Graywater Advisory Committee Report

Recommendations on Graywater Treatment, Disposal and Reuse

State of Oregon Department of Environmental Quality

Submitted to: Oregon Environmental Quality Commission

By: DEQ Graywater Advisory Committee

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Executive Summary

Population growth and climate instability are putting increasing pressure on Oregon's water resources, prompting increased interest in graywater as an alternate water source. Graywater is wastewater originating from showers, baths, bathroom sinks, kitchen sinks and laundries. Graywater does not include toilet or garbage wastes, or wastewater contaminated by soiled diapers. Although it may contain a complex mixture of organic matter, suspended solids, bacteria and common household chemicals, when used judiciously and in a manner that is protective of public health and the environment, graywater can help preserve limited water supplies while advancing the environmental ethic of reusing and recycling limited resources. House Bill 2080, passed by the 2009 Oregon Legislature, directed the Oregon Environmental Quality Commission (EQC) to consider the recommendations of a graywater advisory committee when adopting rules for the permitting of graywater reuse and disposal systems.

This report contains the final recommendations of the DEQ Graywater Advisory Committee. The committee met monthly beginning in December 2009 and, through research and discussion, developed recommendations on the treatment, disposal and reuse of graywater. The 2009 Oregon Legislature directed the EQC to consider these recommendations when adopting new rules for the permitting of graywater reuse and disposal systems. The committee's majority opinions are in the main body of this report. Minority opinions as well as additional background information on the recommendations are in the endnotes.

Policy and Purpose. The committee recommends that the EQC adopt a graywater policy and rules that encourage the use of graywater in a manner that protects public health and the environment as well as acknowledges the public and environmental benefits of using this valuable resource. In addition, the graywater rules should coordinate the requirements of multiple agencies, provide clear guidelines to the public on graywater use, and educate both the public and regulatory bodies on graywater use and potential environmental and public health hazards.

General Provisions. The recommendations include general provisions that pertain to all graywater systems, such as prohibiting the introduction of hazardous chemicals into graywater; requiring non-graywater to be diverted to an approved disposal system; ensuring that the construction of graywater systems meets all plumbing code requirements where applicable; and, specifying that graywater system components are appropriately labelled to prevent unintentional contact with graywater. The committee also developed a general set of recommendations for graywater irrigation systems that are intended to protect ground and surface water resources. These recommendations include limiting graywater discharges to periods when natural precipitation is insufficient to meet plant needs and prohibiting release to sites with steep slopes or shallow groundwater.

Untreated Graywater. The committee recognizes that the use of untreated graywater carries potential hazards to public health and has developed specific recommendations to address these concerns. Direct contact with untreated graywater by humans and domestic pets should be minimized. When used for irrigation, the edible portion of crops should not contact the graywater. Untreated graywater should only be used for subsurface irrigation and composting. Untreated graywater may not be stored for more than 24 hours and, when used for irrigation, must be released under at least two inches of soil, mulch or other cover. Buffers or horizontal setback distances should be maintained from surface waters, stormwater systems and property lines. Because of potentially high concentrations of organic material, solids and bacteria, all graywater originating from kitchen sinks should pass through a system designed to reduce grease, floatable solids and settleable solids.

Treated Graywater. The committee also recognizes that with appropriate treatment, graywater may be safely used for other uses, such as surface irrigation and landscape ponds. The committee recommends that graywater treatment systems either (1) use a technology-based system recognized by an accreditation authority such as the American National Standards Institute or (2) meet performance based criteria of an effluent concentration not to exceed 10 milligrams per liter for both five-day Biochemical Oxygen Demand (BOD_5) and total suspended solids (TSS). With disinfection, graywater may be safely used for additional applications, such as spray irrigation, wash water and various construction uses. Graywater disinfection standards should be consistent with Oregon's definition for Class B recycled water, which is a total coliform concentration not to exceed a seven-day mean of 2.2 colony-forming units (CFU)/100 mL under a three-day/week monitoring frequency. Graywater treatment systems should be subject to monitoring and reporting requirements to show they comply with these standards.

Graywater Permits. Finally, the committee recommends that the EQC adopt a tiered approach to graywater permitting that is primarily based upon the volume of graywater produced. This tiered approach should allow low-volume residential graywater systems, which represent a low threat to public health or the environment, to be permitted with minimal effort, while high-volume, complex systems should be subject to the appropriate review and approval.

- Tier 1 General Permit. A Tier 1 general permit should be available for a single-family residence or duplex that generates less than 300 gallons per day (gpd) of graywater that will be used only for subsurface irrigation. If the system meets certain eligibility requirements, the permit can be obtained by registering the system with DEQ and paying a small fee.
- Tier 2 General Permit. A Tier 2 permit should be available for a single- or multi-family residence, institution, commercial facility or industrial facility employing a graywater treatment system and producing less than 300 gpd for uses other than subsurface irrigation as well as any graywater system producing between 300 and 1,200 gpd. Because these types of systems represent a higher risk to public health and the environment, the permit should be obtained only after paying a fee and submitting documentation on system design and operation to DEQ for review and approval.
- Tier 3 Individual Permit. Any graywater system producing greater than 1,200 gpd should be allowed under an individual Tier 3 permit. Moreover, any low- or medium-volume graywater system that fails to qualify for a Tier 1 or Tier 2 permit can apply for an individual permit. The committee further recommends that graywater disposal options be considered by DEQ under an individual Tier 3 permit. Because of the volume, potential complexity, site limitations or other conditions, these types of graywater systems may require careful review of system design, maintenance and operation. The fee for a Tier 3 permit should be appropriately scaled to the amount of effort required to develop the permit and the volume of graywater produced.

Background

History and House Bill 2080

Graywater, as now defined by statute, is a wastewater originating from showers, baths, bathroom sinks, kitchen sinks and laundries. Graywater is a subset of sewage; and, the authority of the Oregon Department of Environmental Quality (DEQ) to regulate graywater treatment and disposal systems is derived from the Oregon Revised Statutes Chapter 454 – Sewage Treatment and Disposal Systems.

The evolution of the regulation of graywater in Oregon began in the 1980s, when the EQC adopted rules for the onsite disposal of graywater under the Oregon Administrative Rules, Chapter 340, Division 71 (OAR 340-071), *Onsite Wastewater Treatment Systems.* OAR 340-071 allows graywater disposal by discharge to either a graywater waste disposal sump or a reduced size onsite system if graywater has been separated from "black wastes".

In 2008, the Oregon Department of Consumer and Business Services, Building Codes Division (BCD), approved the reuse of graywater in water conservation systems. Under an alternative ruling of the Oregon Plumbing Specialty Code, graywater captured from bathtubs, showers, bathroom sinks and washing machines could be reused for toilet flushing. Oregon's alternate method for water conservation systems focused on manufactured "off-the-shelf" and pre-designed systems. Because graywater was ultimately returned to an approved wastewater disposal system, no permit from the DEQ was required to use graywater for toilet or urinal flushing.

Prior to June 2009, the use of graywater outside a structure was only allowed if a person obtained a water quality permit such as that required by municipal wastewater treatment facilities. Due to the high permit fees, this effectively discouraged graywater reuse. On June 12, 2009, Gov. Ted Kulongoski signed into law legislation (House Bill 2080 or HB 2080) legalizing in Oregon the use of graywater for beneficial purposes. This bill came about through the efforts of many citizen activists and organizations who collaborated with the DEQ to draft legislation that encouraged innovative approaches to water reuse. By making exterior graywater use legal and accessible, approximately half of all domestic water could be reused for irrigation, potentially saving tens of millions of gallons annually. As water becomes increasingly scarce from the joint pressures of population growth and increased climate instability, graywater reuse makes Oregon's water future more secure. The bill recognized the need to conserve the waters of the state and allows a person to construct, install and operate a graywater system upon receiving appropriate permits from the DEQ.

In HB 2080, the Oregon Legislature specified that a person may not construct, install or operate a graywater reuse and disposal system without obtaining a permit from the DEQ. Moreover, the legislation directed the Environmental Quality Commission (EQC) to adopt rules for graywater permits as well as:

- To consider the recommendations of a newly formed graywater advisory committee;
- To minimize the burden of permit requirements on property owners; and
- To prescribe requirements that allow for the treatment, disposal or reuse of graywater that ensure the protection of public health, safety and welfare; public water supplies; and state waters.

Graywater Advisory Committee

DEQ solicited interest groups and organizations for recommendations on individuals to serve on the committee. From the list of interested persons, DEQ's director appointed a committee of technical

experts that represented various graywater interests, including: public health, municipalities, green building and sustainable development, landscape architecture, resource conservation, onsite wastewater treatment, and the general public. The committee members' backgrounds and viewpoints also reflected the diversity of Oregon's geography and climate.

The committee's primary goal was to develop recommendations for the treatment, disposal and reuse of graywater that are protective of public health and the environment. In developing these recommendations, the committee was asked to consider various technical and public health concerns with graywater, including the operation and maintenance of a graywater system. The committee was also asked to account for the distinctive graywater issues that reflect differences in urban and rural environments as well as dry and wet climates. In order to accomplish this task, the committee reviewed peer-reviewed scientific literature, technical information from manufacturers of graywater treatment and reuse systems, trade publications from water reuse organizations and public policy information, including administrative rules and guidance documents developed by other jurisdictions supporting the use of graywater. In addition, the committee considered the practical experiences and testimonies of graywater system users in the United States and other countries.

The Graywater Advisory Committee met monthly from December 2009 through October 2010. The committee's ideal was to develop recommendations based upon the consensus of all committee members. When a consensus among all members was not possible, individual viewpoints were discussed, considered, and finally a vote of the committee members taken. Detailed information on the committee's discussions was recorded in meeting minutes. The recommendations in the body of this report reflect the majority opinion of committee members. Significant minority opinions are expressed in the report's endnotes.

This report to the EQC is the final product of the Graywater Advisory Committee and reflects their technical and policy recommendations on the treatment, disposal and reuse of graywater. The recommendations in this report will be considered by the DEQ when developing rules on graywater treatment, disposal and reuse.

Graywater Characteristics[i]

Studies on residential water use habits in North America indicate that approximately 60% of household wastewater originates from graywater sources, including baths, showers, clothes washers and kitchen sinks (USEPA, 2002). Total graywater flow from an average residence is typically estimated at around 90-100 gallons per day.

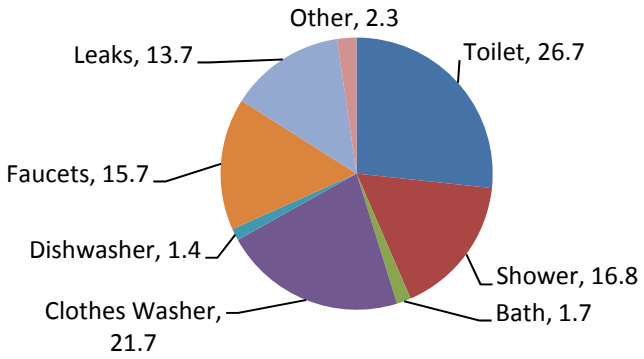

Figure 1. Average indoor water usage for 12 North American cities by fixture or appliance. Data is expressed as percent total flow, which averaged 69.3 gallons per capita per day. This information was taken from the USEPA Report *Onsite Wastewater Treatment Systems Manual* (USEPA, 2002), which adapted the data from the 1999 American Water Works Association Research Foundation's Residential End Use of Water Study.

The chemical and biological characteristics of graywater can vary significantly, based upon the source. In general, graywater shares similar chemical and biological characteristics to combined household wastewater, but at significantly lower concentrations. Graywater originating from showers and sinks used for hand washing typically have the lowest concentrations of bacteria and chemicals. Graywater originating from kitchen sinks is typically higher in bacteria, organic carbon and solids. In many households, graywater originating from kitchen sinks may also contain high concentrations of fats, oils and grease. These characteristics make the use of graywater originating from kitchen sinks challenging and most jurisdictions that allow graywater use have omitted kitchen sink wastewater as a graywater source.

Table 1. Summary of untreated graywater quality from selected studies.

Parameter	Commercial	Residential w/o kitchen sink			Residential w/ kitchen sink				
Reference	Veneman, 2002	Eriksson, 2003	Rose et al., 1991	Casanova et al., 2001	Siegrist, 1980	Travis, 2008*	Huelgas, 2009*	Jong, 2010	Leal, 2010
BOD_5 , mg/L	22-360	26-130		65	145-324	1042		23.5-392.4	
COD, mg/L		77-240				2180	770-2050	119-3740	833
TSS, mg/L	10-200	7-207		35	100-204	1250		72.5-4250	
Total N, mg/L		3.6-6.4	1.7			22	21.9-43.5		41.2
TKN, mg/L	3.1-32.7				5.9-18.4				
NO_3-N, mg/L	<1-17.5	<0.02-0.26	0.98				0.9-5.3		0.12
Ortho-P, mg/L	<0.5-3.7								
Total-P, mg/L		0.28-0.78			2.8-7.8	3.8	2.9-14.5		6.6
pH, S.U.	5.3-10.8	7.6-8.6	6.5	7.5	7.3-8.7	5.7		7.02-7.86	
O&G, mg/L						195			
Total Coliform, CFU/100 mL	$2x10^2$ - $>10^9$	$6x10^3$ – $3.2x10^5$			$2.4x10^7$ - $3.8x10^8$				
Fecal Coliform, CFU/100 mL	ND – $3.5x10^4$		$1.8x10^4$ - $8x10^6$	$5.6x10^5$	$2.1x\ 10^7$ – $2.5x10^7$				
***Kitchen sink only.**									

In addition to organic material and solids, graywater may contain a complex mixture of chemicals used in common household activities such as bathing, cleaning, hobbies and home maintenance. The range of chemicals that may be present in graywater include, but are not limited to, surfactants, detergents, bleaches, dyes, fragrances, flavorings, preservatives, pesticides, pharmaceuticals and personal care products. Unlike combined household wastewater, graywater is typically low in macronutrients such as nitrogen, phosphorus and potassium. Graywater does, however, typically have elevated pH and alkalinity, and it may contain high concentrations of some micronutrients, such as boron.

Since pathogenic organisms are difficult and expensive to quantify, the biological characteristics of wastewater are generally measured through the use of indicator organisms, such as total coliforms or fecal coliforms. Studies on the biological characteristics of graywater have shown that graywater from all sources contains common indicator bacteria. Some studies have shown that wastewater originating from kitchen sinks may contain concentrations of fecal coliform similar to that in toilet wastes. However, indicator organisms are not necessarily a reliable indicator for predicting the presence or concentrations of pathogenic organisms, including bacteria, viruses and protozoa. Furthermore, no studies to date have shown a causative link between the incidence of illness in a household and the use of graywater. However, graywater remains a potential source for the transmission of illness and jurisdictions have typically adopted policies that allow the use of untreated graywater only under conditions that minimize potential risks.

Table 2. Comparison of microbial water quality for different sources, measured as total coliform and reported in MPN/100 mL. Data adapted from *White Paper on Graywater* (Sheikh, 2010).

Water Source	Total Coliform (MPN/100 mL)
Drinking Water	< 1
Class B Recycled Water	< 2.2
Class C Recycled Water	< 23
Undisinfected Recycled Water	20 - 2000
Untreated Graywater	**100 to 100 million**
Raw Wastewater	Millions to billions

Recommendations

1. **Policy.** To encourage the use of graywater in a manner that protects public health, safety and welfare; public water supplies; and waters of the state. The use of graywater is a water reuse approach that reduces the demand on drinking water sources for uses not requiring potable water.
2. **Purpose of the graywater rule.** A good graywater rule will:
    a. Conserve potable water through innovative approaches;
    b. Prevent water pollution;
    c. Enable the use of graywater;
    d. Coordinate the requirements of multiple agencies;
    e. Educate regulatory bodies and the public about graywater reuse;
    f. Provide clear guidelines/rules for installing and maintaining graywater systems; and
    g. Protect environmental and public health.
3. **Definitions.** The following definitions apply to the recommendations in this document:
    a. "**Graywater**" means shower and bath wastewater, bathroom sink wastewater, kitchen sink wastewater[ii] and laundry wastewater. Graywater does not mean toilet or garbage waste or wastewater contaminated by soiled diapers.
    b. "**Graywater disinfection**" means the reduction of possible pathogens in graywater by treatment to achieve a total coliform concentration of no greater than 2.2 CFUs/100 mL.
    c. "**Graywater disposal**" means the land application of graywater at rates that exceed plant needs for supplemental water, as measured by vegetation-specific evapotranspiration less precipitation.
    d. "**Graywater system**" means a graywater collection and distribution system.
        i. "**Low flow graywater system**" means a graywater system producing 300 gallons per day or less.
        ii. "**Medium flow graywater system**" means a graywater system producing between 300 and 1,200 gallons per day.
        iii. "**High flow graywater system**" means a graywater system producing more than 1,200 gallons per day.
    e. "**Groundwater Protection Area**" means an identified DEQ Groundwater Management Area, Voluntary Wellhead Protection Area (as adopted by municipalities) or other areas with special groundwater protection standards, such as the La Pine groundwater area.
    f. "**Primary Treatment**" means the physical removal of grease, floatable and settleable solids from graywater.
    g. "**Subsurface irrigation**" means the application of water below the surface of the ground or substrate with at least two-inches of cover[iii].
    h. "**Treated graywater**" means graywater that has passed through **secondary treatment** to reduce BOD and TSS. Treated graywater includes graywater that has been disinfected after secondary treatment.
    i. "**Treatment**" means any physical, chemical or biological method used to purify, clean or disinfect graywater, including but not limited to aeration, chemical disinfection (e.g., chlorine), biological treatment, sedimentation, coagulation, phytoremediation, UV light, ozone, distillation and ultra-filtration. These recommendations include the physical treatment of graywater to remove grease, floatable and setteable solids within the category of "untreated graywater" due to the low level of treatment involved.

j. "**Secondary treatment**" means the removal of biodegradable organic matter (in solution or suspension) and suspended solids to achieve a 5-day biochemical oxygen demand (BOD_5) concentration of 10 mg/L or less and a total suspended solids (TSS) concentration of 10 mg/L or less.

k. "**Untreated graywater"** means graywater that in all cases has been stored for less than 24 hours post-collection and that (1) may have passed through primary treatment, (2) may have passed through a coarse screen to remove solids such as hair, lint, and other debris, and (3) has not passed through a secondary treatment system.

4. General Recommendations on Graywater, Treatment, Disposal and Reuse.

a. A person may not construct, install or operate a graywater reuse and disposal system without first obtaining a permit from the Department of Environmental Quality.

b. Graywater may not contain hazardous chemicals such as those found in water derived from the cleaning of oily rags; rinsing of paint brushes; disposal of pesticides, herbicides, or other chemicals; waste solutions from home photo labs or similar hobbyist activities or home occupation activities; or from home maintenance activities.

c. Procedures for determining flow. Graywater flow may be calculated as 60%[iv] of peak indoor water use. Total indoor water use may be based on actual records or determined by the values in **Table 3**[v].

d. Unless otherwise approved by permit, graywater systems must be connected to a sanitary sewer or an approved septic system.

e. Non-graywater must be diverted to an approved wastewater disposal system.

f. Graywater collection system components inside a building, such as pipes, valves and fittings, must be labelled and conform to Oregon Plumbing Specialty Code. Construction standards for collection system components not specified in the plumbing code should generally conform to the construction standards in OAR 340-073.

g. Graywater reuse systems, including tanks and distributions systems outside a building (greater than 2-feet away), should generally conform to the construction standards in OAR 340-073.

h. Graywater System Specifications. Graywater systems must meet the following general requirements.

   i. Unless otherwise allowed by permit, graywater systems must have a diversion valve that allows graywater to be directed to allowed uses or another approved disposal system.

   ii. No potable water connection is allowed unless equipped with an air gap or approved backflow prevention device per Oregon Plumbing Specialty Code.

   iii. Graywater systems are limited to the site of generation, unless they satisfy the requirements of OAR 340-071-0130(11)[vi].

i. Site Limitations for the irrigation of graywater[vii]

   i. Unless otherwise specified herein, the siting requirements for graywater irrigation systems should be consistent with the onsite rules in OAR 340-071.

   ii. Unless specifically permitted otherwise, the use of graywater is limited to irrigation sites that meet the following conditions, regardless of the quantity of graywater flow:

      1. A minimum 4-foot separation between the point of graywater discharge and depth to permanent groundwater is required[viii].
      2. No discharge to frozen soils is allowed.
      3. No discharge to saturated soils is allowed.

4. Outdoor irrigation is limited to seasonal use, when natural precipitation does not meet plant demands[ix].
5. No discharge to areas with slopes greater than 45% is allowed[x].

Table 3. Total wastewater flows to be used for determining graywater flow.

Type of Establishment		Gallons Per Day	Minimum Gallons Per Establishment Per Day
Airports		*4 (per passenger)*	*120*
Bathhouses and swimming pools		*8 (per person)*	*240*
Camps: (4 Persons per Campsite, where Applicable)	*Campground with central comfort stations*	*28 (per person)*	*560*
	With flush toilets, no showers	*20 (per person)*	*400*
	Construction camps — semi-permanent	*40 (per person)*	*800*
	Day camps — no meals served	*12 (per person)*	*240*
	Resort camps (night and day) with limited plumbing	*40 (per person)*	*800*
	Luxury camps	*80 (per person)*	*1600*
Churches		*4 (per seat)*	*120*
Country clubs		*80 (per resident member)*	*1600*
Country clubs		*20 (per non-resident member present)*	*—*
Dwellings:	*Boarding houses*	*120 (per bedroom)*	*480*
	Boarding houses – additional for non-residential boarders	*8 (per person)*	*—*
	Rooming houses	*64 (per person)*	*400*
	Condominiums, Multiple family dwellings — including apartments	*240 (per unit)*	*720*
	Single family dwellings	*240 (not exceeding 2 bedrooms)*	*360*
	Single family dwellings — with more than 2 bedrooms	*60 (for third & each succeeding bedroom)*	*360*
Factories (exclusive of industrial wastes — with shower facilities)		*28 (per person per shift)*	*240*
Factories (exclusive of industrial wastes – without shower facilities)		*12 (per person per shift)*	*120*
Hospitals		*200 (per bed space)*	*2000*
Hotels with private baths		*96 (per room)*	*480*
Hotels without private baths		*80 (per room)*	*400*
Institutions other than hospitals		*100 (per bed space)*	*1000*
Laundries — self-service		*400 (per machine)*	*2000*
Mobile home parks		*200 (per space)*	*600*
Motels — with bath, toilet and kitchen wastes		*80 (per bedroom)*	*400*
Motels — without kitchens		*64 (per bedroom)*	*320*
Picnic Parks — toilet wastes only		*4(per picnicker)*	*120*
Picnic Parks — with bathhouses, showers and flush toilets		*8 (per picnicker)*	*240*
Restaurants		*32 (per seat)*	*640*
Restaurants — single-service		*1.6 (per customer)*	*240*
Restaurants — with bars and/or lounges		*40 (per seat)*	*800*
Schools:	*Boarding*	*80(per person)*	*2400*
	Day — without gyms, cafeterias, or showers	*12 (per person)*	*360*
	Day — with gyms, cafeterias and showers	*20 (per person)*	*600*
	Day — with cafeteria, but without gyms or showers	*16 (per person)*	*480*
Service Stations		*8 (per vehicle served)*	*400*
Swimming pools and bathhouses		*8 (per person)*	*240*
Theaters:	*Movie*	*4(per seat)*	*240*
	Drive-In	*16 (per car space)*	*800*
Travel trailer parks — without individual water and sewer hookups		*40 (per space)*	*240*
Travel trailer parks — with individual water and sewer hookups		*80 (per space)*	*400*
Workers:	*Construction — as semi-permanent camps*	*40 (per person)*	*800*
	Day — at schools and offices	*12 (per shift)*	*120*

iii. The committee recommends that additional site limitations not specifically addressed in the rule be discussed in a guidance document on graywater irrigation developed by DEQ. (See also Section 5.f.viii.2.) The guidance document should assist owners/operators of graywater systems with compliance and include technical information, specifications, and other graywater irrigation siting details that are not specifically included in the graywater rule.

5. Recommendations on the Use of Untreated Graywater.

a. Untreated graywater may originate from residential, commercial and institutional sources.
b. Graywater originating from showers, baths, bathroom sinks and laundries may be used without treatment in low flow graywater systems.
c. Graywater originating from kitchen sinks must pass through primary treatment to reduce grease, floatable and settleable solids prior to use.
d. Untreated graywater may not be stored for more than 24 hours.
e. Uses of Untreated Graywater. Untreated graywater may be used for the following beneficial purposes:
    i. Subsurface irrigation of lawns and landscape plants
    ii. Subsurface irrigation of food crops, except root crops or crops with edible parts that contact graywater[xi]
    iii. Composting, provided water discharge is subsurface, at 2-inches below surface
    iv. Vegetated roofs.
f. Unless permitted otherwise, the use of untreated graywater is subject to the following restrictions:
    i. No spray irrigation is allowed.
    ii. No ponding except in approved ponds is allowed.
    iii. No surfacing or off-site runoff is allowed.
    iv. No direct discharge to stormwater management facilities is allowed[xii].
    v. No direct discharge into surface water bodies is allowed.
    vi. Human contact with graywater or irrigated soil must be minimized and avoided (except to service the system).
    vii. The integrity of the graywater system must be maintained to minimize contact of humans and domestic pets with graywater.
    viii. Horizontal separation (setbacks) distances to sensitive features must be maintained.
        1. The horizontal setbacks distances in **Table 4** should be established in rule.

Table 4. Horizontal setback distances for graywater systems[xiii].

Sensitive Feature	*Setback (feet)*	
	Storage Tanks	***Graywater Irrigation Discharge Point***
Groundwater wells	*50*	*100*
Springs	*50*	*100*
Surface public waters	*50*	*50*
Intermittent streams	*50*	*50*
Irrigation canals	*50*	*50*
Stormwater collection systems and catchbasins	*10*	*10*
UICs	*10*	*10*
Property lines	*5*	*2*
Building Structures	*--*	*0*

2. Horizontal separation distances for the following sensitive features should be discussed in a graywater guidance document developed by DEQ:
    a. Groundwater interceptors
    b. Curtain drains
    c. Drainage ditches
    d. Manmade cuts in excess of 30 inches
    e. Escarpments
    f. Water lines, including onsite domestic water service and pressurized water mains
    g. Building foundations
    h. Underground utilities
    i. Sewage pits/cesspools
    j. Sewage disposal fields
    k. In-ground swimming pools.

6. Recommendations on the Use of Treated Graywater.

a. Graywater may originate from residential, commercial, industrial and institutional sources.
b. Graywater may originate from the following fixtures: showers, baths, bathroom sinks, laundries and kitchen sinks.
c. Uses of Treated Graywater. Treated graywater may be allowed for use with any of the following beneficial purposes[xiv]:
    i. Subsurface irrigation
    ii. Surface irrigation, incl. drip irrigation of living walls
    iii. Landscape ponds
    iv. Treatment ponds or constructed wetlands
d. Treated *and disinfected* graywater may be used for the following beneficial purposes under an individual Tier 3 graywater permit (see 8.b.iii):
    i. Wash water (e.g., cars or equipment)
    ii. Flushing sewer lines
    iii. Construction uses (e.g., dust control, concrete cutting, ground cutting)
    iv. Industrial process water
    v. Large scale agricultural irrigation
e. Uses of treated graywater should be allowed with the appropriate level of treatment as outlined in **Table 5**.
f. Specifications for Secondary Treatment of Graywater
    i. Technology-based graywater systems must meet the criteria of an accreditation setting body such as NSF International/American National Standards Institute (NSF/ANSI)[xv], the International Association of Plumbing and Mechanical Officials (IAPMO), the Canadian Standards Association (CSA), or any other standard setting bodies that are recognized by both DEQ and the Building Codes Division[xvi].
    ii. Performance based systems must meet secondary treatment criteria of a 5-day biochemical oxygen demand (BOD_5) concentration not to exceed 10 mg/L and a total suspended solids (TSS) concentration not to exceed 10 mg/L.

Table 5. Recommended graywater treatment requirements for various uses of graywater.

Graywater Uses	Treatment Requirements			Notes
	Primary only	Primary & Secondary	Primary, Secondary & Disinfection	
Subsurface irrigation	X			Covered by at least 2-inches of substrate.
Surface irrigation, incl. drip irrigation of living walls		X		Includes surface drip irrigation.
Landscape ponds		X		Ex: golf course ponds.
Flushing toilets and urinals			X	No permit required by DEQ.
The following uses may generate aerosols and may be allowed under an individual Tier 3 permit:				
Washwater			X	
Flushing sewer lines			X	
Construction uses (dust control, concrete cutting, ground cutting)			X	
Industrial process water			X	
Large scale agriculture			X	
Other uses not identified	Evaluated on a case-by-case basis			
The following "uses" may be allowed for graywater treatment:				
Treatment ponds and constructed wetlands	X			Graywater treatment technologies.

iii. Graywater treatment systems must demonstrate compliance with the secondary treatment standard by monitoring and reporting.
   1. Samples may be collected by the system owner, provided the sampling protocols of the analytical laboratory are followed.
   2. Sampling must be submitted to an analytical laboratory for analysis.
   3. The frequency of monitoring is based upon the size of the graywater system and should be specified in the permit:
      a. Low-flow systems: 1 time/year
      b. Medium-flow systems: 2 times/year
      c. High-flow systems: Evaluated on a case-by-case basis.
   4. A compliance report with the results of system monitoring must be submitted to DEQ annually.

g. Specifications for Graywater Disinfection
   i. Graywater disinfection standards should be consistent with Oregon's definition for Class B recycled water, which is a total coliform concentration not to exceed a 7-day mean of 2.2 CFU/100 mL under a 3-day/week monitoring frequency.

7. Recommendations on Graywater Disposal[xvii].

a. Graywater disposal may be permitted under a Tier 3 individual permit[xviii], but not under a Tier 1 or Tier 2 general permit.

b. Graywater disposal options should be expanded under the onsite rules (OAR 340-071) to allow opportunities for year-round release of graywater to the environment without requiring the installation of a septic system (i.e., split waste method, OAR 340-071-0320).

8. Recommendations on Graywater Permitting.

a. The following recommendations pertain to the permitting of all types of graywater systems:
   i. The state should adopt one uniform state-wide graywater standard[xix].
   ii. A written permit is required for all graywater systems.
   iii. The location of a graywater system (i.e., address) is required.
   iv. An Operations and Maintenance plan (O&M) is required with all graywater systems and must remain with the building upon change in ownership.
   v. New owners or tenants of a property must be notified of the presence of the graywater system and the permit transferred to the new property owner[xx].
   vi. Any requirements of plumbing code, such as testing and inspections, must be followed, where applicable.

b. The committee recommends adopting a three tier permitting system for graywater reuse systems as outlined below and summarized in Tables 6 and 7.
   i. Tier 1 Permit:
      1. General permit. Standard conditions and restrictions described in the rule apply.
      2. Applies to low flow systems (< 300 gpd) only.
      3. Applies to residential sources of graywater only, i.e., commercial and institutional sources are excluded from this type of permit.
      4. Graywater originating from showers, baths, laundry and washbasins (excluding kitchen sink) may be used untreated. Graywater originating from the kitchen sink may be used following primary treatment.
      5. The system owner is required to have a system plan and an Operations and Maintenance (O&M) manual, but they are not required to be submitted for review and approval.
      6. The permit should be a simple registration type permit.
      7. Inspection and testing of low-flow, untreated graywater systems should not be required by DEQ.
   ii. Tier 2 Permit:
      1. General permit. Standard conditions and restrictions described in the rule apply.
      2. Applies to medium flow systems (300 – 1,200 gpd) and low flow systems that do not qualify for a Tier 1 permit.
      3. Medium flow systems located in Groundwater Protection Areas should be permitted under a Tier 3 permit.
      4. Applies to residential, commercial, industrial or institutional sources of graywater.
      5. Evidence of a site evaluation is required and subject to review and approval.
      6. System plans and O&M manual must be submitted with the application and are subject to review and approval.
      7. Record keeping may be required.
   iii. Tier 3 Permit:
      1. Individual Permit. Conditions may be customized based upon system design and actual site conditions.
      2. Applies to high flow systems (> 1,200 gpd) or any system that does not qualify for a Tier 1 or Tier 2 permit.

3. Site evaluation by a qualified person is required and subject to review and approval.
4. Systems with flows greater than 1,200 gpd must be professionally designed.
5. System plans and O&M manual are required and are subject to review and approval.
6. Inspection and testing of the system may be required following installation and prior to operation.
7. Recording keeping, annual testing and a certified system operator may be required.
8. Tier 3 permits should be scaled based upon flow so that low or medium flow systems are not subject to unnecessarily stringent permit requirements.
9. Tier 3 permit fees for low and medium flow graywater systems should be comparable to those required for Tier 1 and Tier 2 permits.

Table 6. General relationships between the type of graywater system (based on flow) and the treatment requirements for various uses.

Permit Type	System Type	Subsurface and Drip Irrigation Must not touch the edible parts of plant, etc,	Other Uses*
Tier 1	**<300 GPD excluding Kitchen Sink**	No Treatment	Primary treatment followed by secondary treatment
	< 300 GPD with kitchen sinks	Primary Treatment	
Tier 2	**Between 300 and 1,200 GPD excluding kitchen sinks**	Treatment depends on source	
	Between 300 and 1,200 GPD with kitchen sinks	Primary Treatment	
Tier 3	**>1,200 GPD and/or some lower flow systems**	Primary Treatment, followed by Secondary Treatment	Primary treatment followed by secondary treatment. Disinfection consistent with Class B recycled water for uses that create aerosols.

*Disinfection required for all uses with direct human contact.

Table 7. Comparison of recommended graywater permits.

General Description		Tier 1 General Permit. Registration only.	Tier 2 General Permit. Review and approval required.	Tier 3 Individual Permit. Review and approval required.
Criteria for permit eligibility				
Flow	**Maximum allowed flow (gpd)**	≤ 300	≤ 1,200	Any
Sources	**Single family & duplex**	Y	Y	Y
	Multi-Family		Y	Y
	Commercial		Y	Y
	Industrial		Y	Y
Treatment	**Untreated (subsurface irrigation only)‡**	Y	Y	Y
	Treated without disinfection		Y	Y
	Treated with disinfection		Y	Y
Design, Operation and Maintenance Requirements for Permit				
Design, Operation, Maintenance Requirements	**Reuse limited to site of generation**	Y		
	Must be connected to sanitary sewer or approved septic	Y	Y	Permit specific
	Standard setbacks	Y	Y	
	System plans	Y	Y	Y
	Operations & maintenance manual (O&M) required	Y	Y	Y
	Professional design by a PE, RG, or REHS			Y - (>1,200 gpd)
	Installation inspection/testing			Y
	Record keeping required		Y	Y
	Effluent testing and monitoring required		Y – secondary treatment	Y – secondary treatment
	Annual reporting		Y – secondary treatment	Y
	Certified operator (WW or DW certified operator)			Permit specific
Permit Application Requirements				
Required with application	**Name**	Y	Y	Y
	System location	Y	Y	Y
	Site evaluation report		Y	Y
	Systems plan		Y	Y
	Operations & maintenance (O&M) manual		Y	Y
	LUCS			Permit specific
General Description				
Permit Type		General permit, with no review	General permit, with review	Individual permit
Fees (to be determined)		Flat registration fee	Variable	Variable
General description of permit scope.		Low flow systems (< 300 gpd) without any secondary treatment. System plans and O&M required by the system owner, but not required to be submitted, reviewed and approved prior to approval. Standard system specifications, siting requirements and exposure controls must be met.	Medium flow systems (300-1,200 gpd), low flow systems that do not qualify for Tier 1 permit. General permit, but requires review and approval of required documents. Standard system specifications, siting requirements and exposure controls must be met.	High flow systems (> 1,200 gpd), any system that does not qualify for a Tier 1 or Tier 2 system. Specific permitting conditions determined on a case-by-case basis. Systems seeking exceptions to basic rule requirements must apply for an individual permit.

‡ Untreated means any graywater that has not passed through secondary treatment to reduce BOD or TSS. All graywater originating from kitchen sinks must pass through primary treatment.

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Figure 2. DEQ Graywater Advisory Committee. Back-row from left: Ken Vanderford, Bill Zekan, Brenna Bell, Lynne Paretchan, Mike Sheets, Bill Richmond, and Phil Roach. Front-row from left: Nir Pearlson, Vicki Simpson, Pat Lando, Gabrielle Schiffer, and Shannon Taylor. Not pictured: Terry Bounds and Deanna Conners.

Endnotes

[i] DEQ wrote the section on graywater characteristics on behalf of the committee. The summary is based upon the technical information reviewed and discussed by the committee.

[ii] The committee noted a possible conflict in the statutory definitions of graywater and sewage. The separate definitions of "graywater" and "sewage" within ORS 454.605 specifically include kitchen, bath and laundry wastes. This makes kitchen sink, bath and laundry wastewaters common denominators in both definitions. Therefore, in order for the graywater rule's definitions not to be ambiguous, the committee recommends (1) these definitions should clearly distinguish between 'untreated' and 'treated' graywater; (2) that ORS 454.605 state that kitchen sink graywater excludes wastewater from dishwashers and garbage disposals because of the potential of high concentrations of organic material, solids and possible pathogens in kitchen sink graywater; and (3) that the definition of graywater in ORS 454.605 be revised to specify that it refers to kitchen sink wastewater with reduced grease, settleable and floatable solids so as to distinguish it from "kitchen sink wastewater" defined as sewage.

[iii] Some committee members felt the amount of soil, mulch or other material cover over the point of untreated graywater discharge should be based upon site specific conditions, such as soil type. Others noted that a 2-inch cover would limit exposure to graywater while also allowing irrigation hoses to be easily moved when required. The committee reviewed other jurisdictions' rules. A 2-inch cover of soil, mulch or other material over the point of graywater discharge was the minimum required by other jurisdictions, such as California.

[iv] Sixty-percent is the approximate fraction of household water that can be attributed as graywater (Roesner, 2009; USEPA, 2002).

[v] The flow values in Table 3 of this report are 80% of those found in Table 2 of OAR 340-071-0220. The committee discussed basing graywater flow on the design flows in the Table 2 of OAR 340-071-0220, but noted the OAR 340-071 flows over estimate the quantity of wastewater generated (even after accounting for safety factors and leaks) and would result in overestimating graywater flows as well. Although it noted by some committee members that overestimating design flows is a conservative graywater management approach that may account for changes an establishment's occupancy, the consensus of the committee was that the flows in OAR 340-071 are outdated given national water conservation requirements for plumbing fixtures implemented beginning in the 1970's and therefore unreasonable. The committee was concerned that using the design flows in Table 2 of OAR 340-071-0220 would force some systems to exceed eligibility requirements for low-flow systems and result in higher permitting costs to the property owner. Since the timeframe for updating Table 2 in OAR 340-071 is unknown, the committee recommended reducing the flows in that table by 20% for use in the graywater rules. The committee also suggested that graywater flows could be based upon measured flow.

[vi] *OAR 340-071-0130(11): [Deletions in ~~strikethrough~~; additions in brackets]*

> *Property lines crossed: All or part of ~~an onsite~~ [a graywater distribution] system, including areas for future repair or replacement, may be located on one or more lots or parcels different from the lot or parcel on which the facility the system serves is located. The lots and parcels may be under the same or different ownership:*

(a) For each lot or parcel different from and under different ownership than the lot or parcel served, the owner of the lot or parcel served must ensure that a utility easement and covenant against conflicting uses is executed and recorded in such owner's favor, on a form approved by the agent, in the county land title records. The easements and covenants must accommodate the parts of the system, including a 10-foot setback surrounding the areas for future repair or replacement, that lie beyond the property line of the facility served and must allow entry by the grantee, successor, or assigns to install, maintain, and repair the system;
(b) For each lot or parcel different from but under the same ownership as the lot or parcel served, the owner of the property must execute and record in the county land title records, on a form approved by the department, an easement and a covenant in favor of the State of Oregon:
(A) Allowing the state's officers, agents, employees, and representatives to enter and inspect, including by excavation, that portion of the system, including setbacks, on the servient lot or parcel;
(B) Agreeing not to put that portion of the servient lot or parcel to a conflicting use; and
(C) Agreeing, upon severance of the lots or parcels, to grant or reserve and record a utility easement and covenant against conflicting uses, in a form approved by the department, in favor of the owner of the lot or parcel served by the system in accordance with subsection (a) of this section.

[vii] These are site characteristics which preclude the use of graywater at a site.

[viii] The committee expressed various opinions on the depth to groundwater restriction. It was noted by a number of committee members that surface soils are excellent treatment systems for graywater and that a 4-foot separation was excessive. Other committee members noted that the treatment capability of surface soils depends on a number of environmental factors such as climates and soil type; consequently, greater separation distances could be appropriate. However, it was agreed that it would be impractical to evaluate soil conditions for every site. The 4-foot separation distance to groundwater was derived from depth to groundwater restrictions in other rules. Although all systems would need to meet this requirement, it was recommended that low-flow system not be required to submit evidence of this evaluation, allowing them to use available information or a "shovel test" to comply with this requirement. The committee also noted that the groundwater separation distance could be potentially eliminated for graywater treated to drinking water standards.

[ix] The committee was split on the requirement to limit graywater irrigation to the growing season. Some committee members recommended that low-flow systems be exempt from a seasonal irrigation restriction because the impact from graywater releases would be small.

[x] A committee member thought that because there is no existing prohibition on watering lawns and gardens at slopes greater that 45%, graywater should be allowed for subsurface irrigation purposes at such sites.

[xi] Various minority opinions were expressed by committee members on the irrigation of food crops. Because of the dearth of information on graywater irrigation of food crops and because some food crops have the potential to concentrate contaminants as well as translocate pathogens that may be present in graywater, some committee members recommended a conservative approach that limited irrigation to fruit and nut trees where the edible portions would not contact the ground. Other committee members recommended that the rules not specify the types of crops that could be irrigated with graywater. The major justifications cited for this recommendation were: (1) a recent study from Canada (Finley, 2009) concluded that food crops irrigated with graywater posed no threat to human health; (2) graywater users are likely to ignore any

restrictions on food crop irrigation and this restriction would cause large numbers of graywater users to be out of compliance with the rules; and (3) restrictions on food crop irrigation would not be enforceable.

[xii] One committee member suggested that a constructed wetland could be used for both stormwater and graywater treatment. This condition could potentially limit options to treat graywater using a constructed wetland.

[xiii] The committee reviewed horizontal separation distance from other DEQ programs and other jurisdictions that allow graywater use. The recommended separation distances are generally consistent with those reviewed.

[xiv] Treated graywater may also be used for flushing toilets and urinals as well as any other internal uses allowed under Plumbing Code.

[xv] Two graywater treatment standards (350 and 350-1) are currently being developed by NSF/ANSI.

[xvi] Since accreditation under recognized standards can be expensive and cumbersome, the rules should encourage flexibility and innovation by also allowing systems to meet the standard, but not be accredited (i.e., performance based systems).

[xvii] "Disposal" is a term of art and the terminology used in HB2080. However, some committee members felt that using the term disposal fails to recognize the potential ecological benefits of year-round graywater discharge, such as groundwater recharge and reducing the demands on community infrastructure. Releasing graywater into biologically active surface soils could effectively treat graywater through natural processes. Graywater disposal could include practices like releasing graywater year-round into appropriate catch basins, swales, ponds and wetlands that treat the graywater before it percolates through the soil profile and enters groundwater.

[xviii] The committee discussed allowing graywater disposal to be allowed under the three different types of permits as follows: **Tier 1 permit**: A clear majority of the Committee did not support allowing graywater disposal under a Tier 1 type permit. **Tier 2 permit:** The committee discussed allowing graywater disposal under a Tier 2 permit, but was evenly split between yes, no and undecided. The split among committee members applied to both untreated graywater as well as graywater that had passed through secondary treatment. **Tier 3 permit:** The committee was unanimous in their support of allowing graywater disposal under a Tier 3 permit, individual permit. It was noted by a committee member that disallowing graywater disposal under a Tier 1 or Tier 2 permit will result in a large number of illegal graywater systems. Many of these types of systems are already in existence and many property owners are interested in installing them; many of these owners will not apply for an individual permit.

[xix] Some committee members noted that a single state-wide standard would simplify implementation of the program and graywater installers would only need to know one code. Other committee members felt that local jurisdictions should have the authority to impose more stringent standards on graywater use as appropriate to local conditions. Although the Committee recommended a single graywater standard, state law currently allows local jurisdiction authority over matters of local concern. ORS 203.035 and ORS 221.410 allow local jurisdictions to adopt local ordinances that are more restrictive.

[xx] After much discussion, the Committee decided to not include a requirement to list graywater systems on the land title record. However, the committee agreed that it was important that new owners of a property be aware of the system and obtain a permit to operate the system. A requirement to notify new owners of the system should also be included as a permit condition.