WATER
CONSERVATION



OVERVIEW OF RETROFIT STRATEGIES

A Guide for Apartment Owners and Managers

PATH
PARTNERSHIP FOR ADVANCING TECHNOLOGY IN HOUSING

U.S. Department of Housing and Urban Development
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OVERVIEW OF RETROFIT STRATEGIES

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INTRODUCTION

Close to a fifth of the United States population lives in multi-family rental housing. Most of these residents do not pay a water bill. Water charges are embedded in their rent and residents are usually free to use as much water as they wish without additional charge.

Water represents a significant amount of the cost involved in operating multi-family housing. In addition to the actual cost of water are associated costs for the treatment of wastewater and the energy required to heat the water. These expenses are likely to increase as groundwater and surface water reserves dwindle, energy costs rise, and treatment requirements become more stringent.

This guidebook is intended to help owners and managers of multi-family properties address these challenges through water conservation. A companion guidebook directed to engineers, contractors, and others responsible for the actual design and implementation of water conservation retrofit strategies is also available from HUD.

Two types of water conservation strategies are generally recognized:

- Behavioral changes to educate and motivate people to become conservation-conscious and engage in conserving practices
- Hardware measures to modify, repair, or remove/replace water-using fixtures or appliances.

This guidebook refers to hardware measures as retrofit strategies.

Where tenant incentive to conserve water may be lacking, owners/managers of multi-family properties must rely on retrofit strategies to reduce water consumption and associated operating costs.

Lowering water use in older multi-family properties presents some challenges. Extensive renovation may not be economically viable for the many properties whose housing units have obsolete, non-conserving water fixtures and appliances. Retrofit strategies, on the other hand, are less invasive and may be better suited for older structures.

Retrofit strategies include the repair/and or replacement of showerheads, faucets, toilets, clothes washers, water meters, irrigation systems, and other features. Specific measures may range in complexity from simply screwing an aerator on a faucet to installing gray water systems that require storage tanks, filters, pumps, and pipes.

Why Conserve Water?

As the world's population grows and water demand increases, many regions across the United States will face the hard realities of groundwater depletion, chronic drought, dried-up rivers, poor water quality, mount-

Retrofit

To provide with parts, devices, or equipment not in existence or available at time of original manufacture. To install or fit a device for use in an existing structure, especially an older dwelling.

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ing infrastructure costs, and diminishing alternatives for additional supplies. Water treatment facilities are quickly approaching their treatment capacity due to the increases in water demand. These constraints are placing limits on how much water will be available and affordable in the future.

Water conservation can:

- Make more water available during droughts or periods of limited supply
- Delay the expansion of existing treatment facilities and the construction of new ones
- Lower energy consumption by reducing water heating and treatment needs
- Lower water and energy bills through more efficient use of water both indoors and in common and outdoor areas
- Increase property values through the modernization of water-using fixtures, appliances, and equipment.

Water Conservation

is defined as any action that reduces the amount of water withdrawn from water supply sources, reduces consumptive use, reduces the loss or waste of water, improves the efficiency of water use, increases recycling and reuse of water, or prevents pollution of water.

New Mexico Office of the State Engineer, 1997

Water Use in Multi-Family Housing

An apartment building typically has both indoor and outdoor water uses. Indoor water use is primarily by the occupants of the housing units, through the use of toilets, showers, bathroom and kitchen faucets, and in some cases clothes and dishwashers. Outdoor water is for areas that may include landscaping and recreational facilities such as swimming pools, spas, fountains, and ponds. In some apartment buildings outdoor uses may include washing cars on the premises.

Several factors affect indoor water use:

- Number, age, and income level of occupants in a housing unit
- Type, age, and condition of water-using fixtures
- Climate
- Price of water where the residents pay directly for water used.

Outdoor water use is highly site-specific and depends on the square footage of landscaped areas and the efficiency of irrigation systems and procedures. The type of water-using recreational facilities will also impact the volume of water used outdoors.

Indoor Use

The volume of water used in a typical non-conserving housing unit can range from around 80 gallons per day to 150 gallons or more, depending on the variables noted above. Two adults living in an apartment with non-conserving fixtures/appliances may use about 56 gallons per person each day. The distribution of water uses shown in Figure 1 is based on apartments with one toilet, one showerhead, two faucets, and standard efficiency clothes and dish washers. It is also based on a number of assumptions regarding how often each fixture or appliance is used. See Appendix A for a complete listing of the assumptions.

Indoor Conservation Potential

Indoor water use can be significantly reduced by repairing leaks and installing low water use fixtures and appliances. If the non-conserving apartment whose water use is illustrated in Figure 1 were retrofitted with faucet aerators, a low flow showerhead, an ultra-low flush volume toilet (ULFT) and high efficiency clothes and dish washers, the total wa-

ter use per day may come down to about 33 gallons per person per day, or roughly 66 gallons per day for the two-occupant apartment. This represents a savings of 46 gallons per day for one apartment, or about 40 percent of the non-conserving water use.

Figure 1 illustrates the volumes of water used in a typical water-conserving apartment. The assumptions made on types of fixtures and frequency of use are listed in Appendix A.

Figure 1. Typical Water Use in Apartment Units

NON-CONSERVING

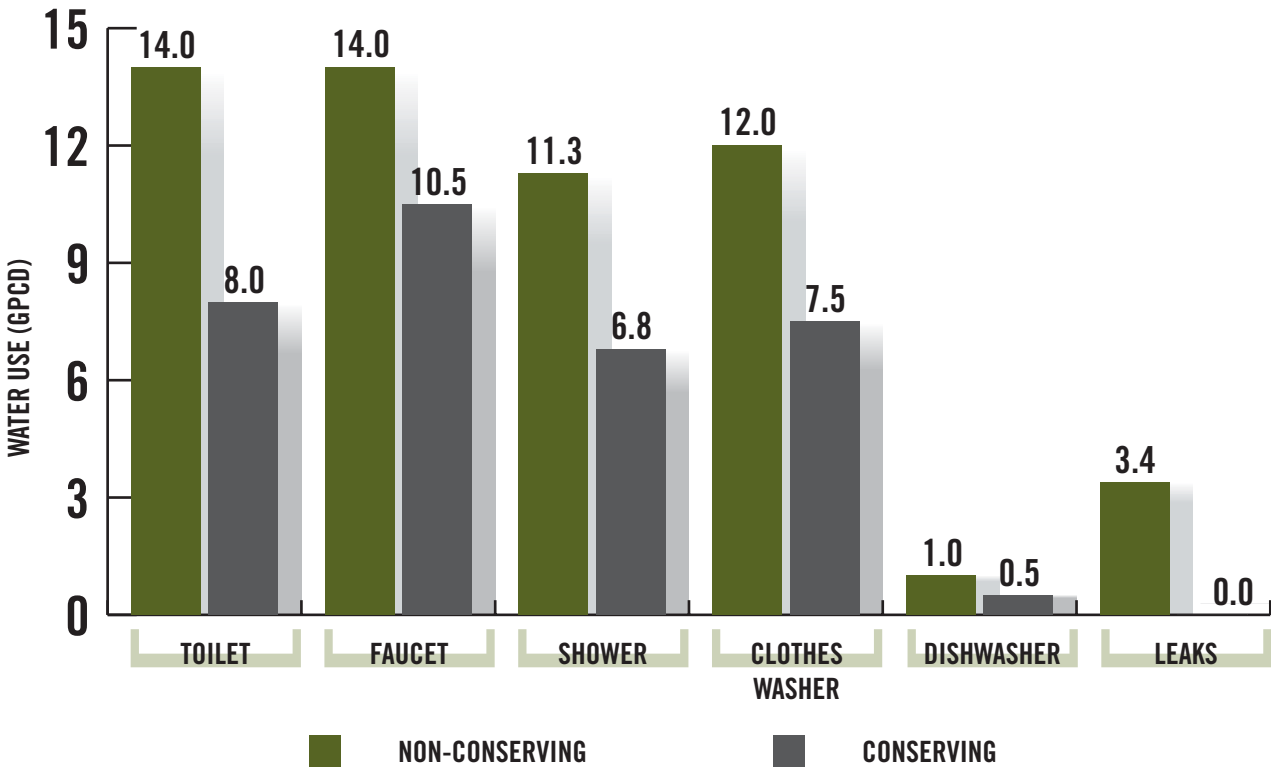
Fixture	GPCD
Toilet	*14.0*
Faucets	*14.0*
Shower	*11.3*
Clothes Washer	*12.0*
Dishwasher	*1.0*
Leaks	*3.4*
Total	*55.7*

CONSERVING

Fixture	GPCD
Toilet	*8.0*
Faucets	*10.5*
Shower	*6.8*
Clothes Washer	*7.5*
Dishwasher	*0.5*
Total	*33.3*

Note

Approximate volumes of water used in gallons per capita per day or "gpcd"



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Outdoor Use

The volume of water used outdoors varies from one property to another, depending on the amenities offered and the square footage of landscaping and turf areas. Outdoor water use in properties with extensive landscaping and lawns may represent more than 20 percent of the total water consumption, while outdoor water uses may account for less than 5 percent of total consumption in properties with little or no landscaping. A 1999 study prepared for the National Apartment Association and the National Multi Housing Council found that common usage (primarily outdoor water use not attributable to apartment residents) averages from 14 to 18 percent of total water use at multi-family housing sites, based on analysis of 32 properties across three states (Florida, California, and Texas).

Lawns are popular in many regions of the country and generally use considerable amounts of water. The actual volume of water used depends on factors such as the amount and frequency of rainfall, extent and root depth of turf grass, soil type, consumptive use requirements, efficiency of application methods, and maintenance practices. Annual water use for lawns reaches peak demand during hot summer months and low or no demand in cold weather months.

As a point of reference: one inch of irrigation over a landscaped area of 1,000 square feet requires 624 gallons of water. How big is an area of 1,000 square feet? Roughly the size of half a singles tennis court.

Outdoor Conservation Potential

Multi-family properties with extensive outdoor water use can save water reducing lawn areas, eliminating narrow strips of turf, using efficient irrigation methods, metering outdoor water use separately, and using native plants with low water consumption in landscaped areas. Limiting outdoor uses such as car washing can also contribute significantly to water savings.

Using efficient irrigation practices and limiting outdoor water use could reduce outdoor water consumption by a third or more. Actual water savings will differ from one property to another and must be evaluated on a case-by-case basis.

RETROFIT STRATEGIES

Indoor Retrofit Strategies

- Quick payback strategies
  - Low-flow faucet aerators
  - Low-flow showerheads
  - Toilet inserts
  - Leak detection and repair
- Utility financed strategies
  - Toilets through direct-install programs
  - Install devices available free of charge in water conservation kits
- Strategies involving utility rebates
- Strategies involving manufacturer discounts
- Submetering

Outdoor Retrofit Strategies

- Eliminate narrow strips of turf
- Reduce lawn areas
- Use separate water meters
- Install soil moisture or rain sensors
- Install special hose bibs
- Replace sprinklers with drip irrigation systems
- Landscape with native plants

Gray Water Use Strategies

- Install rainwater collection systems
- Recycle water for landscape
- Install hybrid rainwater collection and recycling systems

A variety of water conservation retrofit strategies are available to multi-family property owners. Traditional retrofit strategies include a number of indoor and outdoor measures. Less traditional strategies are also available that involve the use of gray water for toilet flushing and/or irrigation.

Indoor Water Use

From a multi-family property owner's perspective, the most advantageous water conservation retrofit strategies are those with quick investment paybacks or those paid for by local water utilities. Utility financed alternatives, of course, are only available to property owners within the service areas of utilities that offer such programs. Appendix B lists some of the water utilities across the United States that offer economic incentives for implementing water conservation measures. Property owners in other areas should consult with their local utilities about the feasibility of obtaining financial incentives or credits for installing water-conserving fixtures and appliances.

Quick Payback Strategies

Retrofit strategies that involve relatively modest investments and quick paybacks from savings on water and sewer bills include:

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■ Low-Flow Faucet Aerators

Screw-on aerators for bathroom and kitchen faucets are generally available in hardware stores for under $2. Property managers or residents can install the aerators with minimum effort. Aerators may save from half a gallon to over 4.5 gallons per faucet per day.

Courtesy of Niagara Conservation

■ Low-Flow Showerheads

Low-flow showerheads (flow rate of 2.5 gallons per minute or lower) are available for as little as $2, although some of the fancier models can cost upward of $20. Their installation involves unscrewing the old showerhead and replacing it with the low-flow model. The replacement of non-conserving showerheads with low-flow fixtures may save between 3 and 6 gallons per showerhead per day.

■ Toilet Inserts

Three types of toilet inserts can be implemented at relatively low cost.

Displacement devices (blocks or bottles placed inside the toilet tank to take up space formerly occupied by water) can be purchased for under one dollar; installation requires only the lifting of the toilet tank lid and the placement of the device inside the tank. Displacement devices may save from 1 to 3 gallons per toilet per day; they should only be used in toilets with large tanks (5 gallons or more).

Courtesy of Niagara Conservation

The flapper valve inside the toilet tank (the device that lifts up to allow water from the tank into the bowl) can be replaced with a **quick-closing flapper** designed to clamp down before the tank is emptied. Flapper valves cost between $2 and $10 and take a plumber or handyman under 20 minutes to install. They may save between 2 to 4 gallons per day per retrofitted toilet.

The water level in the toilet tank can be adjusted to use less water per flush. **Water level adjustments** can best be accomplished using a dual-flush adapter, a device that provides for short or long flushes. Adapters may cost between $8 and $20 and take about 20 minutes to install. Water level adjustments may save from 1 to 3 gallons per toilet per day.

■ Leak Detection and Repair

Toilet, faucet, and showerhead leaks are easy to detect and repair. The repair of faucets and showerheads generally involves a gasket replacement (costs under one dollar), which a handyman can perform in under 15 minutes. Toilets usually leak because of defective flapper valves; flapper valves can be installed for $10 or less in under 20 minutes (the appropriate flapper for the toilet model should be used or leaking may continue). The water savings from leak repairs can be significant. Severe leaks, more common in toilets than in other fixtures, can drain over 100 gallons per day. Even modest leaks can lose 3 to 7 gallons per day per toilet and about a gallon per day per faucet or showerhead.

Utility-Financed Strategies

■ Toilets Through Direct-Install Programs

Many water utilities across the country have recognized the water savings potential of ultra-low flush toilets (ULFT) and offer incentives to replace old toilets with water-conserving fixtures. ULFTs are toilets designed to use 1.6 gallons per flush or less, compared to the 3.5 gallons per flush or

higher in toilets manufactured before 1992. The design of ULFTs, and the levels of user satisfaction, have consistently improved since 1992, when the Energy Policy Act established the national manufacturing standard of 1.6 gallons per flush for most toilets. ULFT direct-install program details change from one location to the next (see Appendix B). Owners are sometimes given a choice of model. A contractor retained by the utility usually installs the toilets, although some direct-install programs call for installation by the property owner with rebates offered for each confirmed installation. ULFTs can save between 10 to 20 gallons per toilet per day.

■ Devices Through Water Conservation Kits

Many water utilities in the United States offer water conservation kits to customers in their service areas (see Appendix B). The kits generally include two or three faucet aerators, a low-flow showerhead, toilet displacement devices, leak detection tablets for toilets, and informational materials. Property owners should undertake installation of the water conserving devices with their own personnel, rather than leave it up to the residents to obtain the full water savings from the free devices.

Rebates

A number of utilities promote the use of ultra-low flush toilets and high efficiency clothes washers through rebate programs. The details of each program vary from one location to the next (see Appendix B).

In ULFT rebate programs the property owner is typically responsible for the toilet installation costs. Rebates currently offered range from $40 to $100 per toilet. For example, the East Bay Municipal Utility District (Oakland, California), the City of Seattle (Washington), and the City of Tampa (Florida) offer up to $100; the City of Albuquerque (New Mexico) and the Metropolitan Water District of Southern California offer $75. Property owners need to check with their local utilities even in the locations quoted, because program details change constantly and their availability may be discontinued.

Rebates for the installation of high efficiency clothes washers currently ranges between $75 and $150 per in-unit washer, and from $50 to $250 for commercial washers in common laundry areas. For example, the East Bay Municipal Utility District (Oakland, California) offers rebates of $150/$50; the City of Seattle (Washington) offers rebates of $75 for in-unit washers and from $150 to $250 for coin-operated machines; and the City of Austin, Texas, offers rebates of up to $250 on high-efficiency washers.

Discounts

Property owners may be able to obtain high volume discounts on the purchase of ULFTs and high efficiency clothes washers. They may also be able to obtain discounts from contractors on multiple installations. Manufacturers or their local representatives should be contacted for information on high volume discounts.

Submetering

Submetering refers to the installation of water meters on the water supply lines to each apartment. The meters track the water consumption of each unit, and the residents are responsible for their own water bills. Water is thus billed according to the amount

Courtesy of Neptune Meters

consumed — the same fashion that electricity and gas have been billed for years.

There may be regulations on local or state water codes that prohibit sub-metering. The states of Massachusetts and New Jersey, for example, explicitly prohibit submetering; regulations are pending in North Carolina. Some municipalities do not allow submetering even if their state water codes do: the city of Augusta does not allow submetering, although the state of Georgia does. The regulatory environment is summarized in Appendix C. Property owners are urged to verify current regulations at the local and state level, because they will change over time.

Property owners have several options when considering a submetering system:

- Hire a large company with offices nationwide
- Hire a local contractor specialized in submetering services
- Implement the systems on their own, as some of the larger property owners have done
- Request direct utility metering at apartment units
- Use a combination of the above.

The cost of implementing a submetering system may vary among regions of the country and even from one property to the next. The way water piping is laid out in a building can impact costs. The total cost must also include the billing and collection processes, handling of customer complaints, increased maintenance requirements, and interaction with the local water utility. Based on limited data, implementation costs may range between $225 and $500 per unit. Operation and maintenance costs may fall between $2 and $3 per month per unit. Some states, such as Texas, do not allow the operation and maintenance costs to be passed on to the residents. Texas also requires either direct utility metering or submetering for all apartment units constructed after January 1, 2003.

The volume of water saved by the implementation of a submetering system, if any, will depend on the cost of water and socioeconomic and demographic factors (location, income level, age of residents, etc.). The water savings may vary considerably from one location to another. One realty company that owns over 75,000 apartment units throughout the country reported average water savings between 20 and 30 percent of total use. A submetering study in Seattle did not record any savings. Reports of minimal savings may be due to the limited conservation options available to residents: fuller loads in dishwasher, shorter showers, better leak reporting. More reliable data may soon be available from an ongoing (2002) national submetering study sponsored by several water utilities.

Outdoor Water Use

Outdoor retrofit strategies involve improving irrigation efficiency and limiting outside water uses. Seven effective means of reducing water consumption are described below.

Eliminate Narrow Turf Strips

The volume of water saved by eliminating narrow strips of turf will depend on the size of the area in question and the material that replaces the lawn: paving/gravel (no water use), or plants/shrubs (some water use). Water savings and costs must be estimated on a case-by-case basis.

A study conducted in Novato, California, showed narrow strips of turf required about four times the amount of water per square foot applied on larger turf areas. Actual water savings will vary in different parts of the country. Property owners should consult landscaping and gardening professionals to assess water conservation potential.

Reduce Lawn Areas

Smaller lawns save water and may reduce maintenance costs. This is particularly true in arid and semi-arid areas where the volume of water used in irrigation can represent a significant proportion of the total water consumption.

The water savings and costs associated with reducing lawn areas depend on the size of the area in question and the material that replaces the lawn: paving/gravel, or plants/shrubs. Water savings from a reduction in turf areas would only accrue during the period the lawn is irrigated.

Use Separate Water Meters

While the meters themselves do not save water, property owner/manager appreciation of the amounts of water used for common areas may prompt them to implement one or more measures to improve outdoor water use efficiency. Reductions in water use of 5 to 10 percent from the use of separate meters are feasible, although actual savings need to be evaluated on a case-by-case basis.

The cost of installing separate meters depends on the size of the meters. Installation charges may be around $100. The water utility generally charges a monthly fee per meter; a 2-inch meter may cost between $10 and $20 per month; a 4-inch meter may cost about $50 per month. If wastewater charges are based on indoor water use, separate meters will have a very quick payback.

Install Soil Moisture or Rain Sensors

The Handbook for Water Use and Conservation (Vickers, 2001) estimates that use of soil moisture sensors/probes or rain sensors can save 5 to 10 percent of water used outdoors, provided the oisture/rainfall data are used to adjust irrigation schedules. This estimate must be applied on a case-by-case basis in multi-family properties.

The cost of implementing moisture or rain sensors will vary depending on the type and quality of devices used. Rain sensors typically cost around $25; installation may take an hour of plumber time and maintenance costs are minimal. Moisture sensors can range from $10 for a simple resistance probe to $75 or more for a tensiometer, a device that measures soil moisture tension by quantifying the amount of water a plant can draw from the soil.

Install Special Hose Bibs

Hose bibs or outdoor faucets may be retrofitted with attachments that require a special key to use the outlet. The retrofit costs under $10 and may be installed in a few minutes by a plumber or handyman.

The volume of water saved by restricting use of outdoor faucets/hose bibs will be site specific. Properties where tenants frequently wash cars on the premises would benefit most from implementation of this strategy. Water use can be reduced by 50 percent or more at each retrofitted hose bib.

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Replace Sprinklers with Drip Irrigation

Drip irrigation systems can save 25 to 75 percent of the water that a sprinkler system would use. Actual savings must be determined on a case-by-case basis, and depend on the type of sprinklers replaced and the characteristics of the irrigated area. The cost of replacing sprinklers with a drip system depends on the size of the area to be irrigated and the type of system installed. *The Handbook of Water Use and Conservation* estimates the cost of installing a drip system at $1 to $1.50 per square foot. Drip systems do require periodic maintenance for efficient operation.

Landscape with Native Plants

The volume of water saved by using low-water use and native plants in place of conventional landscaping needs to be evaluated on a case-by-case basis. Studies conducted in Arizona, California, and Texas found that replacing conventional landscapes with low-water use and native plants reduced outdoor water use from 19 percent (North Marin, California) to 43 percent (Austin, Texas). These studies were conducted in single-family homes; savings in multi-family properties may differ depending on maintenance and irrigation system efficiency.

The cost of replacing high-water-use plants and lawns with low-water use and native plants has to be evaluated on a case-by-case basis. The New Mexico Office of the State Engineer's *Xeriscape 101* pamphlet quotes installation costs at $1 to $4 per square foot. The cost of the native plants can vary from $2 to nearly $100 per plant:

- The California Native Plant Society quotes plant costs between $2.25 and $96
- Florida Native Plants.com offers plants between $5 and $45
- The New England Wildflower Society sells flowers, shrubs and trees from $5 to $75 per unit

An approximate cost of $2 per square foot of area to be planted may be used as a rough "rule of thumb" estimate. Operation and maintenance costs should actually decrease with the native plants, as they are better adapted to local conditions than less water-efficient plants.

Gray Water Use Retrofit Strategies

The least traditional retrofit strategy for water conservation in a multi-family setting is the installation of gray water systems.

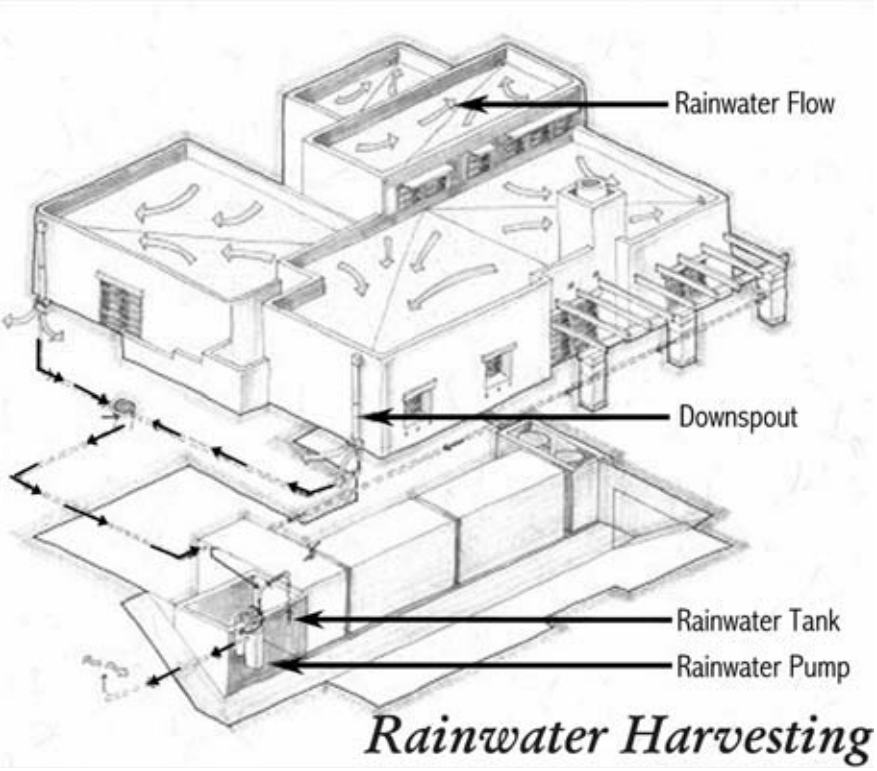
Gray water systems may consist of:

- Rainwater collection
- Gray water recycling
- Hybrid rainwater collection and recycling systems

In terms of cost effectiveness, hybrid systems rank higher than the other two alternatives. Gray water recycling tends to be more cost effective than rainwater collection. The three types of gray water systems are described below.

Rainwater Collection

Rainwater collection or rainwater harvesting technology has been around for centuries as a means to use seasonal precipitation that would otherwise be lost. A rainwater harvesting system concentrates and collects rain



Desert House rainwater collection system in Phoenix, Arizona (Courtesy of Desert Botanical Garden, Phoenix Arizona)

falling on roofs and grounds for direct use and storage; water may be collected or harvested from concrete patios, driveways and other paved areas. The water is typically used for landscape irrigation and/or toilet flushing.

Successful implementation of large-scale rainwater harvesting systems relies on several factors. Most important is a suitable climate that affords periodic rainfall throughout the year; low rainfall and/or extended dry periods limit the reliability and effectiveness of a rainwater harvesting system. The most economically viable systems are likely to have small storage capacities that supplement rather than replace water supplies from local utilities.

The costs of rainwater collection systems vary from one location to another and depend on the situation and life of the system. Contractors in New Mexico and Texas generally charge between $2 and $4 per gallon of storage for the installation of a complete rainwater harvesting system including underground concrete tank, pump, valves, piping, and catchment appurtenances. Systems with above ground storage or with polyethilene or fiberglass tanks would be less expensive (from $0.40 to $1 per gallon of storage). Multi-family properties are likely to require in excess of 10,000 gallons of storage.

Rainwater collection systems that provide water for toilet flushing as well as landscape irrigation will save more water and cost considerably more. Separate piping has to be provided from the storage tank to every toilet on the property. This requires a significant investment in the re-plumbing of the building. Properties about to be renovated and new properties, however, may be able to add the additional piping at a relatively low cost.

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Gray Water Recycling

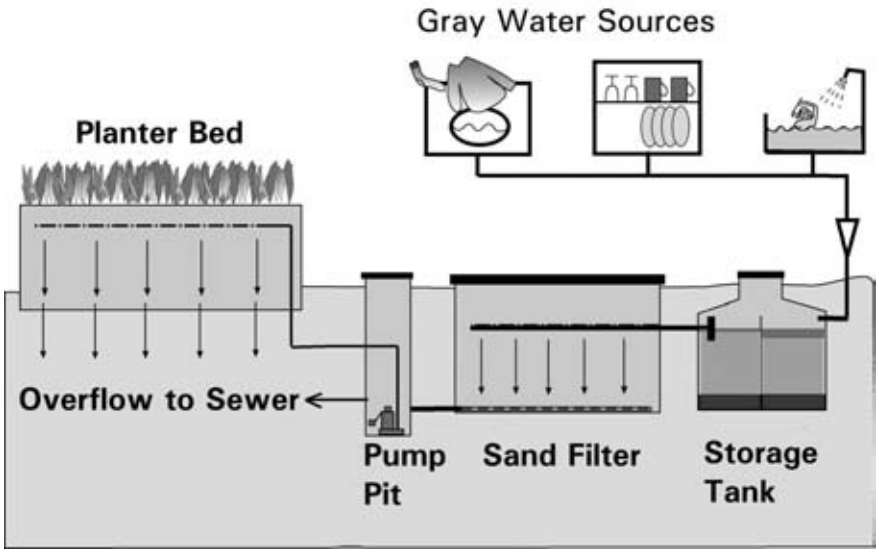
Gray water recycling systems consist of devices attached to the plumbing system for the sanitary distribution or use of gray water (water from bathroom sinks, showers, and clothes washers). These systems require pipes separate from the potable water piping, as well as valves, filters, pumps, and treatment facilities.

Permits are required in most states for the implementation of gray water systems, usually from local or county authorities. The primary concern of regulators and health officials is that gray water may result in water quality problems that pose a threat to public health. Regulations invariably prohibit gray water systems from being connected to potable water systems and typically preclude the use of water containing hazardous wastes or water that comes from the soiling of diapers or similar garments.

Gray water

means untreated wastewater which has not been contaminated by any toilet discharge, has not been affected by infectious, contaminated, or unhealthy bodily wastes, and which does not present a threat from contamination by unhealthful processing, manufacturing, or operating wastes.

The California Water Code (Section 14875-14877.3)



Typical gray water system used for irrigation (Courtesy of Carl Lindstrom)

The costs of gray water systems vary, depending on the size and complexity of the system. Costs may range from $3,000–$5,000 per housing unit for systems that provide enough water to cover irrigation needs. Property owners should consult design professionals to define the size and complexity of recycling systems that meet their needs, and to assess the return period of their potential investment in gray water recycling systems.

Hybrid Systems

Hybrid systems use both rainwater and effluent from bathroom sinks, showers, and clothes washers as their source of water. The source water is typically treated and then distributed to irrigation systems and/or toilets. Hybrid systems discharge excess water to the sewer.

As with simple recycling systems, the hybrid systems require permits from local health authorities. Many states allow only underground irrigation with gray water to prevent human contact with the water.

Hybrid systems can be more cost effective than simple recycling or rainwater collection systems. Once the treatment facilities and related equipment needed for recycling is in place, the rainwater collection portion of the system can be added at a relatively low cost. Property owners should consult design professionals to evaluate the desirability of installing a hybrid gray water system in their facilities.

SELECTING RETROFIT STRATEGIES

A variety of reasons may motivate property owners/managers to conserve water:

- Contribute to the protection of a valued natural resource
- Avoid potential water shortages in the future
- Save money.

Retrofit strategies also may select themselves. If toilets in a multi-family building are over 20 years old and managers are constantly receiving complaints about malfunctions and leaks the time may be right to replace them. Or clothes washers in the laundry room may be out of order and beyond repair. Perhaps low water pressure in the building points to the need for a major overhaul of the water piping.

Reacting to a clear need to upgrade water-using fixtures and appliances is as valid a reason as any to retrofit and conserve water. In some instances, however, retrofitting may present clear advantages even without the pressing need to upgrade.

This section outlines a proactive approach to retrofitting for water conservation. It presents simple guidelines for a property owner/manager to assess water use patterns, select retrofit strategies, estimate conservation potential, and determine approximate costs and how quickly they can be recovered from savings in water/sewer bills.

Water Use Assessment

Is your multi-family property conserving or non-conserving in terms of water use? If you don't know for certain, the property is most likely non-conserving. The determining factor is the water bill. An examination of water bills and a few simple calculations can settle the issue.

Water and sewer bills come in many sizes and formats. To assess water use it is important to determine:

- **Number of days in billing cycle:** Most utilities bill either monthly or bi-monthly; assume 30 days in the billing cycle if billed monthly, 60 days if billed bi-monthly.
- **Volume of water used per billing cycle:** Water utilities use either hundreds of cubic feet (ccf) or thousands of gallons as the units of measurement to record volume of water used.
- **Is there a separate meter for outdoor water use?** Separate meters may be billed separately. If two or more meters are included in one bill the water use from each meter is likely to be prominently displayed.

With information from the water bills and a few facts about occupancy, you can approximate water use per person. Winter and summer water use can be compared for a rough

Useful Water Units

- *1 cubic foot (cf) = 7.48 gallons*
- *1 ccf (commonly used by water utilities as "one unit") = 100 cf = 748 gallons*
- *1 liter = 0.26 gallons*

approximation of outdoor water use, assuming the property is not irrigated during winter months (not always the case in southern states).

More accurate calculations require knowledge of the number of building residents (water users) in a given time period. If these figures are not available, the average number of residents over the past few years may be used to approximate per capita water usage. Following are some basic calculations to help assess specific properties.

Daily water use for the property = (Number of ccf in water bill) x 748 / (Number of days in billing cycle)

Daily per capita use = Daily water use for the property / Number of residents

The per capita water usage should be calculated for several billing cycles, including summer and winter periods. The per capita usage in winter months is likely to reflect indoor water usage. Buildings with no landscaping or significant outdoor water uses should show similar per capita volumes year-round. Buildings with significant outdoor water uses should show higher water use during summer months (except, as previously noted, in southern states). The difference in per capita water usage between winter and summer months may be attributed to outdoor uses for purposes of obtaining a rough estimate of water use.

Resident-related (indoor) water use may be qualified as shown in Table 1, below.

Use of water for landscape irrigation is more difficult to qualify, as it depends not only on the efficiency of irrigation systems but also on the extent of the facilities. A property with extensive lawns and gardens may use significant volumes of water even if irrigated very efficiently.

Property owners should consult with their water utility regarding outdoor water audits, or contact a landscaping professional in their area. Many utilities offer audit services free of charge. The audit involves the physical inspection of the facilities by a utility representative who can identify areas in need of water-efficiency improvements, recommend changes to landscaping, and review irrigation practices and procedures.

Table 1—Indoor Water Use Assessment

GPCD (Gallons per capita per day)	Water Use Assessment
Under 30	*Highly efficient water use, no conservation potential*
30-50	*Efficient water use, some conservation potential if closer to 50 gpcd*
Over 50	*Non-conserving water use, definite conservation potential*

Indoor Water Uses

Strategies may be selected on the basis of property owner preference, conditions specific to the property (for example, toilets need replacement anyway), availability of rebates from water utilities, or availability of special discounts on high volume purchases. The right retrofit strategies may also become apparent from an analysis of the fixtures in place and the ones that may potentially replace them.

A simplified analysis can be conducted by filling out Table 2 on the following page.

The payback periods on Line 13 should be evaluated in light of the longevity of the wa-

Table 2—Estimate of Indoor Water Conservation Potential, Costs, and Payback

Item	Toilet	Faucets	Showerheads	Clothes Washer
1. Flush volume in gallons per flush (gpf) for existing toilets; flow rate in gallons per minute (gpm) for existing faucets and showerheads; average water use per load for existing clothes washers	_____ gpf	_____ gpm	_____ gpm	_____ g/load
2. Flush volume, flow rate, or use per load for water conserving replacements or toilet inserts	_____ gpf	_____ gpm	_____ gpm	_____ g/load
3. Potential reduction in water use (Subtract Line 2 from Line 1)	_____ gpf	_____ gpm	_____ gpm	_____ g/load
4. Daily use for each device (number of flushes for toilets; number of minutes for faucets and showerheads; loads per day for washers)	_____ flushes	_____ min	_____ min	_____ loads
5. Water savings in g/day/device (Multiply Lines 3 and 4)	_____	_____	_____	_____
6. Total number of devices in property	_____	_____	_____	_____
7. Total ccf of water saved per year* (Multiply Line 5 by Line 6 by 0.488)	_____	_____	_____	_____
8. Cost of water per ccf (from water bill)*	_____	_____	_____	_____
9. Dollars saved per year (Multiple Lines 7 and 8)	_____	_____	_____	_____
10. Cost of retrofits/replacements	_____	_____	_____	_____
11. Rebate amounts, if any	_____	_____	_____	_____
12. Net costs (Subtract Line 11 from Line 10)	_____	_____	_____	_____
13. Payback period in years (Divide Line 12 by Line 9)	_____	_____	_____	_____

** Make appropriate corrections if water bill is in thousands of gallons.*

ter savings obtained from the various conservation measures. New toilets may be expected to have a useful life of about 20 years; toilet inserts, however, may last five years or less. Faucet aerators and low-flow showerheads may have a useful life of about ten years. Clothes washers may last 12 years (in-unit) or less (laundry areas).

The table may yield some results that require additional investigation, and the following guidelines are provided to facilitate this research process. Property owners may be able to obtain some of the required data from a water audit conducted by their water utility.

Toilet Flush Volumes

Existing toilets are most likely of the gravity-flush type, that is, they have a tank that discharges water into a bowl after a handle is pulled down. Other types include toilets with pressure-assisted flush and units with flushometer valves, such as the ones found in airports or commercial buildings.

Some gravity flush toilets use over 5 gallons of water per flush, others use less. The ultra-low flush type (ULFTs), use 1.6 gallons per flush or less. If the property already has ULFTs there is no need to consider any toilet retrofit strategy. If older toilets with larger flush volumes are in place, their flush volumes should be determined.

One of the simplest ways to determine flush volume is to measure it. After lifting the toilet tank lid, a tape measure can be used to determine width and length of the tank. The height of the water column used for flushing can be determined by measuring the depth of water before flushing, then flushing the toilet while holding the tape measure in place and recording the lowest depth of water during the flushing process. The difference between the full and near-empty tank depths is the height of the water column.

To determine flush volume:

Multiply the height of the water column by the tank width and length (all in inches), and then by 0.0043 to convert the result to gallons per flush.

This measured flush volume is not exact, as it does not take into account the water that enters the tank as the toilet is being flushed. The measurement is sufficiently accurate, however, for purposes of estimating conservation potential, particularly in light of the fact that several other approximations have to be made.

Ideally all toilets on the property are alike and one measurement of flush volume will suffice. If there are different makes and models of toilets, more than one measurement may be required. An average flush volume for all toilets in the building should be entered in Table 2.

The flush volume after retrofits should be verified with the manufacturers of the various devices. The following values serve as general guidelines:

- Use 1.6 gallons per flush for new toilets
- Reduce initial flush volume by 0.3 gallons for a displacement device, unless manufacturer specifies a higher number (use displacement devices only in high flush volume toilets)
- Reduce initial flush volume by 0.5 gallons for installation of a quick-closing flapper valve or water level adjustment, unless manufacturers specify different numbers.

Faucet and Showerhead Flow Rates

Flow rates depend not only on the capacity of the fixture but also on the available water pressure. The same model fixture will have a higher flow rate in a building with 80 pounds per square inch (psi) of pressure than in a building with 40 psi pressure. If a property has several buildings with different water pressures, the fixtures in each building should be treated separately.

Flow rates may be measured using a stopwatch and a specially designed flow-measuring bag available in hardware stores or from water utilities. The flow rate is measured by setting the bag to receive all flow from the fixture, opening the faucet or showerhead to its normal operating range, and allowing flow into the bag for a pre-determined number of seconds (specified on the bag, usually five seconds). The flow rate can then be read directly from markings on the side of the bag.

The flow rates after retrofits should be verified with the manufacturers of the various devices. The change in flow rate between an old showerhead and a new one, in particular, could vary widely from one property to the next. The following values may be used as general guidelines:

- Reduce faucet flow rate by 0.5 gpm for faucet aerators unless manufacturer specifies otherwise; low flow faucets generally have flow rates of 2.2 gpm or less.
- Assume a flow rate reduction of 0.75 gpm for new showerheads if no other information is available; low flow showerheads generally have flow rates of 2.5 gpm or less.

Clothes Washer Loads

The gallons per load (also termed "per cycle") used by a washing machine are generally included in the literature that comes with the appliance. If the manuals are not available, the volumes may be obtained directly from the manufacturer.

Older, standard efficiency clothes washers use from 33 to over 40 gallons of water per load (the 33 gallons per load figure is from a 1999 study of multi-family common laundry areas in Toronto, Canada; a study performed for Southern California Edison in 2000 found 38 gallons per load; studies in Seattle found over 40 gallons per load). Newer, high performance or high efficiency clothes washers use considerably less water. The 2000 Southern California Edison study (conducted by Battelle Pacific Northwest Laboratories) found that Maytag high performance washing machines used on the average 15.4 gallons of water per cycle; the Speed Queen brand used 17.0 gallons per cycle; and Whirlpool high efficiency washers used on the average 27.4 gallons per cycle.

Daily Fixture/Appliance Use

How many times is a toilet flushed each day? How many minutes does a faucet or a showerhead operate each day? How many loads of laundry are done in each washer per day? These numbers vary from one household to the next. Unfortunately no comprehensive study has been conducted at the national level to determine average usage for fixtures in a multi-family setting. Based on available data, the following guidelines are provided:

- Toilets are flushed roughly 5 times per person per day (*Residential End Uses of Water*, a study conducted in 1999 for the American Water Works Association, found an average of 5.05 flushes per person per day from measurements in close to 1,200 single-family homes). If an apartment houses two people and has one toilet, the toilet would be flushed 10 times per day.
- Faucet use in apartments may be around 14 minutes per day (from a multi-family study conducted in Seattle in 1993). If an apartment has two faucets, the assumption is that each faucet would be used for 7 minutes a day.
- Showerhead use in apartments may be close to 6 minutes per person per day (from the same 1993 multi-family study in Seattle).
- Clothes washer use differs markedly between in-unit machines and washers in common laundry areas.

A 2001 study for the Multi-housing Laundry Association found that the volume of water used for laundry per apartment unit was almost four times higher in properties that had in-unit clothes washers. Dwellers apparently adjust their laundry habits when they have to use common area washers. In-unit washers possibly handle between 0.3 and 0.4 loads per person per day (*Residential End Uses of Water* found a usage of 0.37 loads per person per day in single-family homes). Common area washers may handle about 0.1 loads per person per day (from the Toronto study). So what number should be entered for number of loads of washing in the fourth row of Table 2? If the property has in-unit washers, take the average number of people per apartment and multiply it by 0.37 (or other number judged appropriate to the site in question) to obtain the number of loads per day. If the property has common area washers, take the number of residents in the entire property and multiply it by 0.1 to obtain the number of loads for all common area machines. Then divide that number by the number of machines to obtain the "loads per washer."

Outdoor Water Uses

Outdoor and common area water uses in multi-family properties can range from virtually none to over 20 percent of the total water consumption. Some properties may be able to implement all of the seven outdoor retrofit strategies presented in this guidebook. Others may be limited by the characteristics of their water use to one or two of them.

If it were feasible to implement the seven retrofit strategies outlined in the previous section of this guidebook, in what order of preference should they be considered? Again, the analysis may differ from one region of the country to another, and property owners are urged to consult with landscaping and water conservation professionals in their area. A research paper sponsored by HUD, *Retrofit Water Conservation Strategies for Multi Family Housing* (available online at www.pathnet.org/publications/water.pdf) suggests the following rankings:

1. Eliminate narrow strips of turf
2. Reduce lawn areas
3. Use separate meters for outdoor water uses

4. Install soil moisture or rain sensors
5. Install specially fitted hose bibs to restrict outdoor water use
6. Replace sprinklers with drip irrigation systems
7. Use low water consumption native plants

Property owners may also consider the advantages of another important common-area water use: laundry facilities. As noted previously, transitioning from in-unit clothes washers to common laundry facilities may decrease the amount of water used to wash clothes by more than half.

When selecting outdoors retrofit strategies property owners should consider that:

- Narrow strips of turf use up to four times as much water for irrigation than a lawn of comparable area.
- One inch of water applied to 1,000 square feet of lawn amounts to 624 gallons. In one year a lawn may require 30 inches of irrigation, or 18,720 gallons.
- Meters on outdoor water uses do not save any water themselves; they do promote conservation by helping property owners appreciate the volumes of water used outdoors.
- Soil moisture and rain sensors are only effective if the information derived from them is used to adjust watering schedules.
- Restriction of outdoor uses such as car washing is likely to elicit a negative response from residents upon its introduction; some properties have dealt with this issue by offering discount coupons usable at local car washes.
- Drip irrigation systems significantly reduce water use, but also increase maintenance requirements.

Gray Water

Gray water systems are becoming increasingly attractive, particularly in areas with severe water shortages, limited water and wastewater treatment facilities, and special environmental concerns (i.e. groundwater contamination or highly polluted surface waters).

Rainwater harvesting is gaining acceptance in several states (Hawaii, Texas, Arizona, New Mexico) where summer rain is common. In Hawaii County, more than 8,000 homes have rainwater catchment systems. The city of Austin, Texas, offers rebates for the installation of rainwater harvesting systems. A demonstration home in Phoenix, Arizona, illustrates the advantages of rainwater harvesting. The city of Albuquerque, New Mexico, offers a booklet titled *Rainwater Harvesting, Supply From The Sky* that gives system design and construction information.

Rainwater collection for both landscaping and toilet flushing has been implemented at a number of facilities in the United States, primarily office buildings. Among them:

- The King Street Center in Seattle, Washington, a 327,000 square feet office building, uses a rainwater collection system for toilet-flushing water.
- The Chesapeake Bay Foundation building in Annapolis, Maryland, features rooftop cisterns that capture rainwater for hand washing and fire suppression.
- The U.S. Navy Energy Showcase building at the Naval Construction Battalion Center in Port Hueneme, California, uses rainwater for irrigation.

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One multi-family property, a triplex owned by a builder in Seattle, Washington, has installed a rainwater collection system that provides water for toilet flushing with the intent of evaluating this technology for wider scale use in new construction.

Gray water recycling systems have been implemented in multi-family properties in Ottawa and North Vancouver, Canada. Some properties in the United States have installed dual piping upon construction to use gray water in the future for toilet flushing. The EcoVillage Cohousing Cooperative in Ithaca, New York, is one such property.

Hybrid systems using both rainwater collection and recycling of gray water for toilet flushing have yet to make an appearance in multi-family housing, although they are more cost effective than systems that have rainwater collection or gray water recycling alone. The cost effectiveness of such systems may be enhanced in places where the water storage tanks (the most expensive component of the system after the separate plumbing of toilets) can serve multiple purposes such as detention storage to reduce flooding and erosion from storm water discharges.

Which gray water system, if any, is right for a property? A hybrid system that includes both rainwater collection and gray water recycling is likely to be the most advantageous. A rainwater collection system by itself will have limited use and a relatively high cost of up to $4 per gallon of storage. A system with a 5,000-gallon storage tank could cost about $20,000 and have limited use in locations where rainfall is not distributed evenly throughout the year. For the same $20,000 a property owner would be able to install a hybrid system capable of treating over 100 gallons per day year round. On the other hand, a gray water system without rainwater collection would cost roughly the same as a hybrid system. The incremental costs of collecting rainwater from rooftop and driveway catchments are relatively small.

The cost of installing gray water systems is relatively high when compared to the cost of other retrofit strategies. Certain site-specific conditions, however, could favor the selection of such a system:

- Water is extremely scarce and expensive
- There are severe limitations on wastewater discharges
- The volume of water used for irrigation is over 20 percent of the total water use
- Internal plumbing is such that retrofitting toilet piping is relatively easy
- The property is required to store water for flood and erosion control purposes
- Local utilities offer rebates for the installation of gray water systems.

Property owners are advised to check local health regulations and water codes before consideration of gray water systems. A listing of applicable statutes is included in Appendix D.

RETROFIT SAVINGS AND COST

When properly implemented and maintained, the strategies discussed in this guidebook are very likely to conserve water and lower water, sewer, and power bills. An initial, sometimes significant investment of time and money is required to obtain the water savings. Money spent on retrofits can sometimes be recovered within two years and in other cases over a longer time frame.

Quantifying water savings and implementation costs is difficult. The physical conditions affecting retrofit strategies change from one property to the next. Labor and material costs can also vary markedly from one region to another. These challenges are compounded by the lack of studies in multi-family settings with results that are applicable at the national level.

Difficulties notwithstanding, estimated water savings and costs for the retrofit strategies outlined in this guidebook (other than gray water systems) are presented in Table 3. Water savings will usually fall within the specified ranges but could easily be higher or lower at some properties.

The estimates were derived from data available through multiple sources. Information was gathered with the collaboration of various water utilities, companies offering retrofit services or devices, supporters and proponents of selected retrofit strategies, and research organizations. Studies of multi-family properties and single-family homes were examined.

None of the estimates has universal applicability, but are included to serve as a guide in the preliminary evaluation of the merits of retrofit strategies in multi-family properties.

Other important points to note:

- The table includes water savings in gallons per year. For indoor and outdoor water uses involving devices, the savings are per device (toilet, faucet, showerhead, clothes washer). For outdoor water uses involving irrigation the savings are per thousand square feet of area irrigated 30 inches per year.
- Estimated implementation costs include device and labor costs. Labor costs were estimated assuming plumbers at $60/hour and technicians/laborers at $36/hour.
- The "ease of implementation" is a subjective factor indicating relative difficulty. The strategies easiest to implement were given an "ease" factor of 1.0; the lower the factor the more difficult to implement.
- The "longevity" of a measure is a rough approximation of the useful life of a retrofit. Twenty years was used as the base for the longer lasting strategies.

Full details on how the water savings and costs figures were determined are available in Retrofit Water Conservation Strategies for Multi-Family Housing, available at www.pathnet.org/publications/water.pdf

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Table 3. Estimated Water Savings and Costs

Indoor Water Use Retrofit Strategy	Water Savings per Retrofit (Gallons per Year)	Estimated Implementation Costs per Retrofit	Ease of Implementation	Longevity (Years)
ULFT installation; high volume/multiple installation discount	3,650 – 7,300	$110-$195	0.7	20
Installation of high efficiency clothes washers; high volume/multiple installation discount	3,650 – 5,475	$200 +	0.7	12
Implementation of submetering system	2,410 – 4,820	$225 – $500*	0.5	10
≠ Leak detection and repair—toilets	1,095 – 2,555	$11 – $29	1	2
≠ Installation of low-flow showerheads	1,095 – 2,190	$17	1	10
≠ Installation of low-flow faucet aerators	183 – 1,643	$2	1	10
≠ Installation of quick-closing flappers in toilets	730 – 1,460	$14 – $22	1	5
≠ Installation of toilet displacement devices	365 – 1,095	$2	1	5
≠ Installation of toilet water level adjustment	365 – 1,095	$20 – $32	1	5
≠ Leak detection and repairfaucets	219 – 438	$7	1	2
≠ Leak detection and repair—showerheads	219 – 438	$14 – $29	1	4
Elimination of narrow strips of turf	73,500	$600	0.8	20
Reduction of lawn area	18,720	$288	0.8	20
Installation of soil moisture or rain sensors	3,245	$105	1	10
Replacement of sprinklers with drip systems	24,340	$1,000 – $1500*	0.7	10
Use of low-water consumption and native plants	13,990	$3,000 – $6,000	0.7	20
≠ Installation of special faucets/hose bibs	6,388	$28	1	10

* Additional maintenance costs involved, estimated as follows:

- Submetering: $24–$36 per unit per year
- Drip Systems: $720 per year per thousand square-foot area

≠ Quick pay-back strategies

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APPENDICES

APPENDIX A. HOW MUCH WATER IS USED INDOORS?

How Much Water is Used Indoors?

Indoor water use in multi-family properties depends on a number of sociological, demographic, and technological factors. No single estimate of water use can have universal applicability. To gain insight into how water use is distributed, assumptions used in this guidebook were based on available data as noted below.

General Assumptions

A typical one-bedroom apartment was assumed, with a single toilet, one showerhead, and two faucets, one in the kitchen and one in the bathroom. The apartment was assumed to include a clothes washer and a dishwasher; the distribution of water use would differ in the many housing units that do not include these appliances.

Water Usage Assumptions

Assumptions were derived from a number of studies listed in *Retrofit Water Conservation Strategies for Multi-Family Housing* (HUD 2002). Studies of multi-family settings in Tampa, Florida; Oakland, California; and Seattle, Washington provided the most relevant information. A comprehensive study of single-family housing, the *Residential End Uses of Water*, was also used as a source of data.

Average Occupancy	Two Adults per Apartment Unit
Number of toilets	*One*
Number of showerheads	*One*
Number of faucets	*Two*
Clothes washer	*Yes*
Dishwasher	*Yes*

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Fixture/ Appliance	Non-Conserving Usage	Conserving Usage
Toilet (gallons per flush)	3.5	1.6
Showerhead (gallons per minute)	2.5	1.5
Faucet (gallons per minute)	2.0	1.5
Clothes washer (gallons per load or wash cycle)	40.0	25.0
Dishwasher (gallons per day per cycle)	10.0	5.0
Leaks (gallons per person per day	3.4	0.0

The volume of water used by clothes washers was approximated from two studies. A 2000 study conducted for Southern California Edison showed non-conserving usage of 37.9 gallons per cycle. The same study showed significant differences in water usage among three brands of high efficiency clothes washers: Maytag used 15.4, Speed Queen used 17.0, and Whirlpool used 27.4 gallons per cycle. A 1999 study in Toronto, Canada, showed a 15 gallon per cycle difference between non-conserving and high efficiency washers, and this water savings was assumed in estimating the distribution of water usage in multi-family housing.

Frequency of Use Assumptions

The same sources were used for frequency of use assumptions. The following frequencies were used:

- **Toilet usage:** Four flushes per person per day in non-conserving units, five in ultra-low flush units, based on 1993 Tampa study.
- **Showerhead usage:** 0.75 showers per day per person were assumed based on single-family data from *Residential End Uses of Water*. Shower duration was assumed at six minutes, from Tampa study (*Residential End Uses of Water* found a longer duration of 6.8 minutes).
- **Faucet usage:** 14 minutes per apartment per day, or 7 minutes per faucet for a two-faucet apartment, based on 1993 Seattle study. This is close to the 8.1 minutes per person per day recorded in *Residential End Uses of Water* for single family houses.
- **Clothes washer usage:** The average clothes washer use in multi-family units has not been determined conclusively. Residential End Uses of Water found 0.37 cycles per person per day in single-family homes; multi-family units, with generally less people and children per unit can be expected to use less. The Toronto study found 0.10 cycles per person per day in properties with laundry rooms. A comparison of in-unit and common area washers (A National Study of Laundry Water Use in Multi-Housing, National Research Center, 2001) found that in-unit washers used 3.9 times more water than common area washers (implying 0.39 cycles per person per day if combined with the Toronto data). A conservative estimate of 0.3 cycles per person per day was used.
- **Dishwasher usage:** *Residential End Uses of Water* found an average usage in single-family homes of 0.1 cycles per person per day. This same value was assumed applicable to multi-family housing units.

APPENDIX B. WATER CONSERVATION INCENTIVES

Below are 27 localities that currently (or recently) offer water conservation incentives. Incentives change over time, so check with your local water utility for the most recent listing.

Albuquerque, New Mexico
Atlanta, Georgia
Austin, Texas
Boston, Massachusetts
Cary, North Carolina
Columbus, Ohio
Corvallis, Oregon
El Paso, Texas
Eugene, Oregon
Greensboro, North Carolina
Houston, Texas
Los Angeles, California
Marin County, California
Miami-Dade County, Florida
New York City, New York
North Miami Beach, Florida
Oakland, California
Phoenix, Arizona
San Antonio, Texas
San Diego, California
San Jose, California
Santa Clara County Water District, California
Santa Monica, California
Santa Rosa, California
Seattle, Washington
Tampa Bay, Florida
Tempe, Arizona

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Albuquerque, New Mexico

- **Ultra-low Flush Toilet (ULFT) Rebate Program:** Multi-family residential units receive a $75 rebate per toilet.
- **Residential Audit Program:** City reviews water use patterns and billing, checks for leaks, and assesses outdoor landscaping and sprinkler systems. Also installs of 2.5 gpm showerheads, high-efficiency faucet aerators, auto-shut off hose nozzles, and a toilet fill tube diverter or displacement device if needed.
- **High-Efficiency Clothes Washer Rebate Program:** $100 for each washer replaced.
- **Landscape Rebate Program:** Water bill credit of $0.25 for every square foot of qualifying landscape, to a maximum rebate of $700. Low-and medium-water-use plants must cover fifty percent of the project area at maturity. An inspector must approve the application before commencement of work.
- **Rainwater Harvesting:** Booklet titled *Rainwater Harvesting, Supply From The Sky* gives system design and construction information.
- City prohibits landscape watering between 10 a.m. and 6 p.m. April through October.
- A modest summer rate surcharge is added to water rates.

Atlanta, Georgia (DeKalb County)

- **Watering Restrictions:** No watering between 10 a.m. and 10 p.m. seven days a week. Outside those hours, odd-numbered addresses may use water outdoors on odd-numbered days, even-numbered addresses on even-numbered days.
- **Xeriscape Program:** Landscape consultants visit residential sites and make water conservation recommendations; xeriscape brochures are made available to customers.
- **Low-flow Showerhead Program:** A free low-flow showerhead program is scheduled to be in effect by 2004.

Austin, Texas

- Free ULFT's and $30 installation credit, or rebates from $60 to $100.
- Free low-flow showerheads to replace older models.
- Information on submetering.
- **Clothes Washers:** Up to $250 rebate for replacing standard washers with high efficiency washers; this rebate applies to washers that are installed in common area laundry rooms.
- **Wash-Wise Program:** Up to $100 rebates to apartment and multi-family housing that are water customers; rebate is for in-unit water and energy efficient front-loading commercial clothes washers.
- **Rainwater Harvesting Program:** Rebate up to $500 on the cost of installing a rainwater harvesting system.
- Information on gray water systems.
- **Whole System Audit:** Free evaluation on all aspects of water consumption.
- **Irrigation System Rebates:** up to $150 for certain controllers, rain shutoff devices, pressure reducer value, and certain types of sprinkler heads.
- **Conservation Rate Structure:** Base unit water rate is based on peak and off-peak times of year.
- Revised Plumbing Code will require all new apartments to be plumbed for submetering.

- In 2003, a Texas state law will take effect requiring all water utilities to directly meter or submeter on all new properties.

Boston, Massachusetts

- Water conservation kits offered free to customers and include a low-flow showerhead, two faucet aerators, one toilet tank dam, and leak detection dye tablets.
- **Outdoor Water Use Efficiency:** The Massachusetts Water Resources Authority offers informational materials to customers.

Cary, North Carolina

- **Reclaimed Water System:** Provides non-potable reclaimed water for irrigation systems within the local retail service area.
- **Conservation Rate Structure:** Charges a higher unit rate to residential customers as level of consumption increases.
- **Watering Restrictions:** Odd/even day watering.
- **Water Waste Ordinance:** Prohibits wasteful outdoor watering that falls directly onto impervious surfaces.
- **Rain Sensor Ordinance:** Requires all irrigation systems to install a rain sensor.

Columbus, Ohio

- **Indoor Water Conservation Kit:** Offered free to customers, kits include two faucet aerators, one toilet tank displacement bag, leak detection tablets, and installation instructions.
- **Outdoor Water Conservation Kit:** Offered free to customers, kits include water savings tips and water gages (water grass no more than 1 inch per week).
- **High Bill Inspection (HBI) Program:** Indoor and outdoor water audits offered to customers concerned about high bills.
- **Submetering:** Information about submetering systems is made available to customers on request; implementation is up to the customer.

Corvallis, Oregon

- Perform water audits and give out water savings fixtures (showerheads, faucet aerators, toilet flappers, and toilet displacement devices).
- **Clothes Washer Rebate Program:** Offers $50 for the purchase and installation of a high efficiency clothes washer.
- **ULFT Rebate Program:** $25 rebate.

El Paso, Texas

- **Clothes Washer Rebate:** $200 for a horizontal-axis washing machine.
- **ULFT Rebate:** 75 percent rebate up to $100.
- **Turf Rebate Program:** Incentive to convert only turf areas that are already established to water efficient landscape designs and incorporate low water use plants and common sense horticulture practices that save water.

Eugene, Oregon

- Free low-flow showerheads and toilet flappers to customers.
- **ULFT Rebate Program:** $25 for the first toilet and $10 for each additional toilet
- Rebate for the purchase of a high efficiency clothes washer.

Greensboro, North Carolina

- Provide free low-flow showerheads and toilet flappers to complexes built prior to 1994.

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Houston, Texas

- Water Conservation Kits that include toilet displacement bag, toilet tank, leak detection dye tablets, flow restrictor.

Los Angeles, California

- **ULFT Program:** The Metropolitan Water District (MWD) offers a rebate of $60 for replacing non-conserving toilets with ULFT's; the Los Angeles Department of Water and Power (LADWP) offers free ULFTs in exchange for non-ULFTs or $75 rebates for ULFTs.
- **Residential Clothes Washer Program:** MWD, in partnership with energy utilities, offers rebates from $85-$150 for installing a high efficiency clothes washer; the LADWP offers $150 in rebates for in-unit high efficiency washers and $250 for common area coin/card operated high efficiency washers.
- LADWP offers free 2.0 gpm showerheads and 1.0 gpm faucet aerators.
- **Conservation Rate Structure:** The base unit price for water is higher in the warm (summer) months and lower in the cooler (winter) months.

Marin County, California

- **ULFT Rebate Program:** $75 rebate.
- **Energy Star Clothes Washer Rebate Program:** $75 rebate to customers.
- **Customer Assistance Program:** Consultation of indoor water use; replaces high-water use fixtures (showerheads, aerators) free of cost.
- **Irrigation System Consultation Check:** During the summer months the top 20 percent of water users qualify for a consultation check. This entails looking for leaks and/or breaks in the system.
- A Time of Scale Practice is in the works, which will require installation of 1.6 gpf toilets before selling property.

Miami-Dade County, Florida

- Water conservation kits.

New York City, New York

- Free low-flow showerheads and toilet flappers in home water savings kits.

North Miami Beach, Florida

- **Showerhead Exchange Program:** Provides 2.5 gpm showerheads, 1.5 gpm faucet aerators, and toilet leak detection tablets.

Oakland, California; East Bay Municipal Utility District (EBMUD)

- Free on-site surveys of indoor and outdoor water use.
- Free showerheads and faucet aerators offered if existing fixtures are not low-flow models; toilet inserts also offered.
- **Landscape Program:** Must have separate outside meter to qualify for rebate. A representative will perform an audit on ways to enhance savings outdoors. If any of these suggestions are completed the utility will provide a rebate of 50–100 percent of the cost, includes rain sensors, drip systems etc.
- **Clothes Washer Rebates:** $150 for purchasing a residential high-efficiency Energy Star® rated clothes washers for in-unit facilities.
- **Commercial Clothes Washer Rebate:** $50 for purchasing a high-efficiency machine that meets Consortium for Energy Efficiency (CEE) standards for common laundry facilities.

- **Toilet Replacement Program:** ULFT rebates up to $50 per toilet replaced.
- **Direct ULFT Installation Program:** Free installation of ULFT's to replace higher-flush toilets.
- National Submetering Study, 2001–2002; managed by Richard Bennett of EBMUD and sponsored by several water utilities.

Phoenix, Arizona

- Perform on-site water audits and provide, when appropriate, free replacement showerheads.
- Recommend other measures and project savings from those measures.

San Antonio, Texas

- **ULFT Rebate Program:** $75 per toilet replaced.
- **Clothes Washer Rebate Program:** San Antonio Water System offers $100 and the CPS also offers $100 credit rebate for a possible total rebate amount of $200.
- **Xeriscape Program:** $0.10 per square foot for planning and installing a water saver landscape with a minimum conversion of 1,000 square feet ($100) and a maximum rebate of $500. If over 50 percent of the landscape is planted in turf only half credit will be given.

San Diego, California

- **ULFT Program:** Rebates for replacing a non-conserving toilet with a ULFT range from $60-$100 in the San Diego area: the Padre Dam Municipal Water District offers a rebate of $75; MWD offers a $60 rebate that may be complemented by local water utilities; the Helix Water District and the San Diego County Water Authority offer $75 and will pick up old toilets free of charge.
- **Horizontal-Axis Washing Machine Vouchers:** Vouchers up to $300 off the cost of new high-efficiency washing machines. The Padre Dam Municipal Water District and San Diego County Water Authority offer $125; MWD, in partnership with energy utilities, offers rebates of $85-$150; the Helix Water District offers up to $300 off the price of a coin-operated washer.
- **Residential Water Use Survey Program:** The Helix Water District offers the services of an expert surveyor who reviews indoor and outdoor water use for the entire complex and offers water-saving suggestions; low-flow showerheads and faucet aerators are provided free of charge. The Padre Dam Municipal Water District offers a similar service to multi-family accounts with above average annual water use.
- **Landscape Assistance Program:** Multi-family properties with at least one acre of landscaping qualify for an evaluation of water use. A surveyor will conduct an audit either by telephone or in person to determine water conservation opportunities. The same program is offered through the Helix Water District, the Padre Dam Municipal Water District, and the San Diego County Water Authority.
- **Public Information Program:** A speaker will come out to a meeting with the residents and cover water conservation topics tailored to their interests.

San Jose, California

- Water audits offered through San Jose Water.
- $40 cash back per ULFT installed with free delivery.

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Santa Clara County Water District, California

- **ULFT Rebate Program:** Customer pays $15 per toilet, includes installation.
- **Survey/Audit Program:** Includes irrigation inspection for sites with less than one acre of landscaping; includes installation of showerheads, faucet aerators, toilet flappers, and/or toilet displacement devices.
- **Irrigation Technical Assistance Program (ITAP):** A large landscape audit program free for sites with more than one acre of landscaping.
- **Clothes Washer Rebate Program:** Amount depends on what city the complex is in.
- Free showerheads and faucet aerators can be ordered over the phone or on the internet.

Santa Monica, California

- **Direct-Install Program for Toilets:** Direct installation of ULFTs for $35 per toilet.
- **Tank Type ULFT Rebate Program:** Choose a tank type ultra low flow toilet (1.6 gallons per flush) to install from the city's list of approved water-saving fixtures for a $75 rebate.
- **Flushometer Valve Type ULFT Rebate Program:** Rebate of $150 for retrofitting flushometer valve (no tank) type toilets. The bowl must be replaced with a 1.6 gallons per flush bowl and the valve retrofitted with a 1.6 gallons per flush retrofit kit.
- Helpful water savings tips.
- Landscape ordinance regulating amount of turf, plant species, and irrigation systems.

Santa Rosa, California

- Offers free informational publications on landscape conservation.
- **Direct-Install Program:** Will pay the cost of materials and labor when participating plumbing contractors change toilet(s), showerheads and faucet aerators to low-flow models.
- **"Go Low-Flow" Plumbing Incentive Program:** Replace a minimum of one high flush-volume toilet with a low-flow model (1.6 gallons per flush), as well as change any showerheads and faucet aerators that do not meet the current flow-rate standards. Old toilet(s) need to be recycled at Waste Management and receive a rebate.
- **Horizontal-Axis (H-axis) Coin-Operated Clothes Washing Machine Rebate Program:** Rebate of $450 per top-loading coin-operated washing machine that is replaced with water conserving H-axis models.
- **Efficient Landscape Water Management Rebate Program:** Customers irrigating with city water through a dedicated irrigation meter can apply each year. Eligible customers can earn $500 for each acre-foot (325,851 gallons) of water savings below their Efficient Irrigation Goal each year.

Seattle, Washington

- $40 to $100 for replacing water-wasting toilet with a ULFT, depending on income and area.
- Free showerheads and toilet flappers to customers.
- **Laundry Wise Program:** Rebates between $50 and $150 per machine depending on property location.

- $250 rebate per coin-operated laundry machine.
- Information on submetering
- **Water Efficient Irrigation:** Funding for up to 50 percent of new equipment such as rain sensors and irrigation controllers
- **Home Water Saver Apartment/Condominium Program:** Program aimed at the multi-family residential sector, offering installation of low-flow showerheads and faucet aerators; aerators and low-flow showerheads remain available to apartment buildings free of charge upon request

Tampa Bay, Florida

- **Toilet Rebate Program:** Rebates to customers who replace high flush toilets with ULFT's; up to $100 for first toilet, $80 for second, and $60 for third; rebates are per apartment unit
- **Free Low-flow Fixtures:** Include a showerhead (2.5 gpm) and faucet aerators
- Free rain sensors
- **Irrigation Evaluation and Rebate Program:** Surveyor evaluates irrigation system and suggests ways to improve water efficiency; if suggested retrofits are completed, up to $3,500 rebated
- According to Florida state law, all new irrigation systems must include a rain sensor

Tempe, Arizona

- Water conservation kits that include a low-flow showerhead, 2 faucet aerators, a toilet dam, a toilet tummy, toilet tank bank, leak detection tablets, Teflon tape to install showerhead, and a water displacement bag
- Rebates for ultra-low flush toilets
- Rebates for low water use landscaping

WATER CONSERVATION

APPENDIX C. SUBMETERING REGULATIONS

The information in the following table was derived from the working draft of a paper titled *Current Legal Status of Water and Sewer Submetering, Allocation and Billing For Apartment Properties In The United States,* being developed by the National Submetering and Utility Allocation Association (NSUAA).

Submetering Regulations, Page 1 of 3

State	Is Submetering Legal?	Applicable State Regulations/Regulatory Agency	Is it Legal to Add Fees to Resident's Water Bill?	Are There Rules that Govern Submetering at the Local Level?
Alabama	Yes	Public Service Commission does not have authority to regulate submetering	No known prohibitions on fees	-
Alaska	Yes	-	-	-
Arizona	Yes	Arizona Residential Landlord Tenant Act	Recovery of administrative costs allowed	-
Arkansas	Yes	Public Service Commission	No	Permission from the City required in Little Rock
California	Yes	The California Public Utilities Commission has not typically regulated owners who provide water to residents	Yes	Check local regulations. The cities of Petaluma, San Bruno, Santa Clara, and Vacaville specifically prohibit resale of water.
Colorado	Yes	Property owners may be subject to regulation by the Public Utilities Commission	Fees not allowed for gas and electricity, not specifically prohibited for water.	-
Connecticut	Yes	Private water companies are regulated by the Department of Public Utility Control	Through permission from Department of Public Utility Control	-
Delaware	Yes	Delaware Residential Landlord-Tenant Code	Pass-through rule must be complied with	Encouraged in Newark
Florida	Yes in jurisdictions controlled by Public Service Commission	Public Service Commission has jurisdiction over about half the counties in the state	State does not prohibit fees, some local authorities do	Check local regulations. The cities of Margate, New Smyrna Beach, Pinellas County, and West Palm Beach specifically prohibit submetering.
Georgia	Yes	Code of Georgia	Yes if stated in lease	Augusta/Richmond County prohibits resale of water
Hawaii	Yes	-	-	-
Idaho	Not specifically prohibited	Public Utilities Commission does not regulate submetering	-	-
Illinois	Yes	Illinois Tenant Utility Payment Disclosure Act	No	Napierville, Springfield, and areas served by the Northern Illinois Service Company prohibit submetering
Indiana	Yes	Indiana Utility Regulatory Commission	Yes	-
Iowa	Indirectly allowed	Iowa Landlord/Tenant Law	-	-
Kansas	No specific laws address submetering but legality of submetering is implied	Landlord Tenant Act	Yes if stated in lease	Specifically prohibited in Olathe
Kentucky	Yes	Public Utilities Commission	Yes	-
Louisiana	Unclear	Unclear whether Public Service Commission permits submetering	-	Baton Rouge has indicated they will not permit submetering
Maine	Yes	Maine statutes appear to empower the Public Utilities Commission to regulate submetering	Yes	-

Submetering Regulations, Page 2 of 3

State	Is Submetering Legal?	Applicable State Regulations/Regulatory Agency	Is it Legal to Add Fees to Resident's Water Bill?	Are There Rules that Govern Submetering at the Local Level?
Maryland	Yes as long as landlord is not operating for profit	State of Maryland treats billing companies as collection agencies	Yes	-
Massachusetts	No; recently introduced bill may allow submetering	Department of Public Health has indicated that landlords are required to provide water to tenants at no charge	No	-
Michigan	Yes	None	-	City of Coldwater prohibits the resale of water
Minnesota	Yes	None	Yes	-
Mississippi	No	Public Service Commission	-	-
Missouri	Yes, as long as landlord is not operating for profit	Public Utility Commission	Yes	-
Montana	Yes	Public Service Commission	No	-
Nebraska	Yes	Public Utility Commission only regulates private water companies	-	-
Nevada	Yes	Public Utilities Commission	-	-
New Hampshire	Yes, as long as the owner is not supplying water to the general public	Public Utility Commission	Yes	-
New Jersey	Yes	Board of Public Utilities	Yes if stated in lease	-
New Mexico	Yes	Landlord Tenant Law/ Public Utility Commission	Yes	-
New York	Yes	None	Yes	Specifically prohibited in the Town of Webster, Village of Webster, and Suffolk County
North Carolina	Yes	Utilities Commission	Yes, with $2/month limit	Specifically prohibited in Fayetteville, High Point, and Washington.
North Dakota	Not specifically prohibited	-	-	-
Ohio	Yes	Public Utilities Commission	Yes if stated in lease	-
Oklahoma	Yes	State Water Law	Owners may pass 10% of cost per billing cycle to tenant	-
Oregon	Yes	Oregon Water Law	Yes	Specifically prohibited in Salem
Pennsylvania	Yes	Pennsylvania Water Law	Yes, as long as the pass-through rule is followed	-

Submetering Regulations, Page 3 of 3

State	Is Submetering Legal?	Applicable State Regulations/Regulatory Agency	Is it Legal to Add Fees to Resident's Water Bill?	Are There Rules that Govern Submetering at the Local Level?
Rhode Island	Yes	Rhode Island Water Law	Yes	-
South Carolina	Not specifically prohibited	Public Service Commission	-	-
South Dakota	Not specifically prohibited	-	Not specifically prohibited	-
Tennessee	Not specifically prohibited	Tennessee Regulatory Authority	Yes	Specifically prohibited in Jackson
Texas	Yes	Texas Natural Resources Conservation Commission	No	A city code in Waco may be interpreted to prohibit submetering
Utah	Yes	Division of Public Utilities	-	-
Vermont	Yes	Landlord-Tenant Law	Yes	-
Virginia	Yes	Virginia State Corporation Commission	Meter reading fees prohibited, billing fees limited to $2/month	Check locally
Washington	Yes	Washington Utilities and Transportation Commission	Yes	-
West Virginia	Allowed in certain situations	Public Service Commission	-	-
Wisconsin	Unknown	-	-	Specifically prohibited in Kaukauna
Washington D.C	Yes	DC Water and Sewer	-	-
Wyoming	Yes	Public Service Commission	-	-

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APPENDIX D. GRAY WATER REGULATIONS

Permits are required in most states for the implementation of gray water systems, usually from local or county authorities. Thirty-six states have explicit gray water regulations, as noted on the table that follows. The primary concern of regulators and health officials is that gray water may result in water quality problems that pose a threat to public health. Regulations invariably prohibit gray water systems from being connected to potable water systems; cross-connections are typically avoided with air-gaps (a physical opening to the atmosphere between the two systems that does not allow flow from one system to enter the other). Regulations typically preclude the use of water containing hazardous wastes or water that comes from the soiling of diapers or similar garments. Storage tanks for gray water usually require a cover. Some regulations also address maintenance requirements. Some of the location-specific limitations/constraints are listed in the table that follows, compiled from 1999 data in the *Humanure Handbook: A Guide to Composting* - Appendix 3–State Regulations-Gray Water (Jenkins, 1996).

Gray Water Regulations, Page 1 of 4

State	Applicable State/Code	Limitations/Constraints
Alabama	State Health Board, Chapter 420-3-1; 402-3-1.27	An effluent distribution line of 50 linear feet shall be used to dispose of gray water.
Alaska	Alaska Administration Code 72.990 defines gray water	None
Arizona	Arizona Department of Environmental Quality Bulletin Number 12; Arizona Administration Code Title 18, Chapter 9, Article 7.	Gray water may be used only for drip or flood irrigation, not for spray irrigation; system requires approval by Arizona Department of Environmental Quality.
Arkansas	Department of Health Alternative Systems Manual	Case-by-case
California	California Administration Code (Uniform Plumbing Code), Appendix G	Gray water may be used only for subsurface irrigation; administrative authority must approve system.
Colorado	Department of Public Health, Chapter 25, Article 10	Gray water systems shall meet at least all minimum design and construction standards for septic tank systems based on the amount and character of wastes for the fixtures and the number of persons served.
Connecticut	Public Health Code Section 19-13-B103b and f; Technical Standards.	Shall be constructed with a septic tank and leaching system at least one-half the capacity specified for the required residential sewage disposal system.
Delaware	No existing regulations	None
Florida	Title XXIX, of the Florida Administrative Code, Public Health Chapter 381.0065	The minimum effective capacity of the gray water retention tank shall be 250 gallons, with such system receiving not more than 75 gallons of flow per day.
Georgia	Rules of the Department of Human Resources, Public Health, Chapter 290-5-26	The minimum effective capacity of the gray water retention tank shall be 500 gallons.
Hawaii	Hawaii Administrative Rules, Chapter 11-62	Design of gray water systems for dwelling units shall be based on a minimum gray water flow of 150 gallons per day per bedroom; gray water tanks, when required, shall be sized with no less than a 600 gallon capacity.
Idaho	IDAPA 16, Title 01, Chapter 03; Technical Guidance Manual Section 10	Current Idaho rules permit gray water systems only as experimental systems

WATER CONSERVATION

Gray Water Regulations, Page 2 of 4

State	Applicable State/Code	Limitations/Constraints
Illinois	No existing regulations	Governed under experimental systems.
Indiana	No existing regulations	None
Iowa	No existing regulations	None
Kansas	Kansas Administrative Regulations Chapter 25, Article 5	County health departments have authority to grant variances for alternative onsite wastewater treatment and disposal systems.
Kentucky	902 Administration Regulations 10:085, Section 2(13)	Gray water: in Section 2(13) means wastewater generated by water-using fixtures and appliances, excluding the toilet and the garbage disposal.
Louisiana	No existing regulations	None
Maine	Maine Subsurface Waste Water Disposal Rules 144A CMR 241	Gray water includes only separated laundry disposal systems.
Maryland	Innovative & Alternative Program	Innovative gray water designs are currently allowed on a case-by-case basis.
Massachusetts	310 CMR 15.000, Title 5	A filter system specifically approved by the Department can be used instead of a septic tank. Non-traditional gray water systems, such as those which use constructed wetlands or evapotranspiration beds, are approved on a piloting, site-specific basis.
Michigan	Michigan has one of the oldest existing guidelines for composting toilets and gray water systems. However, as there is no statewide sanitary code, the 46 local health departments define the criteria for onsite sewage disposal and "each county runs its own show."	Alternative systems and gray water systems should be tested by the National Sanitation Foundation (NSF) under Standard 41 testing protocol or by an equivalent independent testing agency and procedure. Lacking this testing procedure, the local health department should require performance data prior to approval.
Minnesota	Chapter 7080.9010, Alternative and Experimental Systems	Use of alternative systems is allowed only in areas where a standard system cannot be installed or is not the most suitable treatment.
Mississippi	No existing regulations	None
Missouri	Missouri Laws for On-Site Disposal Systems, Chapter 701, Section 701.025	There are no design recommendations or regulations governing gray water systems.

Gray Water Regulations, Page 3 of 4

State	Applicable State/Code	Limitations/Constraints
Montana	Circular WQB 5. Minimum Design Standards for On-Site Alternative Sewage Treatment and Disposal Systems	Gray water must be disposed of through a septic tank and drainfield system.
Nebraska	Title 124, Rules and Regulations for Design, Operation and Maintenance of Onsite Wastewater Treatment Systems.	Gray water is defined, but no systems are necessarily allowed under Title 124.
Nevada	Nevada Administrative Code 444.750	A system that uses gray water for underground irrigation may be used only for a single-family dwelling (this 1998 statute may have been modified, as some of Las Vegas largest hotels use gray water for irrigation).
New Hampshire	Chapter Env-WS 1022 deals with alternative systems	Before an innovative/alternative waste treatment system may be used the technology shall be evaluated and approved in an Innovative Technology Approval
New Jersey	New Jersey Administrative Code 7:9A	Administrative authority must approve systems.
New Mexico	20 New Mexico Administrative Code 7.3 Subpart 1, Part 107.AF	System must run through a septic tank and be used only for subsurface irrigation.
New York	Public Health Law 201(1)(1) Appendix 75-A	Gray water systems shall be designed upon a flow of 75 gpd/bedroom.
North Carolina	No existing regulations	None
North Dakota	Chapter 62-03-16-91.6	Gray water systems shall pass through a septic or other approved sedimentation tank prior to its discharge into soil or other system; surface application requires special approval.
Ohio	No existing regulations	Director of Health approval required; must be tested to show results of the system are equivalent to those obtained by sewage disposal.
Oklahoma	Oklahoma Administration Code 252:640 deals with alternative systems	Department of Environmental Quality approval required.
Oregon	Revised Statute 447.115; Oregon Administration Rules Chapter 340, Division 71	Environmental Quality Commission approval required.

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Gray Water Regulations, Page 4 of 4

State	Applicable State/Code	Limitations/Constraints
Pennsylvania	Title 25, Chapter 73	Liquid wastes, including kitchen and laundry wastes and water softener backwash, shall be discharged to a treatment tank.
Rhode Island	Gray water defined under Chapter 12-120-002	None
South Carolina	No existing regulations, gray water defined under Chapter 61-56	A permit applicant could elect to install separate systems to handle gray water.
South Dakota	Chapter 74:53:01:10	Design of gray water systems shall be based on a minimum gray water flow of 25 gallons per day per person. Three days retention time shall be provided for each gray water tank.
Tennessee	No existing regulations	None
Texas	Subchapter H: 285.80	Comprehensive state rules have not been adopted. Each system has to be approved by the city or county health department
Utah	No existing regulations, R317-502-3 deals with alternative systems	Department of Environmental Quality approval required.
Vermont	No existing regulations. Innovative systems are regulated under Chapter 1 of Environmental Protection Rules.	Alternative systems are allowed in Vermont only if a backup, in ground conventional (septic) system is installed.
Virginia	No existing regulations	None
Washington	Washington Administration Code 246-272 Section B	Gray water may be used for subsurface irrigation only.
West Virginia	Title 64, Interpretive Rules Board of Health, Series 47	Those houses served by a gray water disposal system must have a house sewer of not more than two inches in diameter. Houses served by gray water disposal systems shall not have garbage disposal units. Manufactured gray water disposal systems must be approved by the director.
Wisconsin	No existing regulations	None
Wyoming	No existing regulations	None

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