-chair
Max Rietschier, co-chair
Bill Morris
Ernest U. Earn
David Freedman
Randy Starr
Chris Kumnick
Ryan Meres
Gregory Jeffers
Bill Guinade
Marvin Richards
Tom Carty
Bob Freeman
Philip T. McCreanor, Ph.D
Eddie Van Giesen
Shawn Hatley
Frank Henning
Nicole Nichols

The Guidelines Committee wishes to take this opportunity to express our sincere appreciation to Chris Kumnick and those individuals who donated their time and effort to the development and production of this document.

Disclaimer and Notice:

While the information presented in these guidelines is believed to be correct, the parties involved assume no responsibility for its accuracy or for the opinions expressed herein. The material presented in this publication is not considered "Code" and should only be used for reference and guidance in complying with the requirements of Appendix C 'Gray Water Recycling Systems.' All gray water recycling systems shall comply with the Georgia State Minimum Standard Plumbing Code (2006 IPC with Georgia Amendments) and all other applicable State Minimum

Standard Codes for construction. Users of information from this publication assume all liability arising from such use.

The 2009 Georgia Amendments to the International Plumbing Code which contain Appendix C 'Gray Water Recycling Systems' can be downloaded from the Department of Community Affairs website at the following link:

http://www.dca.state.ga.us/development/constructionCodes/programs/codeAmendments.asp

This Guidance document can be downloaded from the DCA website at:

DCA Link Here

Table of Contents

Page

1. SCOPE..... 5

2. GRAY WATER RECYCLING..... 5

3. HEALTH AND SAFETY..... 6

4. TERMINOLOGY, DEFINITONS AND GLOSSARY..... 9

5. GRAY WATER RECYCLING SYSTEM DESIGN.....11
   - 5.1 Consideration for the reuse of Gray Water.....11
   - 5.2 Sources of Gray Water 12
   - 5.3 Collection of Gray Water.....12
   - 5.4 Make Up Water 12
   - 5.5 Storage of Gray Water 13
   - 5.6 Pumps.....15
   - 5.7 Treatment of Gray Water.....15
     - 5.7(a) Filtration.....16
     - 5.7(b) Disinfection.....18
     - 5.7(c) Chlorination 18
     - 5.7(d) Ultraviolet Light.....19
     - 5.7(e)Other 19
   - 5.8 Identification, Coloring and Purple Piping.....20

6. OPERATION AND MAINTENANCE.....20

7. SUBSURFACE LANDSCAPE IRRIGATION SYSTEMS.....21

8. REFERENCES, CONTACT INFORMATION AND LINKS.....21

Gray Water Recycling System Guidelines

1. SCOPE

According to the 2009 Georgia State Amendments to the International Plumbing Code (IPC), 2006 Edition, gray water recycling systems for the use of flushing water closets and urinals or for subsurface irrigation, if treated according to Code Standards, is allowed. In Chapter Three of the IPC, 'General Regulations' Section 301.3, has been amended to allow gray water (waste water from bathtubs, showers, lavatories, clothes washers, and laundry trays) to discharge to an approved gray water recycling system. This change also allows gray water to be used for other purposes when designed by an engineer licensed in the State of Georgia and approved by the authority having jurisdiction.

Appendix C includes requirements regarding the installation, filtration, disinfection, drainage and identification of gray water recycling systems. These requirements must be met before gray water can be used for the flushing of toilets and/or urinals. Appendix C also allows gray water to be used for subsurface irrigation of landscaping which must be permitted by the local county board of health under the requirements of the Department of Human Resources' *'Georgia Manual for On-site Sewage Management Systems'*.

2. GRAY WATER RECYCLING

In recent years, with growing populations and limited amounts of fresh water available, water conservation, or the efficient use of water, has assumed greater importance in the lives of Georgians. In the pursuit of managing the State's natural water resources, homeowners, builders, and water authorities are looking for ways to use less water or to use water more efficiently. This leads some people to wonder how or if they should recycle gray water. The information in these guidelines should help you decide whether it is possible or feasible for a gray water system to be used for flushing of toilets and urinals, or for use for subsurface landscape irrigation.

The most obvious advantage of domestic gray water use is that it potentially can replace some potable water consumption in uses such as toilets, urinals and irrigation. Gray water usage

may offer financial savings to homeowners and businesses depending on the reduction in potable water usage and cost of the recycling system. However, diminished sewer flows could potentially result in insufficient flows to carry waste to the sewer plant (e.g. pipes with low slopes), or may result in a high strength sewage that combined with lower flows may lead to odor and corrosion problems in the centralized sewerage systems.

These systems require that installation work be performed by a plumber, licensed in the State of Georgia, when gray water is recycled and used to flush toilet and/or urinals. Please contact the local building department for requirements and approval. For gray water subsurface irrigation systems, the work must be performed by a Department of Human Resources (DHR) certified on-site septic installer working under a permit obtained from the local county health department.

What is gray water? (also spelled graywater, greywater, and grey water)

Gray water is waste discharged from lavatories, bathtubs, showers, clothes washers and laundry trays. Although not gray water by definition, condensate may be discharged to a gray water recycling system.

3. HEALTH AND SAFETY

Gray water systems refer to the recycling of gray water for flushing toilets and/or urinals or for subsurface irrigation in order to conserve water. Any gray water recycling practices must guard against risks to public health, include safety, and protect the environment. Different qualities of gray water may require different levels of treatment and processes depending upon the potential risks. Gray water must be treated to remove substances that compromise human health, the environment, and performance of plumbing fixtures. The appropriate treatment method depends upon the desired end use. Gray water should be understood for the hazard it can become if not handled properly.

Gray water is of lesser quality than tap water, but generally of higher quality than black water, or waste water from toilets, urinals, bidets, kitchen sinks and garbage disposals. Water from the kitchen sink, garbage disposal and dishwasher is considered black water in Georgia because of high concentrations of organic wastes such as fats, oils, and food particles. There are many difficulties and risks associated with reusing waste water from black water sources.

The water quality of gray water can vary depending on number of household occupants, their age, health, water source, and household products used (such as soaps, shampoos, detergents, mouthwash, toothpaste, etc). Chemicals from these products can contain boron, chlorine, phosphorous, sodium, and nitrogen based compounds.

Gray Water Source	Characteristics*
Clothes Washer	Bacteria, Bleach, High pH, Sodium, Oil and Grease, High Suspended Solids, High Biological Oxygen Demand, Nitrates, Foam, Hot Water
Bathtub and Shower	Bacteria, Oil and Grease, Surfactants, Suspended Solids, Hair, Hot Water, Odor
Sinks	Bacteria, High pH, organic matter, High Biological Oxygen Demand, Chemicals (mouthwash, toothpaste, etc.), Cleansers, Hot Water

* These Characteristics make it necessary to handle gray water carefully

Gray water may contain varying levels of disease-causing microorganisms that are washed off during bathing or from clothes during laundering, and may also contain fats, oils, grease, hair, lint, soaps, cleansers, fabric softeners and other chemicals. Soaps and detergents are biodegradable, but they can present problems for vegetation when gray water is used for irrigation over an extended period of time. The main problem with most cleaning agents is that they contain salts which, if present in excessive amounts, can create an alkaline condition and damage the soil structure. Elevated levels of chlorides, sodium, boron compounds (Borax), and sulfates, high electrical conductivity (salt concentrations), and the high pH (alkaline) characteristics of gray water may also be harmful to some plants. Gray water should not be used to irrigate root crops, or edible food crops.

A gray water recycle system owner and user must consider the kinds of chemicals that may end up being flushed down sinks (household cleaning products, washing detergents, soaps, shampoos and conditioners), especially when gray water is used for subsurface irrigation. These products can contain many potentially harmful chemical contaminants that can affect the safety of gray water reuse applications (e.g. petro-chemicals, chlorine, caustics, sodium lauryl sulfate, etc.). Because gray water contains similar contaminants and potential disease causing microorganisms as mixed waste water, gray water reuse applications require the same public health, safety, and environmental considerations as would be the case for mixed waste water sources. While there are exceptions, most gray water is expected to have a low enough concentration of contaminants and disease causing microorganisms that reuse applications can be considered with approved treatment and disinfection. Gray water reuse is limited to applications with low risk of direct public or environmental contact such as toilet or urinal flushing and subsurface irrigation.

The reuse of gray water can be a health hazard without proper collection, storage, filtration, disinfection, and distribution. Particular attention should be given to the prevention of cross contamination with the potable water supply. Gray water system design and maintenance are critical to prevent gray water from turning into waste water with black water strengths. Bacteria can quickly multiply in gray water systems. Turbidity and odors may increase, making gray water difficult to filter and treat. Strong odors and equipment problems such as toilet malfunctions and pump failures can occur unless systems are designed to handle this higher strength wastewater. It is best management practice to design these systems so that gray water is used within 24 hours of collection.

The maintenance of gray water systems must also be considered. It is the user's responsibility to keep these systems operational and safe. It is recommended that professional maintenance through a service contract be acquired because of the potential health risk and importance of a properly functioning system. Minimally, filters will require frequent cleaning, and small amounts of disinfectants and dye need to be regularly added to these systems. Failure to perform required maintenance will result in poor performance and possible system failure.

It's not Gray Water If...

Different sources of waste water pose higher risks and should not be used. Water should not contain hazardous chemicals derived from activities such as cleaning machinery or for certain hobbies. Some high risk water sources include:

- **Car parts cleaning**
- **Drain cleaners**
- **Home photograph development lab chemicals**
- **Hobbies that rely on using hazardous chemicals**
- **Paint brush rinse water or solvents**
- **Water exposed to known illness or disease in the home**

Gray Water May Contain Bacteria, Viruses, and Other Hazards to Health

(E.coli, Salmonella, Hepatitus, Norovirus, Hazardous Household Chemicals)

4. TERMINOLOGY, DEFINITIONS AND GLOSSARY

The following terms shall have the meaning herein but are not considered "Code". Please reference the current Appendix C 'Gray Water Recycling Systems' of the 2009 amendments to the 2006 International Plumbing Code.

C101.3 CONDENSATE. Condensed water collected from the surfaces of an air conditioning unit's evaporator coils or a dehumidifier unit's evaporator coils.

C101.3 GRAY WATER. Wastewater discharged from bathtubs, showers, lavatories, clothes washers or laundry trays.

C101.4 PERMITS. Check with the local authority having jurisdiction for permit requirements

C101.5 INSTALLATION. In addition to the provisions of Section C101, systems for flushing of water closets and urinals shall comply with Section C102. Except as provided for in Appendix C, all systems shall comply with the provisions of the *International Plumbing Code.*

C101.6 MATERIALS. Above-ground drain, waste and vent piping for gray water systems shall conform to one of the standards listed in Table 702.1. Gray water underground building drainage and vent pipe shall conform to one of the standards listed in Table 702.2.

C101.7 TESTS. Drain, waste and vent piping for gray water systems shall be tested in accordance with Section 312

C101.8 INSPECTIONS. Check with the local authority having jurisdiction for inspection requirements.

C101.9 POTABLE WATER CONNECTIONS. Only connections in accordance with Section 102.3 shall be made between a gray water recycling system and a potable water system.

C101.10 WASTE WATER CONNECTIONS. Gray water recycling systems shall receive only the waste discharge of bathtubs, showers, lavatories, clothes washers or laundry trays. Although not considered gray water, condensate may be discharged to a gray water system.

C101.11 COLLECTION RESERVOIR. Gray water shall be collected in an approved reservoir constructed of durable, nonabsorbent and corrosion-resistant materials. The reservoir shall be a closed vessel. Access openings shall be provided to allow inspection and cleaning of the reservoir interior.

C101.11.1 COLLECTION RESERVOIR BYPASS. A full open valve shall be installed prior to the collection reservoir to allow gray water to discharge directly to the sanitary drainage system during maintenance of the gray water system.

C101.12 FILTRATION. Gray water shall pass through an approved filter system prior to distribution.

C101.13 OVERFLOW. The collection reservoir shall be equipped with an overflow pipe having the same or larger diameter as the influent pipe for the gray water. The overflow pipe shall be indirectly connected to the sanitary drainage system.

C101.14 DRAIN. A method for draining the collection reservoir shall be provided and shall be indirectly connected to the sanitary drainage.

C101.15 VENT required. The reservoir shall be provided with venting to allow for the induction and release of air to allow for the proper operation of the reservoir.

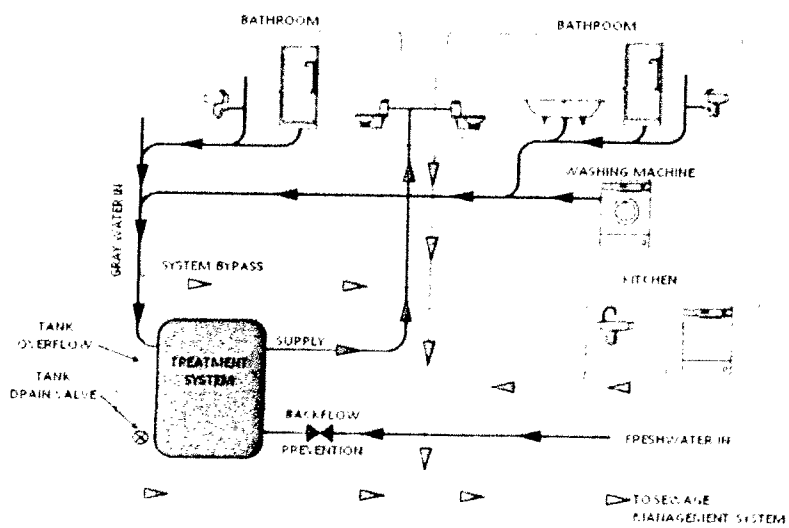
5. *GRAY WATER RECYCLING SYSTEM DESIGN*

5.1 Considerations for the Reuse of Gray Water

A number of key issues of concern need to be taken into consideration when contemplating the reuse of gray water. The system should be simple and as easy to use as possible, while minimizing risk to human health. A gray water system must be carefully designed. The design must determine how much gray water is produced daily, what the application demands, how much storage is necessary to meet the demand, and how it is to be distributed. The demand for gray water should be estimated to ensure that the demand and supply are reasonably well matched. Gray water must be filtered and treated to remove suspended solids and biodegradable contaminants; otherwise the gray water may become septic and may generate noxious odors and create other aesthetic and operational problems. Disinfection is also necessary to minimize the risks when animals and humans come in contact with the gray water. Any design of these systems should lastly consider accessibility and ease for performing inspections and necessary maintenance.

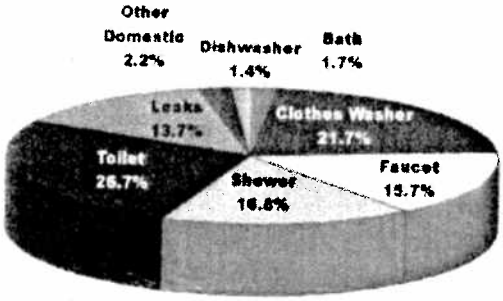
In the case of reuse for toilet flushing, gray water is diverted from the various sources, collected, filtered, treated, dyed and distributed. The components of any type of gray water system may therefore be summarized as follows:

- **Gray Water Sources**
- **Collection**
- **Make up Water**
- **Storage**
- **Filtration**
- **Disinfection**
- **Coloration**
- **Distribution**
- **Identification**



5.2 Sources of Gray Water

Sources of gray water include waste water that flows from bathtubs, bathroom sinks, showers, and wash basins. Laundry water from clothes washing machines and laundry tubs can also be used, but will increase the need for treatment and disinfection. Waste water from the kitchen sink and automatic dishwasher is considered blackwater and is prohibited for reuse. Condensate, however, is another potential water source in gray water recycling systems.



Typical Household Water Use
(Indoor)

After "Residential End Uses of Water" by permission
Copyright 1999, American Water Works Association and AWWA Research Foundation

5.3 Collection of Gray Water

Collection of the gray water requires a plumbing network which simply takes the gray water, keeping it separate from the non-gray water, and directs it to a point where it can be collected, filtered, disinfected, dyed, and then reused.

The *Georgia State Minimum Standard Plumbing Code* will also determine the choice and use of necessary valves, any air breaks, back flow preventers, and all venting. Gray water systems must be designed so that during times of maintenance, or failure, the waste water completely bypasses, drains or overflows indirectly to either public sewer or an on-site septic system. In new construction, separating usable gray water from the black water may be fairly simple and require little extra expense. However, retrofitting a separate drainage system into an existing building will require more difficult installation work and expense depending on the existing plumbing system.

5.4 Make Up Water

Design of any gray water system must consider the eventuality of the demand for recycled gray water may exceed the supply. A potable back up source of water must be provided to ensure the proper operation of the toilet and urinal fixtures when this happens. If potable

water is used as back-up, then the non-potable gray water must not be allowed to contaminate the potable water supply. This can be accomplished by providing an air gap or back flow prevention device in accordance with Section 608 of the *International Plumbing Code, 2006 Edition*, on the back up water supply at the storage tank. The design of any gray water system must ensure that the fixtures operate properly and that the potable water supply is protected from cross-contamination.

5.5 Storage of Gray Water

Designing gray water recycling systems includes tanks needed for storage, surge, and/or settlement of the effluent. These tanks can come in many sizes and are made from different materials. Tanks approved for waste water storage should be used. Waste water tanks have typically been tested, by an independent testing laboratory, to consider a minimum life expectancy of twenty years service under these intended uses. Gray water systems should also limit the storage of gray water to the amount of that can be used in twenty four (24) hours.

Concrete, resins and sealants used in the tank manufacturing process must be capable of effectively resisting the corrosive and decaying influences of gray water components and possible soil burial. Materials must be formulated to withstand vibration, shock, normal household chemicals, and earth and hydrostatic pressure both when full and empty. Tanks should be constructed to be watertight for the designed life of the tank and protected against light to control the growth of algae. Lids or covers should also be sufficiently water tight and secured for safety in order to prevent unauthorized entry into the tank. Since routine maintenance is critical to the proper function of these systems, access to lids and any control panels should be secure but convenient. Openings such as vents should also be protected from vectors by screens.

Gray water is waste water, setbacks must be considered when installing any tanks that are external from the structure. No tank shall be installed less than fifty feet (50') from existing or proposed wells/springs, sink holes, and tanks should be located downgrade from wells or springs if physically possible; less than twenty-five feet (25') from lakes, ponds, streams, water courses, and other impoundments; less than ten feet (10') from pressure water supply lines, or less than ten feet (10') from a property line.

TANKS MINIMUM SETBACK REQUIREMENTS	
Property Lines	**10 ft**
Pressure water supply lines	**10 ft**
Stream/lake/pond	**25 ft**
Water Wells	**50 ft**

All plumbing, appurtenances and fittings installed, above-ground, including drain, waste and vent piping for gray water systems, must conform to one of the standards listed in Table 702.1. Gray water underground building drainage and vent pipe must conform to one of the standards listed in Table 702.2. Only designated knockouts and openings should be used and gaskets, seals and fillers must be water tight once installed.

Tanks must be constructed or installed per the manufacturer's requirements and should be placed on a foundation that will prevent settling; typically a 3" or greater concrete slab is used. Backfill, for underground tanks, should be placed so that a stable fill results and undue strain on the tank is avoided. Earth backfill must be free of voids, large stones, stumps, broken masonry, or other such materials. A minimum earth cover of six inches (6") over the tank is recommended. Underground tanks installed in shallow groundwater tables or pump tanks which empty once dosed must provide means to prevent these potentially buoyant tanks from floating.

If a gray water system is unused for a period of time, for example the system owners go on vacation, the stored gray water may become anaerobic and quickly go septic creating unpleasant odors and will make treatment difficult. Most sources recommend that pipes be self draining, and that tank bases, etc. be angled, with provision for slow drainage, so that the entire system can be emptied of water.

A settling tank is sometimes recommended as a means of removing solids from gray water. Substances denser than water will gradually fall out of suspension to the bottom of the tank. On the other hand, grease, oils, and other small particles will float to form a surface scum layer. The remaining liquid can then be reused. A settling tank also has the advantage of

allowing hot water to cool before reuse. Please note that the longer gray water is stored the higher the level of treatment that is needed before use, which will increase the complexity and cost of a system.

5.6 Pumps

Pumping can be a problem if the right pump is not used. The pump can burnout or clog and cause premature failure if not all factors affecting performance are considered. Factors of choosing a pump include: (1) characteristics of gray water; (2) desired flow rate and/or operation pressure; and (3) total dynamic head. The pump should be designed to handle gray water effluent. It must be constructed of corrosion resistant materials. Most importantly, the pump must be capable of delivering the fixture's required flow rate at the designed total dynamic head. Poor performance and costly failures can be expected if the pump selection inadequately addresses all the mentioned factors or the uniqueness of a specific project. Larger systems such as commercial or institutional facility should be equipped with a spare pump so maintenance and repairs can occur without disruption of service.

5.7 Treatment of Gray Water

Treatment must be sufficient to ensure proper operation and longevity of the plumbing fixtures. All equipment and components in a gray water system should be certified by the manufacturer for use with waste water. A number of methods of treating gray water are available, although, the type of treatment required should be determined by the quality of the incoming gray water, what the end use will be, and the degree of maintenance desired by the system user. In all cases, the treatment must include filtration, disinfection, and dyeing of the treated graywater.

REASONS FOR GRAY WATER TREATMENT:

- **To reduce substances which may be harmful to human health;**
- **To reduce substances which may generate noxious odors and aesthetic problems;**
- **To reduce substances which may clog the gray water system; and**
- **To dye the gray water to distinguish it as recycled non-potable water.**

Where gray water is used for flushing toilets and/or urinals, effluent quality must be improved. High amounts of suspended solids will interfere with the operation of the plumbing fixtures and make disinfection difficult. Because of the potential exposure to gray water by people and pets, any disinfection treatment should reduce the number of illness causing pathogens. After disinfection, total coliform bacteria should be reduced to 500 cfu/100 ml. or less. Fecal coliforms levels should be less than 100 cfu/100 ml. Treated gray water effluent which will be used for subsurface irrigation must meet the requirements found in the Division of Public Health's *Manual for On-site Sewage Management Systems.*

Recommended Minimum Water Quality Guidelines For Design of Recycling Gray Water Systems	
Turbidity (NTU)	**10 NTU (nephelometric turbidity unit)**
Total Coliform Bacteria	**500 cfu/100ml (colony forming unites per 100 milliliter)**
Fecal Coliform Bacteria	**100 cfu/100ml (colony forming unites per 100 milliliter)**

15.7(a) Filtration

Filtration is essential to remove particles harmful to a gray water system. Gray water filters must be cleaned and changed regularly to ensure proper filtration. Oftentimes, multiple filters must be used to provide adequate particulate removal for gray water systems. Pre-filters should be use to remove large suspended solids such as hair or lint that might settle in the holding tank, increase clogging, and interfere with the operation of the pump and subsequent filters. Pre-filters, which are normally placed in the system prior to gray water storage, often do not require a pressurized system to operate properly. They must be easily accessible for frequent cleaning. Finishing filters capable of removing smaller particles normally are placed on the discharge side of the pump, which provides pressure to the plumbing system.

The presence of suspended material in water is indicated through turbidity and is measured in nephelometric turbidity units (NTU). High turbidity interferes with disinfection. In order to improve the effectiveness of disinfection, the system should be designed to meet a turbidity standard of no higher than 10 NTU.

Commercially available cartridge filters can be used for gray water systems. These include activated charcoal, cellulose, or ceramic cartridges filters. Typically they are placed on the discharge side of the pump. To ensure adequate flow and pressure of the water supply, filters need to be sized for the intended use of the gray water. A number of different filters can be used to provide the particulate removal necessary for the proper functioning of the plumbing fixtures and carbon filtration can absorb volatile organic compounds (VOC's) and objectionable odors. In general, a 5 micron (μm) filter is sufficient, but a 3 μm filter or less may be recommended to improve disinfection effectiveness and physically filter protozoan parasites such as *Cryptosporidium* and *Giardia*. Filters of different sizes and from numerous manufacturers are available. Filters certified meeting Standard 61 of the National Sanitation Foundation (NSF) are recommended. Low cost, commercially available water filters are a popular choice. However, water quality is very important if they are to be utilized. High strength effluent, poor water quality, will require a filter to be frequently cleaned or replaced.

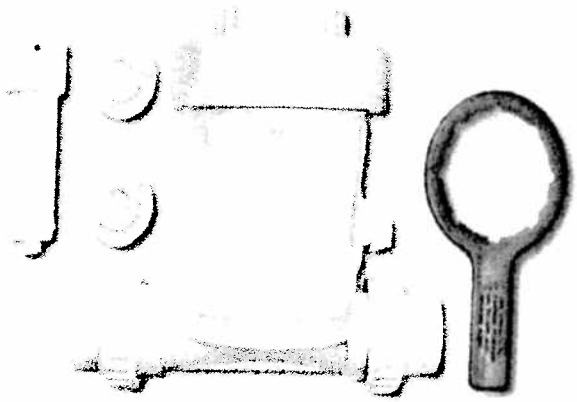
Similar to cartridge filters are sand filters which, top to bottom, include layers of sand and medium gravel. Sizing and materials of construction are critical to the proper functioning of these types of filters. Media filters can be subject to clogging, as with all types of filters, and may require cleaning or replacement of the top layer of media. Multi-media filters require less frequent maintenance and cleaning than a commercially available filter but have higher installation costs. The design of these types of filters must include protection of ground water by having lined beds or use of water tight tanks. They must also prevent rainwater from entering the gray water system.

No matter what kind of filter is considered, the greater the degree that the gray water is treated, the better the operation and function of the system. Better filtration may also reduce the level of disinfection needed.

5.7(b) Disinfection

Gray water must be disinfected to reduce the number of potentially pathogenic microorganisms present after filtration. Disinfection not only reduces pathogens but controls microbial growth that causes offensive odors and the biomat formation that can lead to system failure. Disinfection can be achieved in a number of ways, but must be regarded as critical, and must follow filtration. Any disinfection method chosen must consider the waste water's temperature, turbidity, pH, contact time with the agent and should be designed to meet a fecal coliform bacteria standard of 100 cfu per 100 ml or less.

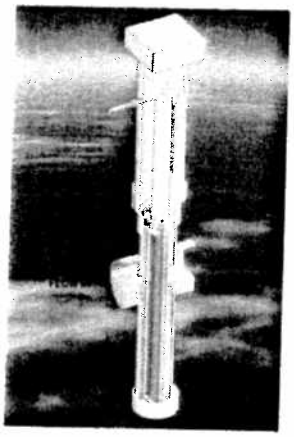
5.7(c) Chlorination



One of the most common methods of disinfection is to add chlorine. Following filtration, an in-line erosion chlorinator, or an injection pump can be used to disinfect gray water. With an in-line erosion chlorinator, calcium hypochlorite tablets or pellets are placed inside the chlorinator. As the water flows through the unit, the calcium hypochlorite slowly dissolves and releases chlorine into the water. A metering pump using a chlorine solution can also be used. Granular calcium hypochlorite products are often mixed with water to form a liquid bleach solution that is fed with a metering pump. Due to its high chlorine content, calcium hypochlorite containers should be kept tightly closed and stored away from combustible materials such as oils, fuels, and greases.

In order to ensure that disinfection is taking place, a chlorine residual of at least 0.2 mg/l must be maintained at all times in the distribution system. Chlorine residuals can be easily measured with a test kit. Chlorine is caustic in nature and is very corrosive. Chlorinators are often placed after the pump to protect the pump against corrosion. The use of chlorine compounds that are certified in accordance with ANSI/NSF Standard 60 is recommended. Do not use products designed for use in swimming pools as these products may contain cyanide based stabilizers.

5.7(d) Ultraviolet Light



Ultraviolet (UV) disinfection may also be considered, but its effectiveness is highly dependent on the water quality and the transmission of light through the water, and is adversely affected by particulates and colloidal particles. Biological treatment and a high level of filtration is often a prerequisite to UV disinfection. The Environmental Protection Agency (EPA) has adopted benchmark standards for using ultraviolet light for disinfection. A UV disinfection unit should be certified by ANSI/NSF Standard 55 which establishes testing requirements for these types of water treatment systems. UV systems that meet Class A requirements under this standard are capable of producing a UV dose of 40 mJ/cm^2. The UV light must be rated to accommodate the design flow. Maintenance of the systems involves cleaning the quartz sleeve and the UV light bulb. Some UV lights are designed with an integral wiper unit. The manufacturer's instructions and recommendations must be followed.

5.7(e) Other Forms of Treatment

Ozonation is another means of disinfection, involving the onsite generation of ozone gas, and diffusion of that gas into the gray water. The benefits include no odor or chemicals to add but these kinds of systems are expensive and must be off gassed because of ozone's toxic nature.

Other types of disinfection systems of varied complexity may be considered, but the evidence consistently points to simpler systems being more reliable. The most complex systems

are sometimes abandoned due to high maintenance costs and disinterest by the system owner due to the amount of intervention required. The suitability of a design's approach is largely determined by the quality of the incoming gray water, its end use, the need for storage, and the degree of care and intervention desired by the user. The cleaner the gray water to begin with, the less treatment required. A more complex, catch-all system is best suited to an establishment where maintenance can be scheduled by the user and attention is paid to what goes into the gray water, and how it is used. However, this relatively complex system requires more maintenance, and is more expensive. Please remember, because of health risks associated with direct contact, protective measures such a wearing protective eyewear, a mask, and latex gloves should be taken when maintaining gray water systems. A system that recycles gray water for use in flushing toilets and/or urinals must always be disinfected before reuse.

5.8 Identification, Coloring and Purple Piping

Gray water must be dyed with a food grade vegetable dye before supplying a toilet or urinal. To further distinguish the recycled non potable water supply, all piping must follow the criteria found in the IPC, Section 608.8, for purple piping. Gray water systems must be identified with a label, signs, or placard, as "NON POTABLE", on the distribution piping and reservoir tanks. The lettering should be bold and clearly visible. Every toilet and urinal fixture should also be permanently identified to indicate that non potable water is being used.

6. OPERATION AND MAINTENANCE

It is very difficult for gray water recycle systems to offer any guarantee of longevity or be completely passive. It is anticipated that local authorities will require operational permits to help ensure proper functioning of these types of systems. These permits may also require that service work be preformed by trained professionals. Routine maintenance is critical for the continued use of recycled gray water. To ensure that the system does what it is designed to do, prevent health risks and ensure properly functioning fixtures, its owner must be willing to perform the required maintenance.

7. SUBSURFACE LANDSCAPE IRRIGATION SYSTEMS

Gray water may be used for the subsurface irrigation of landscapes and shall be permitted by the local county board of health in accordance with DHR regulations as a separate onsite sewage management system. Permits and inspections are required by the local county board of health.

Subsurface irrigation systems will require the following:

- Must be permitted and approved by the county board of health
- Must be in compliance with the DHR's Rules for *On-Site Sewage Management Systems* Chapter 290-5-26
- Requirements include but are not limited to: engineered design, soil surveys, DHR installer certification for on-site septic systems, 3 year maintenance and service agreements, the use of DHR approved products, etc.

8. REFERENCES, CONTACT INFORMATION AND LINKS

References:

Lye D.,.2002. Health risks associated with consumption of untreated water from household roof catchment systems. Journal of the American Water Resources Association 38(5):1301-1306.

Mack W.N. 1977 "Total Coliform Bacteria in "Bacterial Indicators/Health Hazards Associated with Water".

Siegrist, R.L., M. Witt, and W.C. Boyle. 1976. The characteristics of rural household wastewater. Journal of the Environmental Engineering Division, American Society of Civil Engineers, 102:533-548. Proceedings.

Vickers, A., 2001. Handbook of water use and conservation: Water Plow Press.

Vogel M., 1976 "Residential Greywater - a Review". Clivus Multrum USA Inc. Cambridge, MA

Links:

BC Green Building Code Background Research Greywater Recycling
http://www.housing.gov.bc.ca/building/green/Lighthouse%20Research%20on%20Greywater%20Recycling%20Oct%2022%2007%20_2_.pdf

CA Gray Water Standards
http://www.owue.water.ca.gov/docs/graywater_guide_book.pdf

Colorado State University Extension, 2008
http://www.ext.colostate.edu/pubs/natres/06702.html

DHR/Public Health Manual for On-Site Sewage Management Systems
http://health.state.ga.us/programs/envservices/landuse.asp

NSW Guidelines for Greywater Reuse in Sewered Single Household Residential Premises
www.dwe.nsw.gov.au/water/

Texas Department of State Health Services, Testing for fecal coliforms,
www.dshs.state.tx.us/lab/default.sht

The Water Conservation Alliance of Southern Arizona Graywater Guidelines
http://www.watercasa.org/publications/Graywater_Guidelines.pdf

United States Environmental Protection Agency, Drinking water requirements,
www.epa.gov/safewater/mcl.html