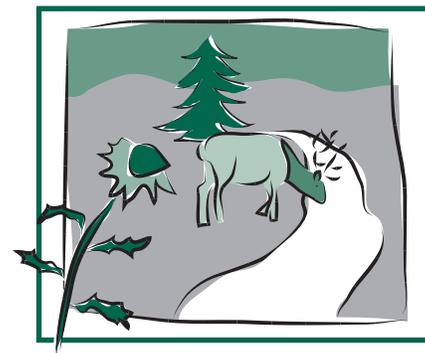


Graywater Reuse and Rainwater Harvesting

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Natural Resources Series | Water



by R. Waskom and J. Kallenberger*

Graywater Systems

Graywater refers to the reuse of water drained from baths, showers, washing machines, and sinks (household wastewater excluding toilet wastes) for irrigation and other water conservation applications.

Contrary to common belief, graywater is not a benign product - it may contain bacteria and other potential pathogens. Consequently, the potential reuse of graywater is a public health issue, not a water conservation priority.

Graywater is of lesser quality than tap water, but generally of higher quality than blackwater, or water from sewage systems. Water from the kitchen sink, garbage disposal and dishwasher is considered blackwater in some states because of high concentrations of organic waste and the difficulties of reusing this water safely.

The most obvious advantage of domestic graywater use is that it may potentially replace other water used for landscape irrigation, although many interests are now advocating the use of gray water for toilet flushing. Filtered graywater is most suitably used for subsurface irrigation of nonedible landscape plants. Not only does its use on landscapes conserve treated tap water, but graywater may also benefit plants because it often contains nutrients such as nitrogen or phosphorus.

Graywater use may offer financial savings to already overburdened municipal sewage treatment facilities because graywater use diminishes sewer flows, thereby lessening the need to expand such facilities. However, diminished sewer flows may have a downside because graywater use can result in insufficient sewer flows to carry waste to the sewer plant. Another concern is that with

increased use of graywater, less effluent water will be available for treatment, resulting in less reclaimed water for municipal uses and downstream appropriators. *Herein lies the source of the potential water rights concerns associated with graywater reuse.*

Graywater systems vary from simple, low-cost systems to highly complex and costly systems. A common (but illegal in Colorado and most other states) method for reusing graywater is to drain the washing machine directly onto outside vegetation. Sophisticated systems treat graywater prior to disposal using settling tanks and sand filters in order to remove solids and pathogens. (Note: settling tanks and filters will not remove pollutants that are dissolved.)

Water Quality Issues Surrounding Graywater Reuse in Colorado

Practically speaking, the use of graywater systems is not viable for most homeowners in Colorado. Currently graywater is regulated under the State of Colorado Guidelines on Individual Sewage Disposal Systems and applicable county Individual Sewage Disposal System (ISDS) regulations. The Colorado Department of Public Health and Environment (CDPHE) does not currently separate graywater from blackwater in its regulations. Consequently, both surface and subsurface applications require permitting and may trigger monitoring requirements.

If graywater is discharged in the soil below the root zone in the manner of a leach field, a permit from the local health department is required. Your local county health or planning department will have specifications for adequate soil cover for leach fields that amount to a minimum of 18 to 24 inches of soil cover. However, this deep application of the graywater will not meet the practical needs of most homeowners, unless they want to install a windbreak of trees or large shrubs. If graywater is used to irrigate

Quick Facts

- Graywater reuse may not be a permissible use of water under a domestic well permit or a community water supply system.
- Rainwater harvesting is the process of intercepting storm-water runoff and putting it to beneficial use.
- In most areas of Colorado, the most common way to use rainwater is to direct roof gutter downspouts to landscape areas you wish to water.
- The state of Colorado allows limited collection and use of precipitation from residential property rooftops in cases where the landowner uses or is entitled to only certain types of well permits to use well water for their domestic non-potable water supply.

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Graywater is different from warm-up water (wasted tap water that is allowed to run down the drain before it reaches a desired temperature). Warm-up water that has not been used for bathing or dishwashing is generally free from bacteria and other pathogens. The amount of wasted warm-up water can be significant in homes where water heaters are located a considerable distance from showers or tubs and where no recirculation system is installed. Catching this water in a bucket and using it to water plants can contribute to home water conservation savings.

below the soil surface, but within the root zone (above frost line), a local permit plus monitoring is required.

If the graywater is applied to the surface, a means of disinfecting the graywater is necessary. Bacteria and other fecal borne pathogens in graywater are a concern and may require installation of advanced treatment systems. If estimations of graywater volume or soil intake rates are inaccurate, ponding or runoff can become a problem. Graywater may also contain sodium and chloride, which can be harmful to sensitive plant species.

Municipal Applications. A graywater system is defined as a type of individual sewage disposal system that requires the owner to secure an installation permit from the local county health department prior to construction. Many county ISDS regulations prohibit the issuance of any type of individual sewage disposal system permit for a lot within 400 feet of service by a municipal or community sewage treatment facility. Many municipalities have similar connection and usage requirements that technically prohibit the use of graywater in urban areas.

Rural Applications. On properties served by a permitted ISDS, submit a request to install a graywater system to your local county health department.

Many counties require the following criteria to permit a graywater system:

- The system must be designed by a registered professional engineer.
- The graywater plumbing system collection lines must be segregated from the blackwater (toilet) lines and must be a maximum of 2 inches in diameter.

- The graywater system design must meet all minimum design and construction standards of ISDS (except tank sizing).
- A graywater system must incorporate a first stage treatment unit consisting of a two-compartment septic tank (sized with a 30-hour detention time) or an NSF (National Sanitation Foundation) approved filtration or aeration tank unit.
- The graywater system design components must meet the minimum requirements for vertical and horizontal separation distances as defined in ISDS regulations.
- For normal permitting processes, the final disposal of the graywater outflow must be to a subsurface absorption field meeting sizing, construction, and siting requirements.
- Graywater systems designed for use via sprinkler irrigation, direct surface application, or subsurface disposal to shallow soil depths must be sampled at least weekly for applicable effluent limitations as contained in the ISDS guidelines. The use of graywater for irrigation may also be subject to water rights limitations (as regulated through the Colorado Division of Water Resources), which should be confirmed prior to considering graywater reuse of any kind.

Water Rights Issues Surrounding Graywater Reuse in Colorado

If considering a graywater system where the source of water is from a well, consider other issues. Well permits are issued pursuant to Colorado statutes. The Colorado Division of Water Resources regulates well water permits to prevent well pumping from injuring other water users. Graywater use may not be a permissible use of water under a well permit, due to return flow requirements that are part of the well permit's approval. This must be clarified prior to installing a graywater system. In some cases, the conditions of approval under which a permit was issued would not prohibit the capture and use of graywater. In other cases, the permit conditions would not allow it. Specifically, if the permit was issued for ordinary household purposes inside a single-family dwelling, with no outside uses, the capture and use of graywater for any use outside the dwelling (including lawn and garden irrigation) would not be allowed.

Well permits that were issued in areas of the state where the stream system is not over-appropriated may qualify for use of a graywater system. Old wells that are unregistered and were constructed prior to laws being enacted that required a well permit, may qualify for graywater systems if the historical uses included lawn and garden irrigation and they can be late registered pursuant to section 37-92-602(5), CRS. For wells operating under court-approved plans for augmentation, the terms and conditions of the decrees entered would have to be evaluated to see whether or not graywater systems would be allowed. In most cases, these plans for augmentation rely in part on the return flows generated by the individual well. In such cases, graywater systems might not be allowed.

Many of the permits issued throughout the state on parcels of land less than 35 acres contain restrictions that disallow the use of graywater. Permits issued on tracts of 35 acres or more with a return flow requirement could possibly utilize a graywater system, but if allowed, the consumption of water could not be increased.

Rainwater Harvesting

Rainwater harvesting is the process of intercepting storm-water runoff and putting it to beneficial use. Rainwater is usually collected or harvested from rooftops, concrete patios, driveways and other impervious surfaces. Buildings and landscapes can be designed to maximize the amount of catchment area, thereby increasing rainwater harvesting possibilities. Intercepted water then can be collected, detained, retained and routed for use in evaporative coolers, toilet flushing, pet and car washing, indoor plant watering, pet and livestock watering, and for lawn and garden irrigation.

Rainwater harvesting systems vary from the simple and inexpensive to the complex and costly. Typically, these systems are simple, consisting of gutters, downspouts,

Application of graywater from systems that discharge 2,000 gallons or more per day requires a permit from the Colorado Department of Public Health and Environment; smaller systems require permits from your local health department.

and storage containers. Directing rainfall to plants located at low points is the simplest rainwater harvesting system. In this system, the falling rain flows to areas with vegetation. Inexpensive rainwater storage systems commonly make use of above ground containers such as a barrel or plastic tank with a lid to reduce evaporation and bar access for mosquito breeding. Any container capable of holding rain dripping from roof or patio can be used as a rainwater harvesting system.

Water Quality Issues Concerning Rainwater Harvesting

Rain in urban and industrialized areas may contain various impurities absorbed from the atmosphere, including arsenic and mercury. In Colorado, rain is infrequent, but rainwater quality is generally good. However, the infrequency of rainfall results in accumulation of bird droppings, dust and other impurities on rooftops between rain events. These impurities may occur in high concentrations in rooftop runoff when it does rain. The best strategy is to filter and screen out contaminants before they enter the storage container. Dirty containers may become a health hazard or a breeding ground for mosquitoes and other pests.

Various methods can be used to purify rainwater. First-flush devices ensure a certain degree of water quality in harvested rainwater. The first several gallons of runoff from a gutter, roof, or other surface are likely to contain various impurities such as bird droppings and dust. A first-flush device prevents this initial flow from draining into the storage tank. Many first-flush devices have a simple design. Such devices include tipping buckets that dump when water reaches a certain level. In addition, there are containers with a ball that floats with the rising water to close off an opening after an inflow of 5 gallons. Water is then diverted to a pipe leading to the storage container. This use of simple technology is an attractive feature of rainwater harvesting. Roof washing is not needed for water used solely for irrigation purposes. However, pre-filtering to keep out debris will reduce sediment buildup in the irrigation system.

Due to concerns surrounding microbial contamination of harvested rainwater, it is

not recommended as a source of drinking water for humans. However, properly designed, constructed, and maintained systems that include disinfection steps have been successfully used for private domestic water supplies.

Check with the Colorado Division of Water Resources and your local building, zoning, and environmental departments before you develop a rainwater harvesting system to determine what plumbing requirements, local restrictions, neighborhood covenants, or other regulations or guidelines might apply to your project. Rainwater catchments, distribution systems, and landscape holding areas must be located and used entirely within the property boundaries of the individual or the entity that is using the system. These systems must be maintained in an acceptable manner and not cause damage or interference to neighboring property. Standards for construction must be consistent with industry standards or as determined by the local administrative authority.

Water Rights Issues Concerning Rainwater Harvesting

The diversion and use of rainwater is subject to the Constitution of the State of Colorado, state statutes, and case law. New Colorado residents should understand that water rights in Colorado are unique compared to other parts of the country. The use of water in this state and other western states is governed by what is known as the prior appropriation doctrine. This system of water allocation controls who uses how much water, the types of uses allowed, and when those waters can be used. A simplified way to explain this system is often referred to as the priority system or “first in time, first in right.”

An appropriation is made when an individual physically takes water from a stream or well (when legally available) and puts that water to beneficial use. The first person to appropriate water and apply that water to use has the first right to that water within a particular stream system. This person, after receiving a court decree verifying their priority status, then becomes the senior water right holder and that water right must be satisfied before any other

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Of course, the appropriation system is much more complicated than described above. Some priorities on major stream systems in Colorado date back to the 1850s and most of the stream systems have been over-appropriated, meaning that at some or all times of the year, there will not be enough water in that stream system to satisfy all vested water rights. Practically speaking, this means that in most river drainages, a person cannot divert rainwater and put it to a beneficial use without a plan for augmentation that replaces the stream depletions associated with that diversion.

Senate Bill 09-080, which was passed and signed during the 2009 legislative session, allows limited collection and use of precipitation for Colorado landowners. The changes apply only to residential properties that are supplied by a well (or could qualify for a well permit). Landowners will complete a permit application, supplied

by the Division of Water Resources, that will provide notice of their intent to collect precipitation and a description of how they intend to do it. To qualify for a permit, you must meet a minimum of the following criteria:

1. The property on which the collection takes place is residential property.
2. The landowner uses a well, or is legally entitled to a well for the water supply.
3. The well is permitted for domestic uses according to Section 37-92-602 or Section 37-90-105, C.R.S..
4. There is no water supply available in the area from a municipality or water district.
5. The rainwater is collected only from the roof.
6. The water is used only for those uses that are allowed by, and identified on, the well permit.

In addition, HB 09-1129, also allows developers to apply for approval to be one of ten statewide pilot projects that harvest rainwater and put it to beneficial, but non-essential, use in the subdivision. These projects may only operate according to an engineered plan, submitted to the state engineer for approval and eventually, to the water court. This new law does not apply at all to individual homeowners.

Additional Information

Additional information, including frequently asked questions (FAQs), is available by visiting the Colorado Division of Water Resources at <http://water.state.co.us/>.

For more information, contact your local county health or planning department or visit:

- Colorado Department of Public Health and Environment: www.cdphe.state.co.us
- Colorado Division of Water Resources: <http://water.state.co.us>
- American Rainwater Catchment Systems Association: www.arcsa.org
- Texas Rain Water Collection information: www.twdb.state.tx.us/innovativewater/rainwater/docs.asp