

Innovation Incubator Spring 2020

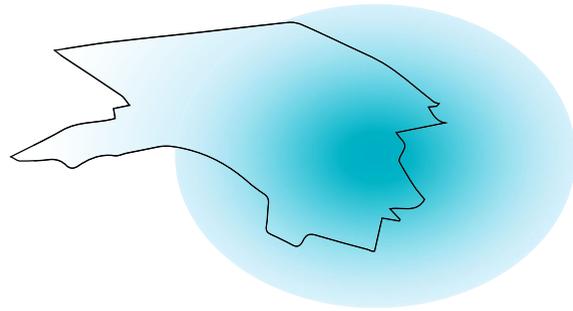
Greater Los Angeles Greywater Program



Perkins&Will



Getting to Greywater

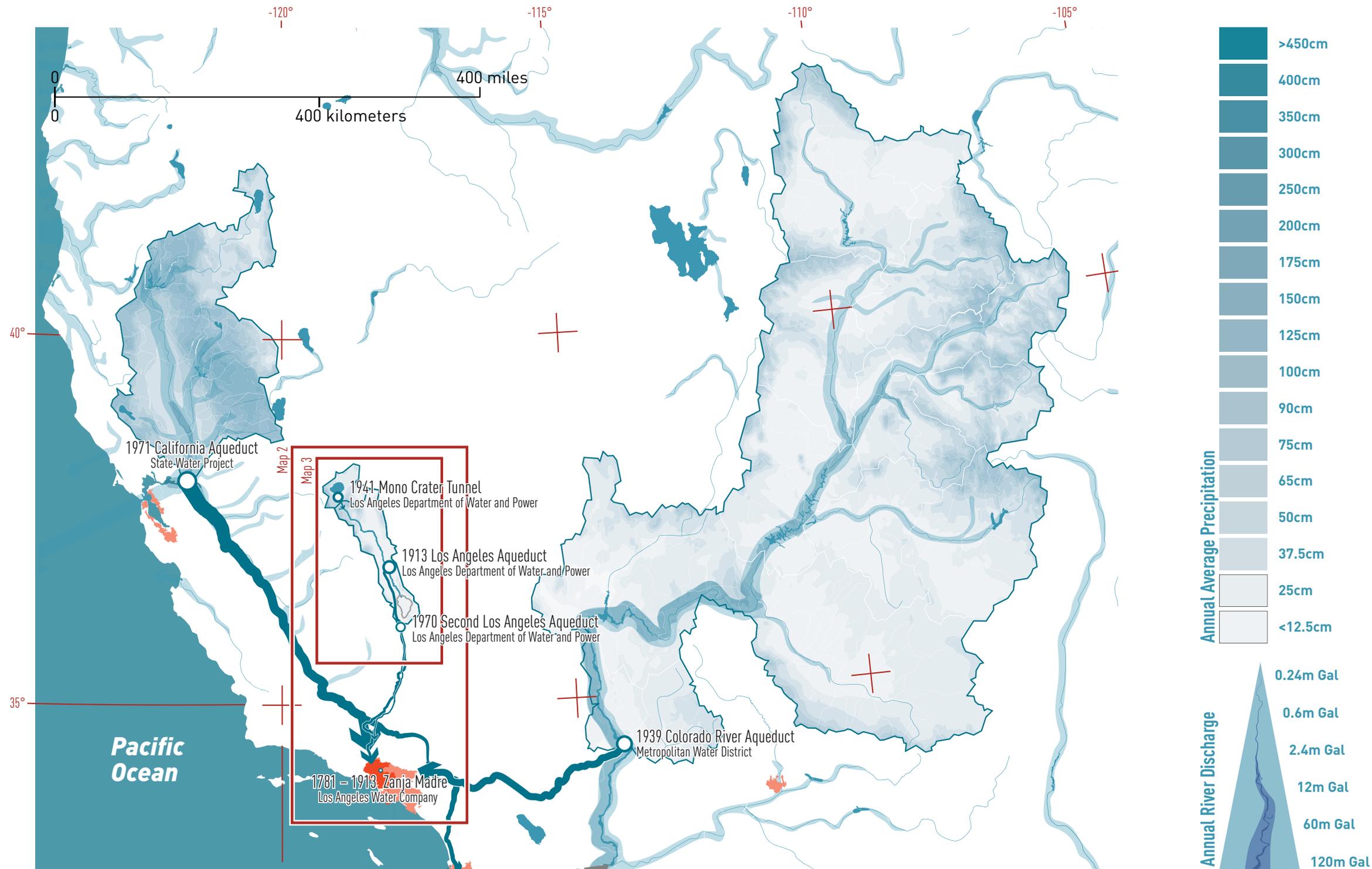


Greywater for use on single family residential yards in LA County is a great untapped local and sustainable water resource. If implemented more widely with the use of strategic incentives and marketing, residential greywater could yield a higher quality and quantity of shade and fruit trees for homeowners across a wide range of neighborhoods in the county. The program would reduce the share and quantity of potable water used for landscape irrigation and divert it from sewage treatment. As a piece of a greater roadmap towards a resilient water future for the region, these simple greywater systems that require no permit, implemented by individual homeowners could divert a volume of water comparable to the annual flow of the LA River. This consumer-led effort could start our county on a path to resilience today, with no red tape (well, maybe some plumbers tape).

How do we take an environmentally-minded goal and make it realistic within the confines of the current market economy? By pushing for the greater adoption of existing simple greywater reuse strategies by the homeowners of Los Angeles. To reduce unsustainable reliance on water from out of state, to increase resilience, to water trees that would provide shade that would lead to a more walkable and liveable city.

Greater Los Angeles Greywater will market to consumers who are also the co-owners of the public utility that will charge them more in the future if they don't cut back on water usage now. Trees could die. Water will become more expensive. Looking ahead, the city, its residents and the utility companies must prepare the groundwork for a resilient water future.

What is the Story of Greywater in LA?



Map 1: Aqueductsheds of Los Angeles, stretching to the headwaters of the Feather River and Colorado River.

Scale 1:6,000,000 Albers Equal Area Projection 96° W & 23°N, North American Datum 1927.

from "RechargeLA" Barry Lehrman, Cal Poly Pomona

What is the state of Greywater today?

In Los Angeles County, “greywater” is defined as.....

Untreated waste water which has not come into contact with toilet waste. Includes waste water from **bathtubs, showers, bathroom wash basins, clothes washing machine, laundry** tubs, or an equivalent discharge as defined by the Department of Public Health. ²

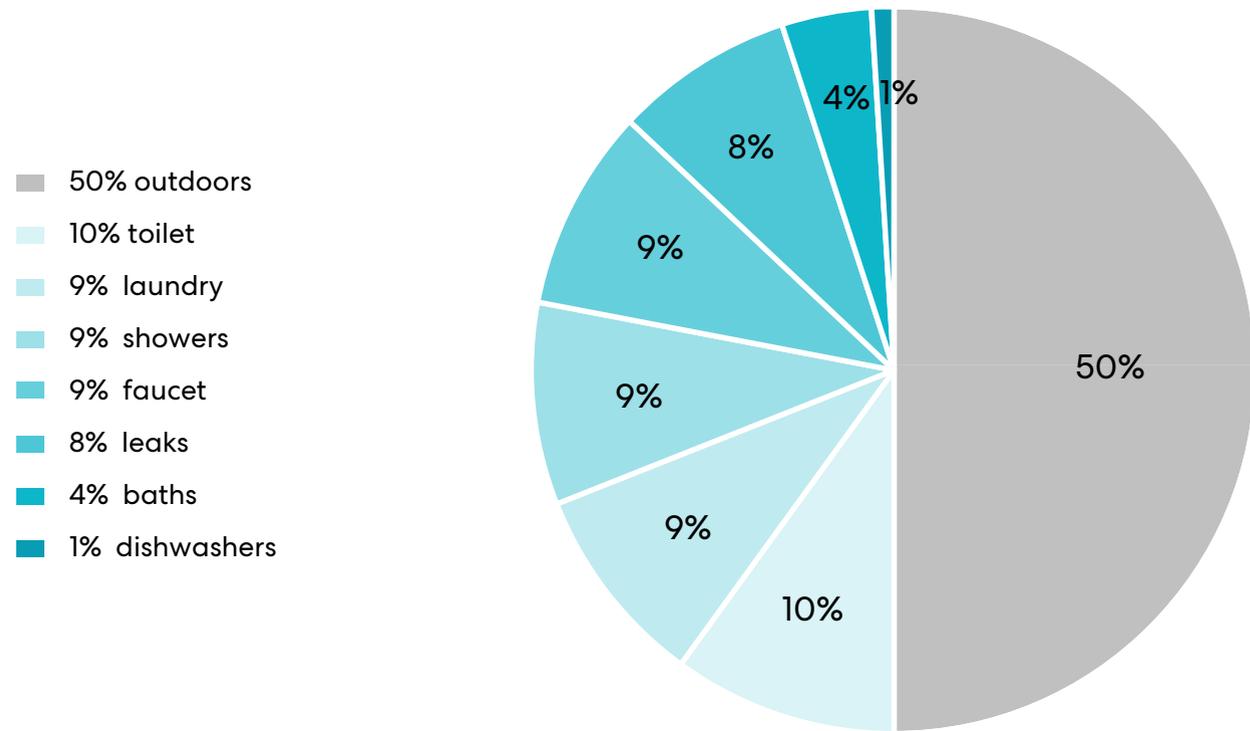
It **does not include wastewater from kitchen sinks**, photo lab sinks, **dishwashers**, or laundry water from soiled diapers

Rainwater harvested from roofs is an alternate water source that may be combined with greywater.

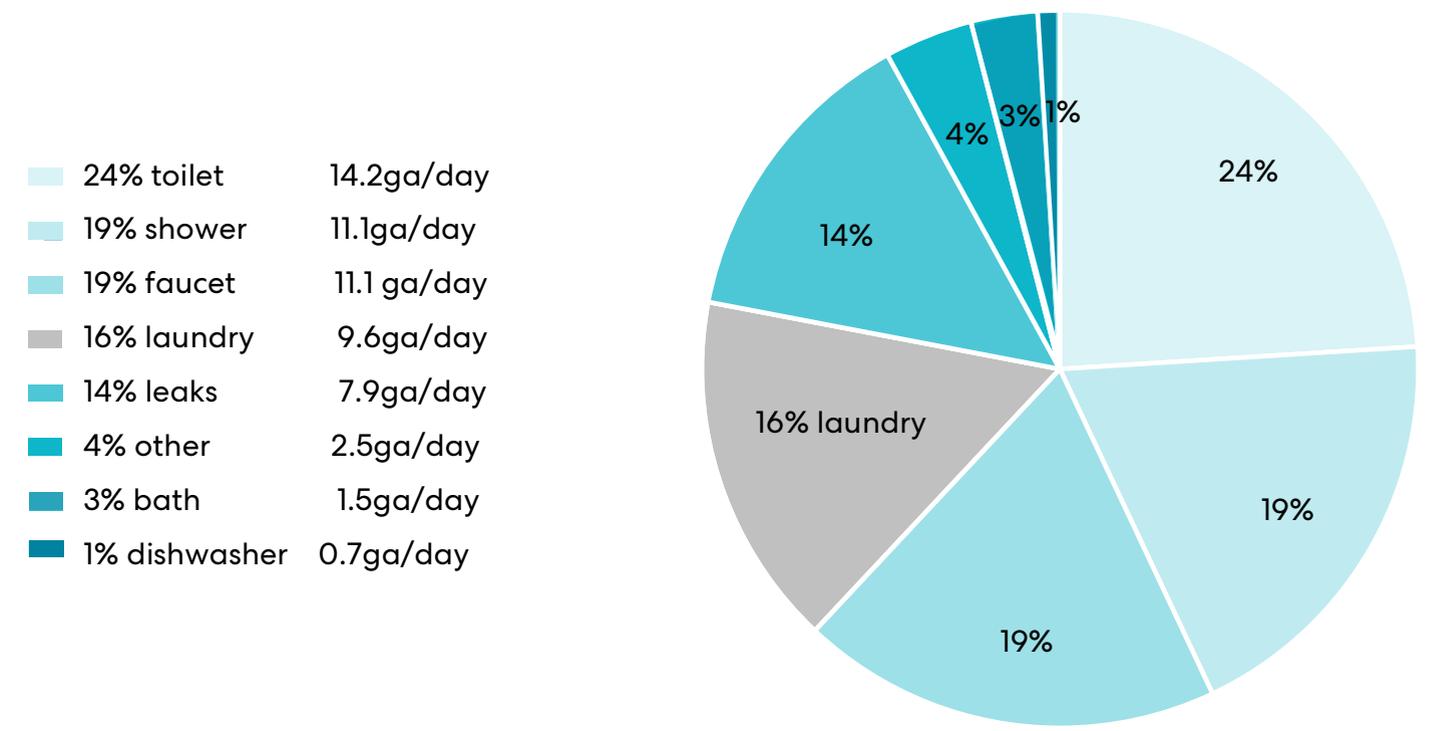
2. http://www.publichealth.lacounty.gov/eh/EP/lu/lu_graywater.htm

10,039,107 people live in LA County₃ in 3,328,398 households with an average household of 2.96 people.

California Household Water Use₁₈



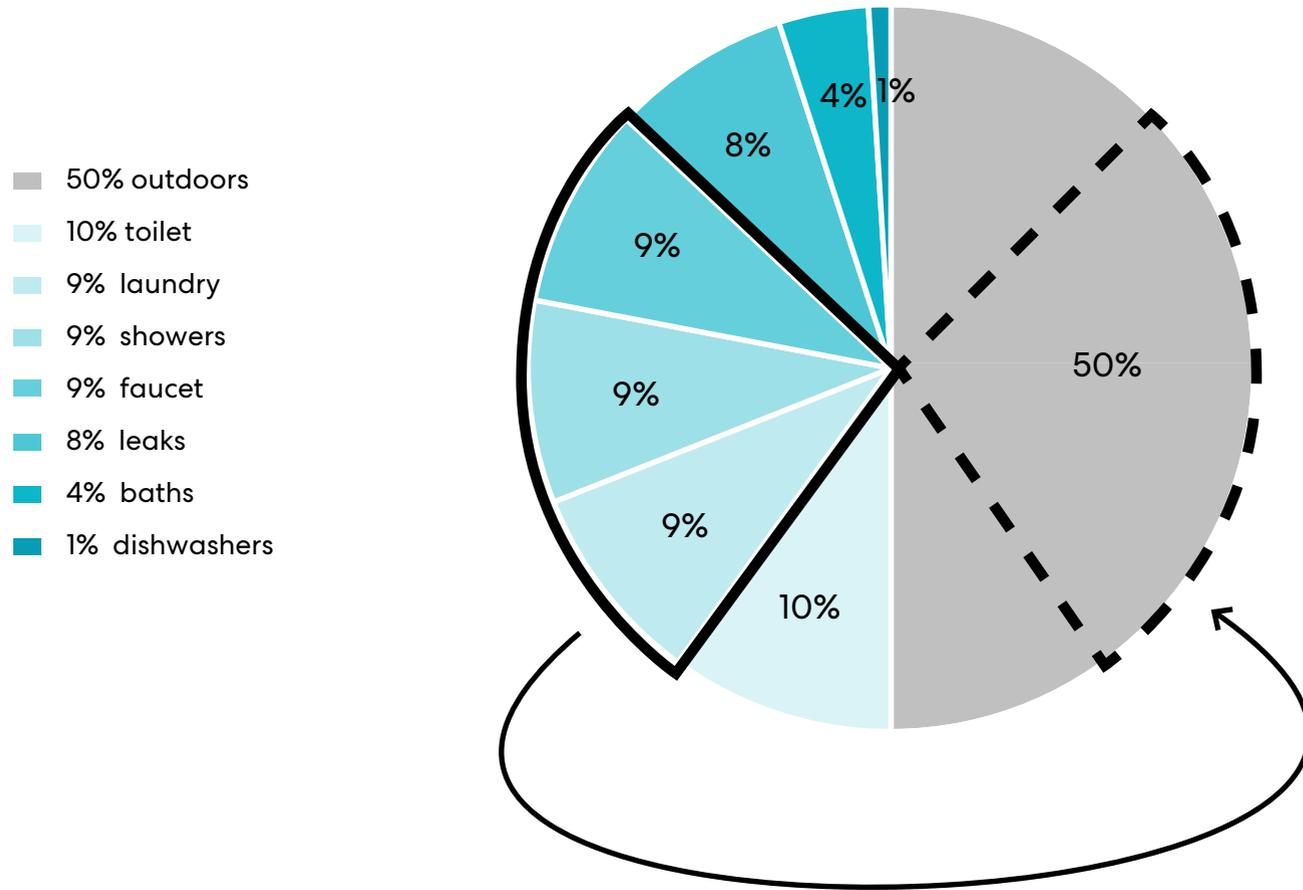
Residential Indoor Water Use₁₉



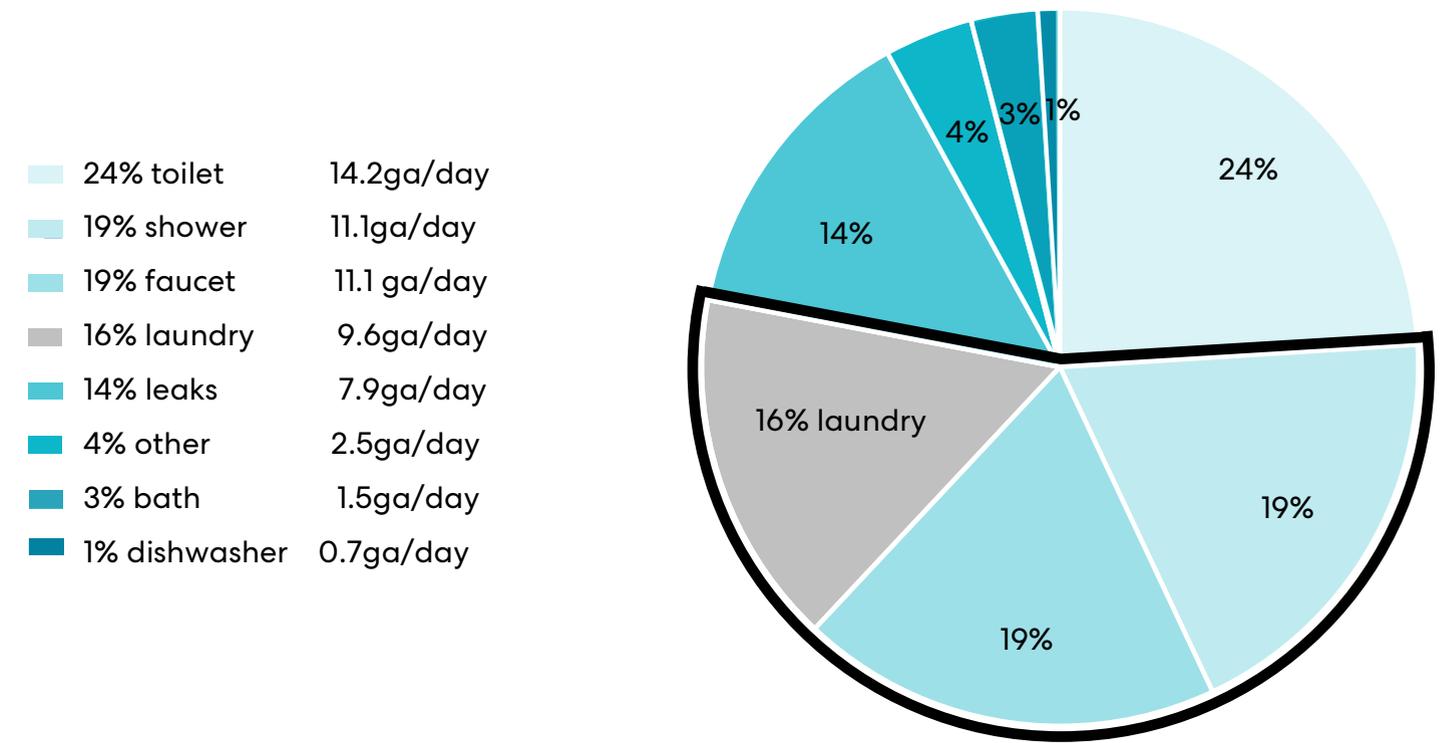
18 2015 Pacific Institute "Average California Household Water Use" https://pacinst.org/wp-content/uploads/2020/06/PI_Water_Use_Trends_June_2020.pdf

19 Residential End Uses of Water, Version 2 (REUS 2016) Executive Report https://www.circleofblue.org/wp-content/uploads/2016/04/WRF_REU2016.pdf

Greywater in CA Household Water



Greywater is up to 54% of Indoor Water



54%=181,416m Gal
is the total possible "greywater" for
recapture from LA county households



90,851m Gal
is the yearly total flow of rainwa-
ter collected by the LA River



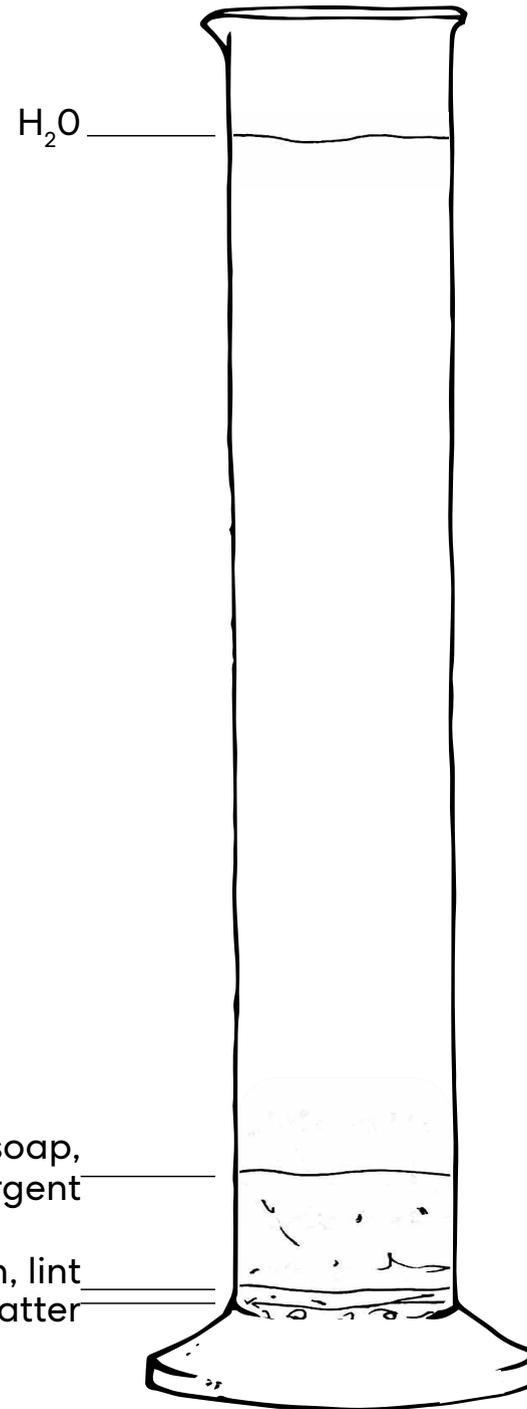
When controlling the composition of the direct-to-landscape greywater produced by laundry or showers, care must be taken to divert the flow if it contains salts, boron, bleach or other harsh chemicals. Soaps, shampoos, hydrogen peroxide, a variety of safe detergents listed below and vinegar may be used.

Oasis, Vaska, Puretergent, FIT Organic, ECOS, Bio Pac are all brands of laundry detergent that is safe for greywater use on landscape. Liquid detergents tend not to contain boron and salts whereas powdered ones often do.

To summarize: **Boron and salts are not acceptable ingredients to flush down the system. Bleach is to be avoided as well as water softeners and fabric softeners.**

A list of recommended products should be posted for users who are new to such a system.

When to filter or divert

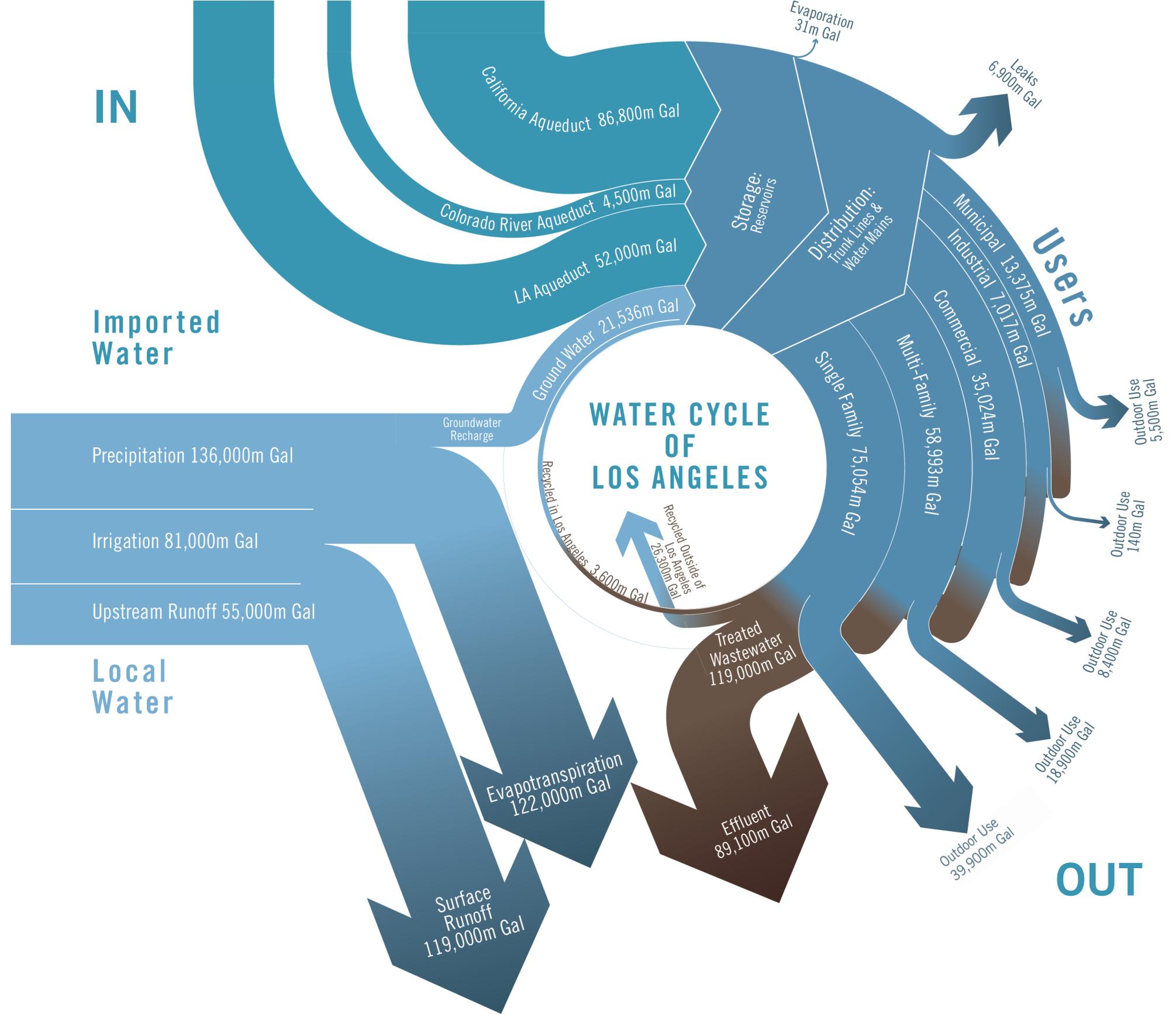


Greywater Composition

| Physicochemical characteristics of greywater | |
|--|-------------------|
| Parameter | USA |
| pH | 6.4 |
| Turbidity (NTU) | 31.1 |
| EC ($\mu\text{S}/\text{m}$) | 23 |
| TSS (mg/L) | 17 |
| TDS (mg/L) | 171 |
| BOD5 (mg/L) | 86 |
| COD (mg/L) | - |
| Cl (mg/L) | - |
| Oil and grease (mg/L) | - |
| Nitrate (mg/L) | - |
| T. Nitrate (mg/L) | 13.5 |
| T. Phosp (mg/L) | 4 |
| FC (CFU) | - |
| <i>E. coli</i> (CFU) | 5.4×10^5 |

Table 2 from Oteng-Pepurah, Michael et al. "Greywater Characteristics, Treatment Systems, Reuse Strategies and User Perception-a Review." *Water, air, and soil pollution* vol. 229,8 (2018): 255. doi:10.1007/s11270-018-3909-8

Water Usage



**What is the vision for the future of
Greywater in LA?**

Los Angeles mayor's "Green New Deal":

Sustainability pLAn 2019

- **Source 70% of L.A.'s water locally** and capture 150,000 acre ft/yr of stormwater by 2035
- **Recycle 100% of all wastewater for beneficial reuse by 2035**
- **Reduce potable water use per capita by 22.5% by 2025**; and 25% by 2035; maintain or reduce 2035 use through 2050
- Starting 2021: **Plant and maintain at least 90,000 trees citywide to maintain shade tree corridors.**
- Support the planting of 20,000 trees annually **on residential and public properties**
- Identify and leverage state and federal funding to plant, preserve, and maintain an additional 4,000 trees annually
- **Increase tree canopy in areas of greatest need by at least 50% by 2028 to grow a more equitable urban forest** that provides cooling, public health, habitat, energy savings, and other benefits.



Who are the stakeholders?



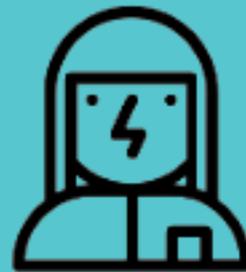
LA County



**DWP
(a public utility)
and other
utility providers**



**88 Mayors in
LA County**



**City Planning
Departments**



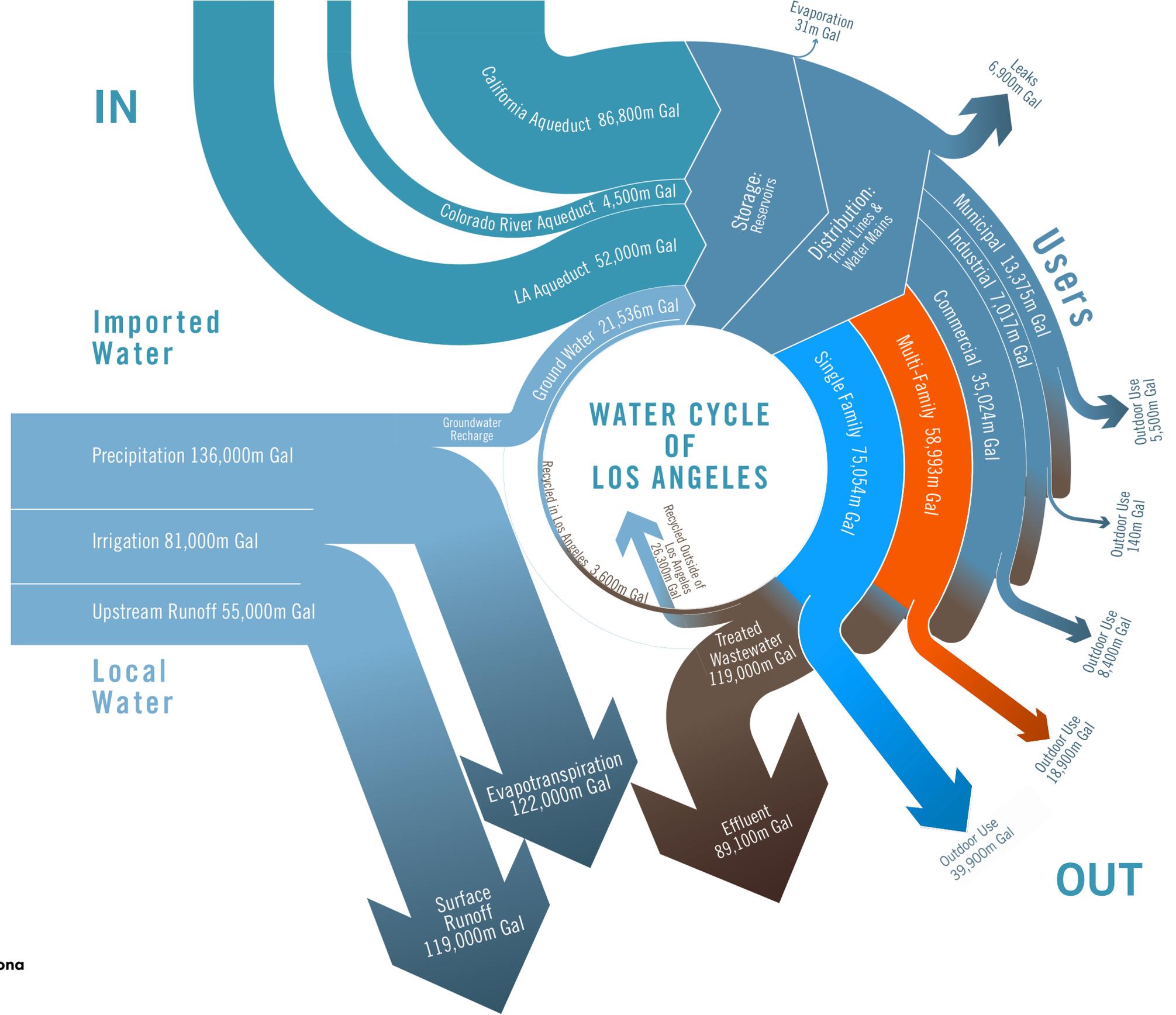
**Homeowners,
property owners,
landlords and
their professional
consultants**



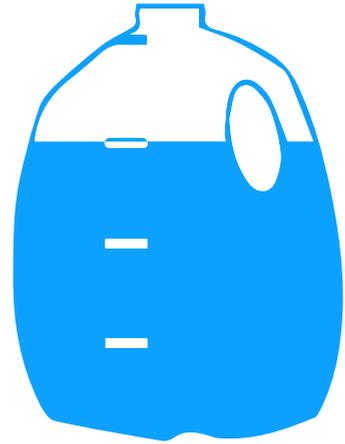
All county residents

What is the potential of different sectors to contribute to this change?

Water Usage



Gallons of water

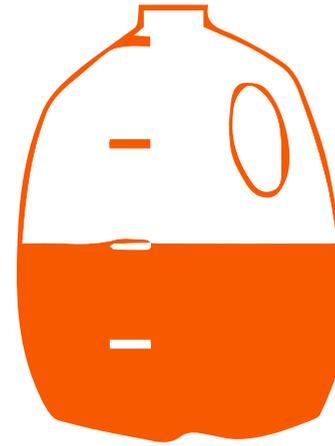


188,105m Gal

Single-Family Residential/Duplex/ADU

(total yearly flow of water through all single family residential)

- 39.6% of total water use in gallons
- incentives: rebates for certain equipment, Pasadena has whole system rebate. More rebates are needed. Current cost of simple system is \$200-400 without labor.
- non-financial and financial motivation
- with enough education and outreach, a certain percentage of homeowners would install a simple system at minimum cost.

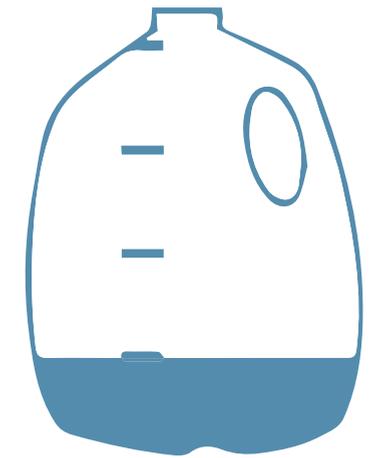


147,852m Gal

Multi-Family Residential

(total yearly flow of water through all multi-family residential)

- 31.1% of total water use in gallons.
- incentives: at Corazon de Valle, more landscaping was allowed because of the fact of greywater system implementation.
- financial motivation - appeal to tenants
- LEED BD+C points
- benefits would be weighed against cost by individual owners.



87,779m Gal

Non-residential, non-industrial

(total yearly flow of water through all commercial)

- 18.5% of total water use in gallons.
- financial motivation - appeal to tenants
- LEED BD+C points
- benefits would be weighed against cost to owner.
- each tenant would require some training in system operation.

Proposal:

A big impact on change of water use patterns can be made by identifying and motivating key segments of the population. Marketing this idea will require educating that segment.

Motivation

Investment in the future livability of LA, future tenant appeal, water and utility cost savings, desire to meet targets. They belong to various groups that comprise the stakeholders.

How to align them?



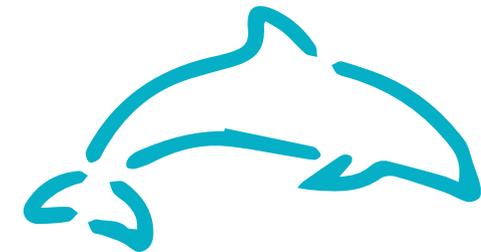
Utilitarian argument: ROI calculation checks out

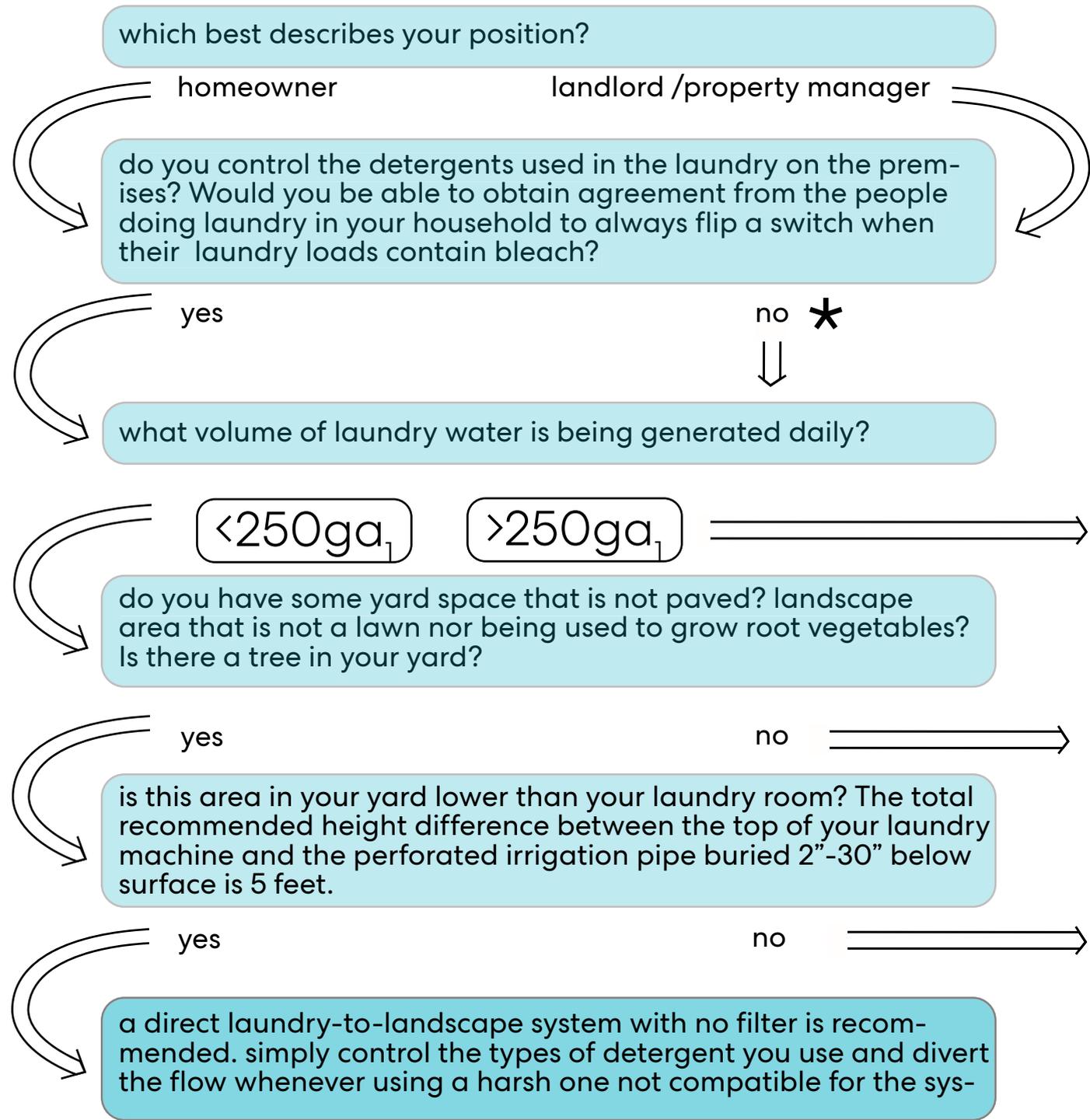
- **Installed costs are estimated to range from as little as a couple hundred dollars for a do-it-yourself laundry-to-landscape system to more than \$5,000 for a professionally installed pumped system. If the payback period exceeds the expected life span of the greywater system, the system will have a net cost to the customer.**
- **Landscape-based greywater systems are more likely to be cost-effective to the homeowner if:**
 - A. Home has a high marginal volumetric water (or water/sewer) rate**
 - B. Home has a high occupancy rate**
 - C. Home is located in area with long irrigation season (e.g. >7 months for landscape-based greywater systems)**
 - D. A low cost greywater system is installed**
 - E. The greywater system has low operations and maintenance costs**
 - F. A Do-It-Yourself greywater system is installed during home construction vs. retrofit**
- **Greywater financial benefits to the utility: reducing customer water demands can financially benefit a water utility, especially if the utility is operating at or near its system's peak production rate or if it is faced with a shortage of water supply. O&M costs associated with laundry-to-landscape and branched drain systems are minimal.**

Emotional argument: bleach kills dolphins

We try to steer people away from the notion that a greywater system can be viewed as a high-ROI item in terms of saving on their water bills. In most municipalities, water is provided so cheaply it would take a considerable amount of time for a system to pay for itself. Nonetheless we really try to emphasize how much of an environmental benefit greywater offers in offsetting both consumer water demand and downstream impacts from sending so much water into the sewer system.

-Hayley Stansell, Greywater Corps in an email 10/5/2020





renter ⇒ consider talking to others in your building and to your landlord. Assess your options based on the property's criteria. Installation is ultimately the landlord's choice.

Greywater Decision-Making Tree

consider a larger-scale laundry-to-landscape system. Perhaps incorporating shower and bathroom sink water into the system. You will need a permit, so will need a plan, a filter, and a pump. It would be best to consult a design professional who will work with a greywater specialist to assess and propose the right-size system for you.

consider converting part of the hardscape on your property to a planter or converting a part of your lawn to planting bed.

consider adding a pump to your system. unfortunately, this triggers the need for a permit. consider an alternate greywater reuse method.

* a laundry-to-landscape system with the diverter switched to the "sewage" position until the content of the effluent is controlled is recommended here. Alternatively, consider a filtered system that requires a permit.

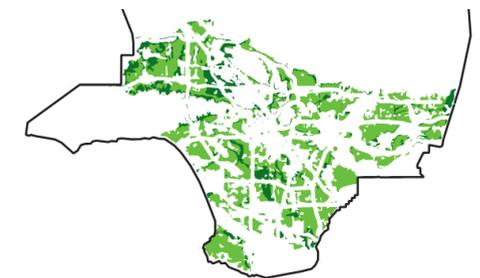
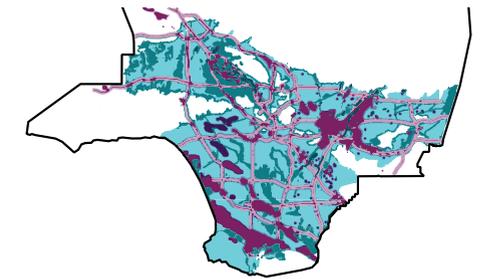
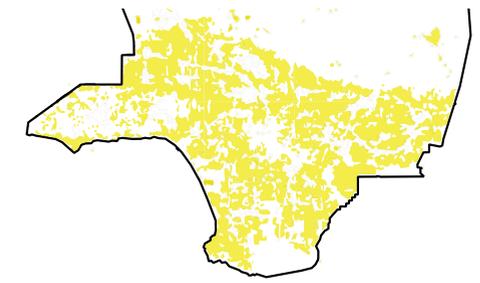
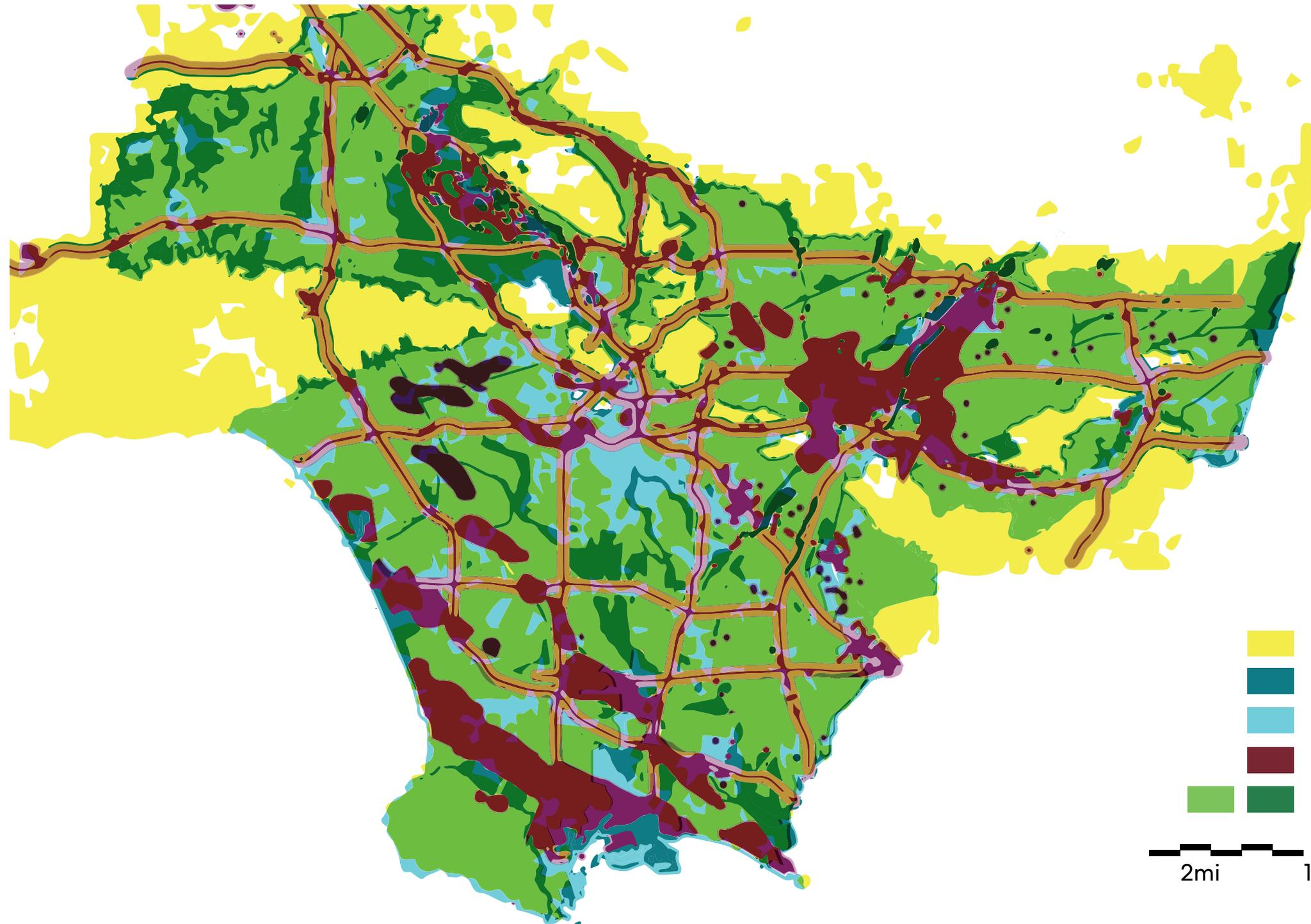
1 250 gallons₂₀, calculated with an estimated 15 gallons/ day for laundry per occupant

Single Family Residential Path

54% of of total water used is **101,576m Gallons,**
the total possible greywater for recapture in single family residential

16% of the total water used is **30,095m Gallons,**
the total possible greywater for recapture in single family **laundry**

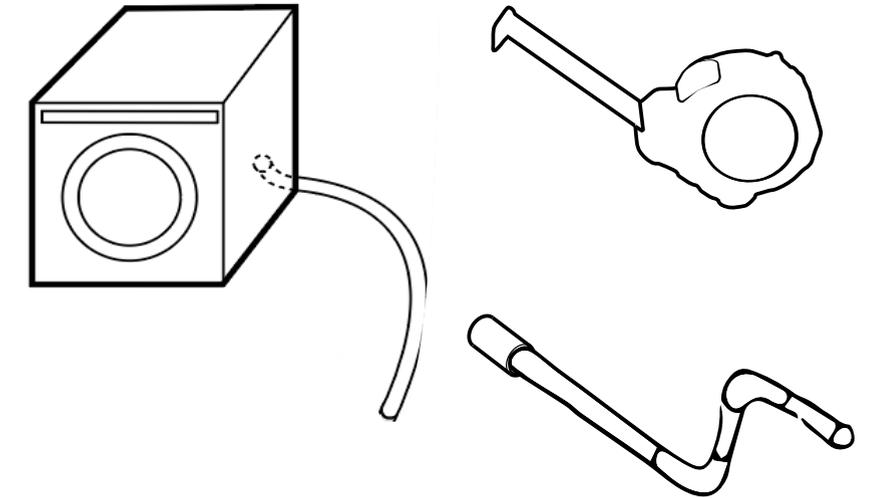
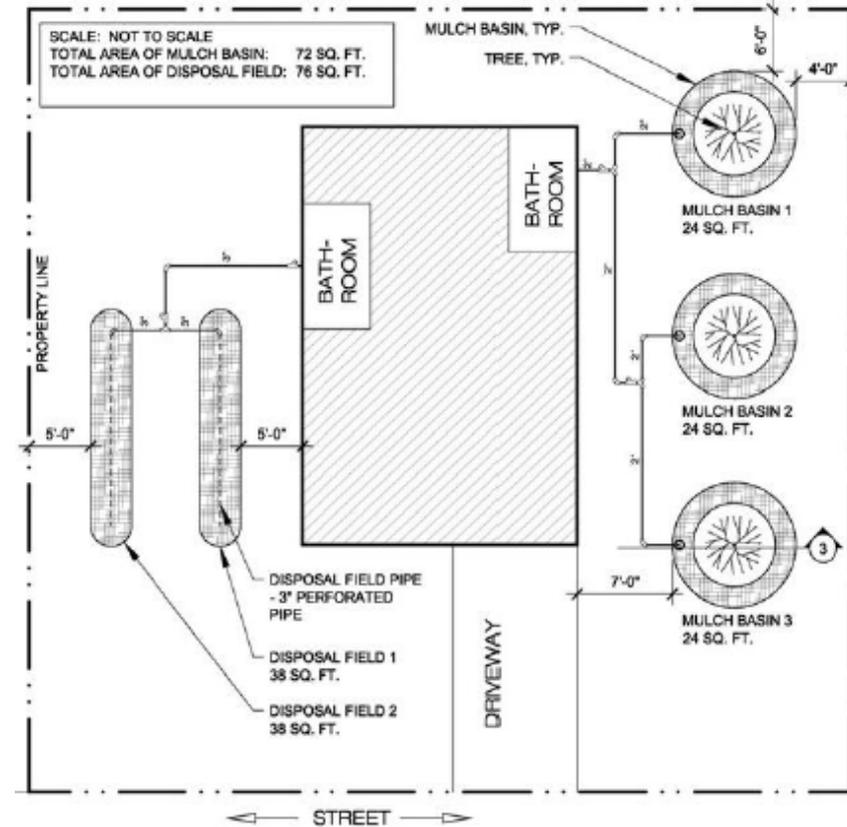
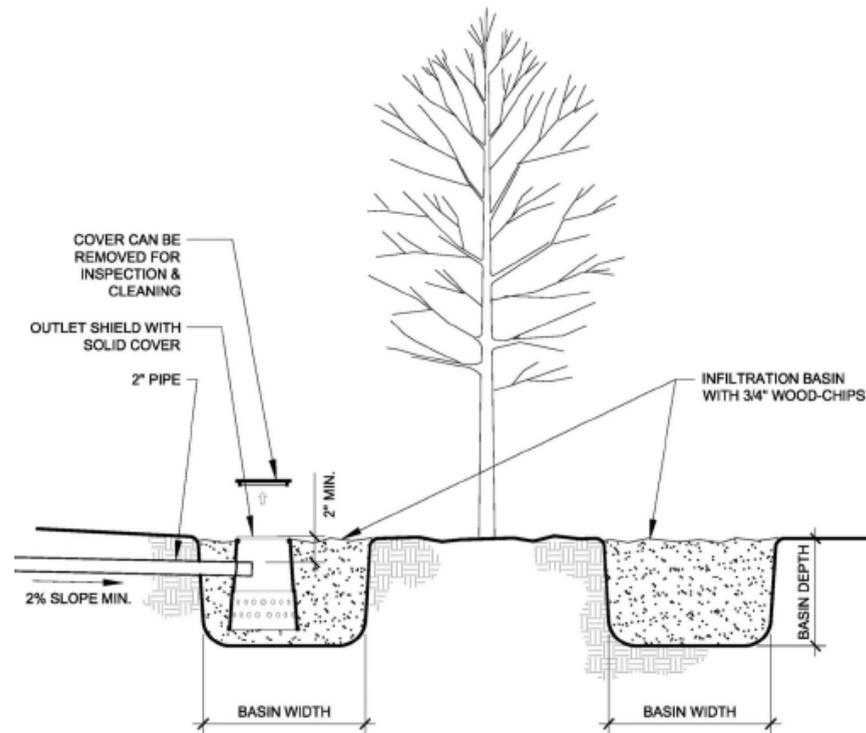
Residential Greywater Zones



- Single-family (1 unit) residential area
- Soils with good infiltration potential
- Soils with infiltration potential
- Soil/groundwater contamination
- Single-family greywater potential

2mi 10mi

Permitting and Implementation



- **There are two simple systems.** One requires a permit while the other is required to meet 13 conditions, and have a site plan and a manual, but needs no permit.

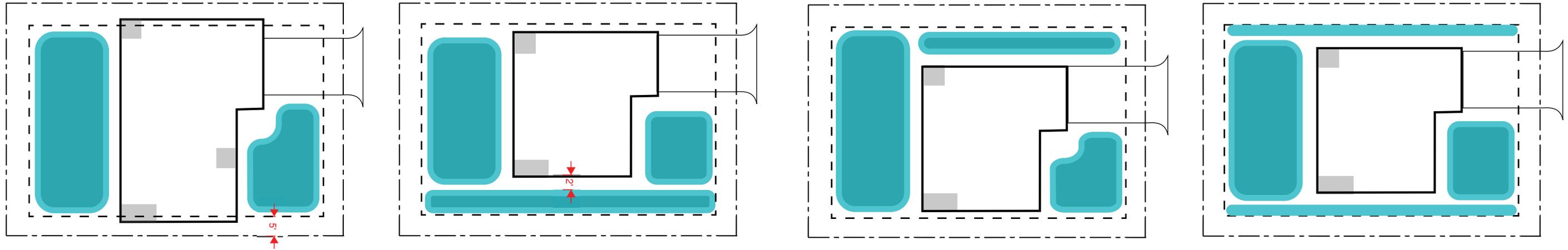
- **Setbacks - 5' from property line and 2' from building** are required to be maintained for both systems. The water outlet must be at least 2" below the soil surface in section and outside of the setback in plan.

- **A manual** should be included with information on the parts used to build the greywater system.

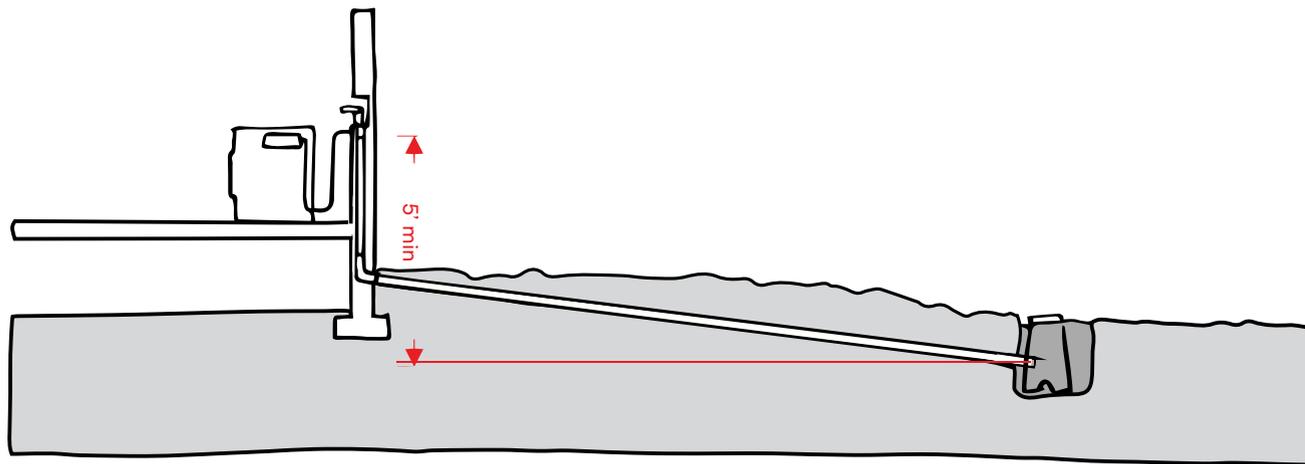
Diagram from
LADBS Information bulletin IB-P-PC2014-012

Diagram from
LADBS Information bulletin IB-P-PC2014-012

Site and system configuration

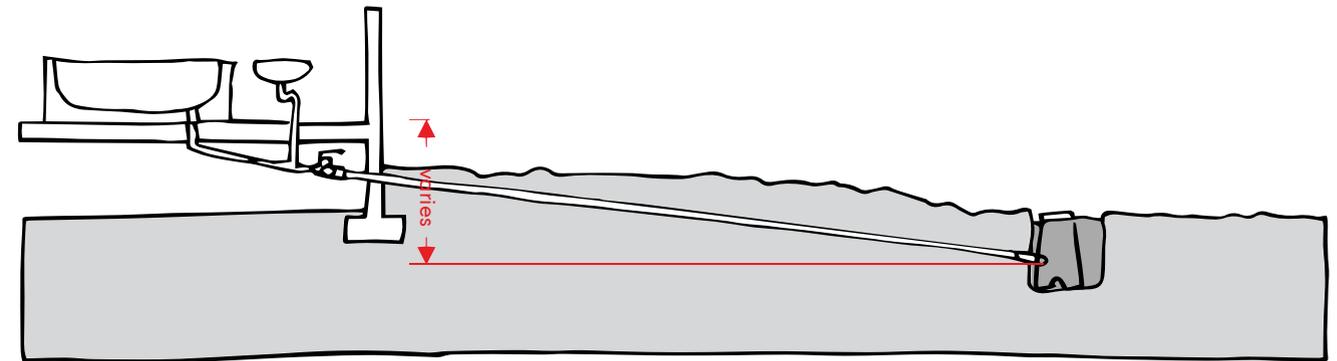


Setback requirements can limit the zones available to disperse the greywater; a rule of thumb is that the diverted laundry water can water about 5 trees. Plants should be grouped by similar watering needs into one of several “hydrozones”.



Simple System 1: Laundry to Landscape

The pump integral to the laundry machine pumps the used water out. A diverter valve is installed to toggle between sewer and landscape.



Simple System 2: Bath /Shower to Landscape

This system requires a permit.

Checklist

- 1. If required, notification has been provided to the Enforcing Agency regarding the proposed location and installation of a graywater irrigation or disposal system.
- 2. The design shall allow the user to direct the flow to the irrigation or disposal field or the building sewer. The direction control of the graywater shall be clearly labeled and readily accessible to the user.
- 3. The installation, change, alteration or repair of the system does not include a potable water connection or a pump and does not affect other building, plumbing, electrical or mechanical components including structural features, egress, fire-life safety, sanitation, potable water supply piping or accessibility. Note: The pump in a clothes washer shall not be considered part of the graywater system.
- 4. The graywater shall be contained on the site where it is generated.
- 5. Graywater shall be directed to and contained within an irrigation or disposal field.
- 6. Ponding or runoff is prohibited and shall be considered a nuisance.
- 7. Graywater may be released above the ground surface provided at least two (2) inches (51 mm) of mulch, rock, or soil, or a solid shield covers the release point. Other methods which provide equivalent separation are also acceptable.
- 8. Graywater systems shall be designed to minimize contact with humans and domestic pets.
- 9. Water used to wash diapers or similarly soiled or infectious garments shall not be used and shall be diverted to the building sewer.
- 10. Graywater shall not contain hazardous chemicals derived from activities such as cleaning car parts washing greasy or oily rags, or disposing of waste solutions from home photo labs or similar hobbyist or home occupational activities.
- 11. Exemption from construction permit requirements of this code shall not be deemed to grant authorization for any graywater system to be installed in a manner that violates other provisions of this code or any other laws or ordinances of the Enforcing Agency.
- 12. An operation and maintenance manual shall be provided. Directions shall indicate the manual is to remain with the building throughout the life of the system and indicate that upon change of ownership or occupancy, the new owner or tenant shall be notified the structure contains a graywater system.
- 13. Gray water discharge from a clothes washer system through a standpipe shall be properly trapped in accordance with Section 1005.0

Information for a Manual

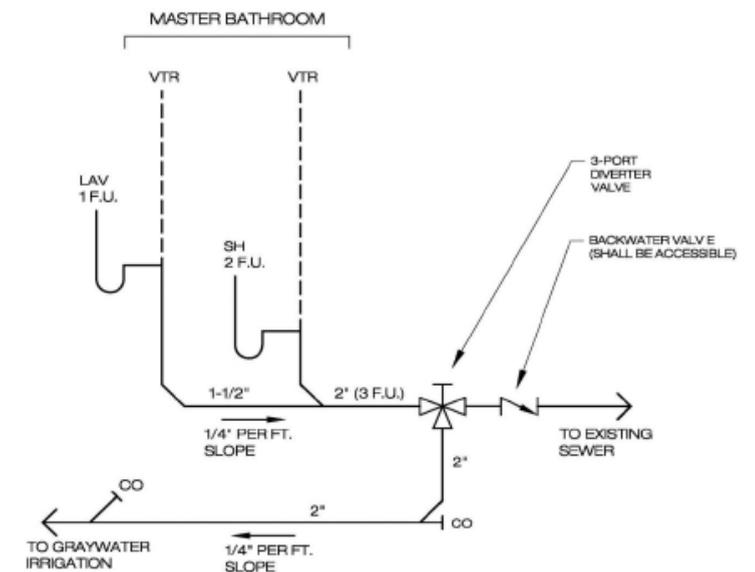


A manual should include a plumbing diagram, site plan and information on the parts used to build the greywater system. It is best practice to include construction photos of the system before it was covered.

Each manual is unique.

A great guide for compiling a system and manual, with step by step instructions, is contained in a book by Laura Allen titled "Greywater Green Landscape".

Example Plumbing Diagram from LADBS
IB-P-PC2014-012

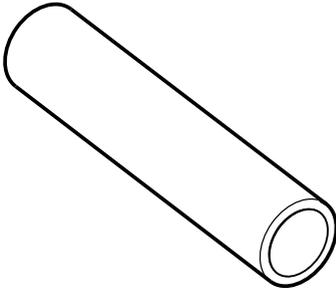


Kit of Parts

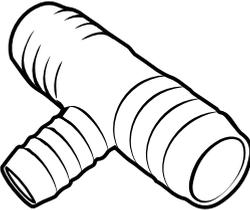
Auto-vent



1" inner HDPE tubing



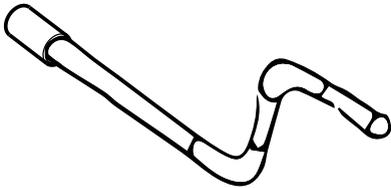
1" to 1/2" PVC tee



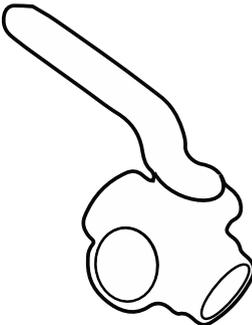
1/2" PVC outlet



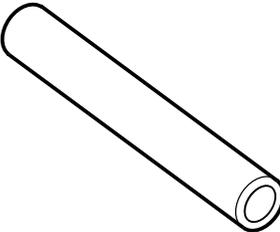
At least 2' of horizontal 1" PVC pipe for diverter valve



3-way diverter valve



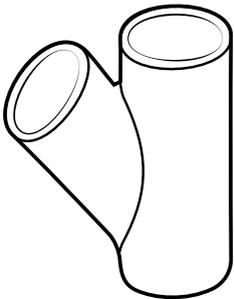
1/2" tubing



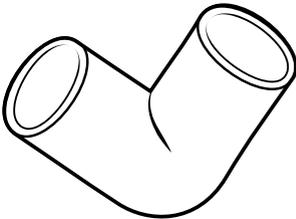
Wood chip mulch



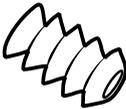
Cleanout



1" inner diameter PVC elbows



1/2" PVC barbed tee



7" to 10" irrigation valve box



Rebates/incentives

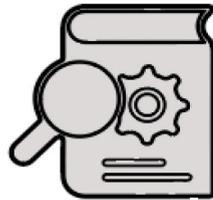
Rainwater barrel, cistern, irrigation upgrade, ADU, urban agriculture incentive, Pasadena greywater installation rebate.

Rebates that are available elsewhere that could benefit the greater adoption of greywater recycling by single family homeowners:
3 way diverter valve rebate in San Francisco.

LEED (and LEED Homes) credits are available for simple greywater systems as well as complex permitted ones.



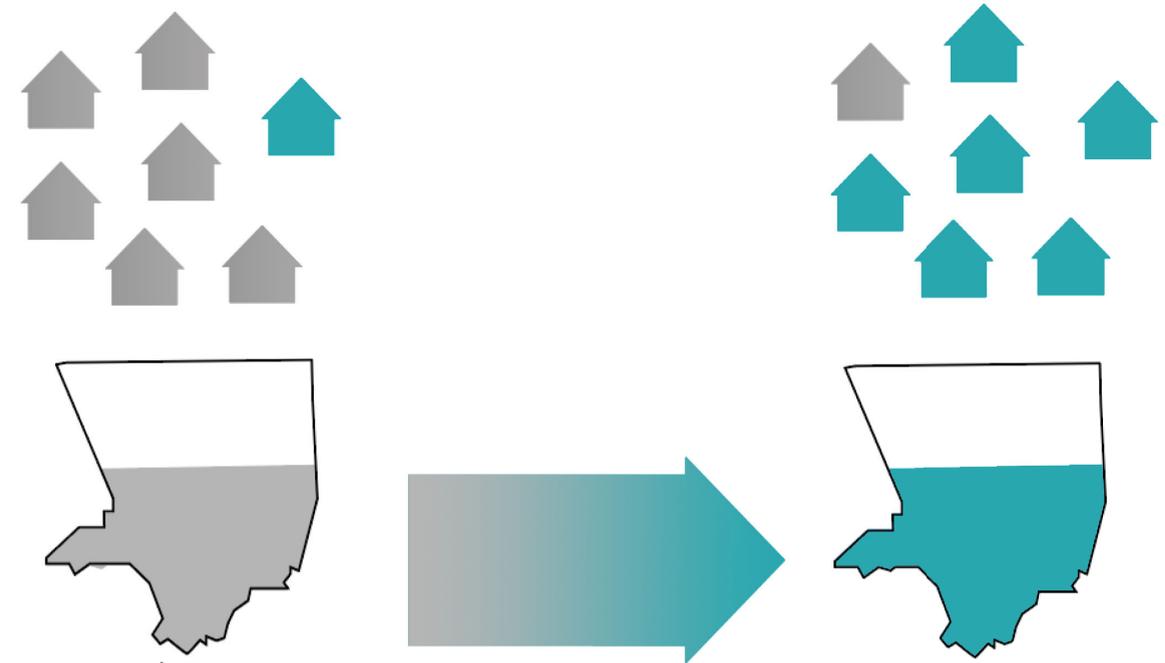
Support of local AHJ
in the form of incentives
to homeowners



Manual for adoption in
LA County

Future Benefits

- long term shade tree and landscape planting resilience,
- energy and emissions savings,
- fewer chemicals used in water treatment,
- a greater awareness of the water cycle among its users.
- recharging the aquifer.

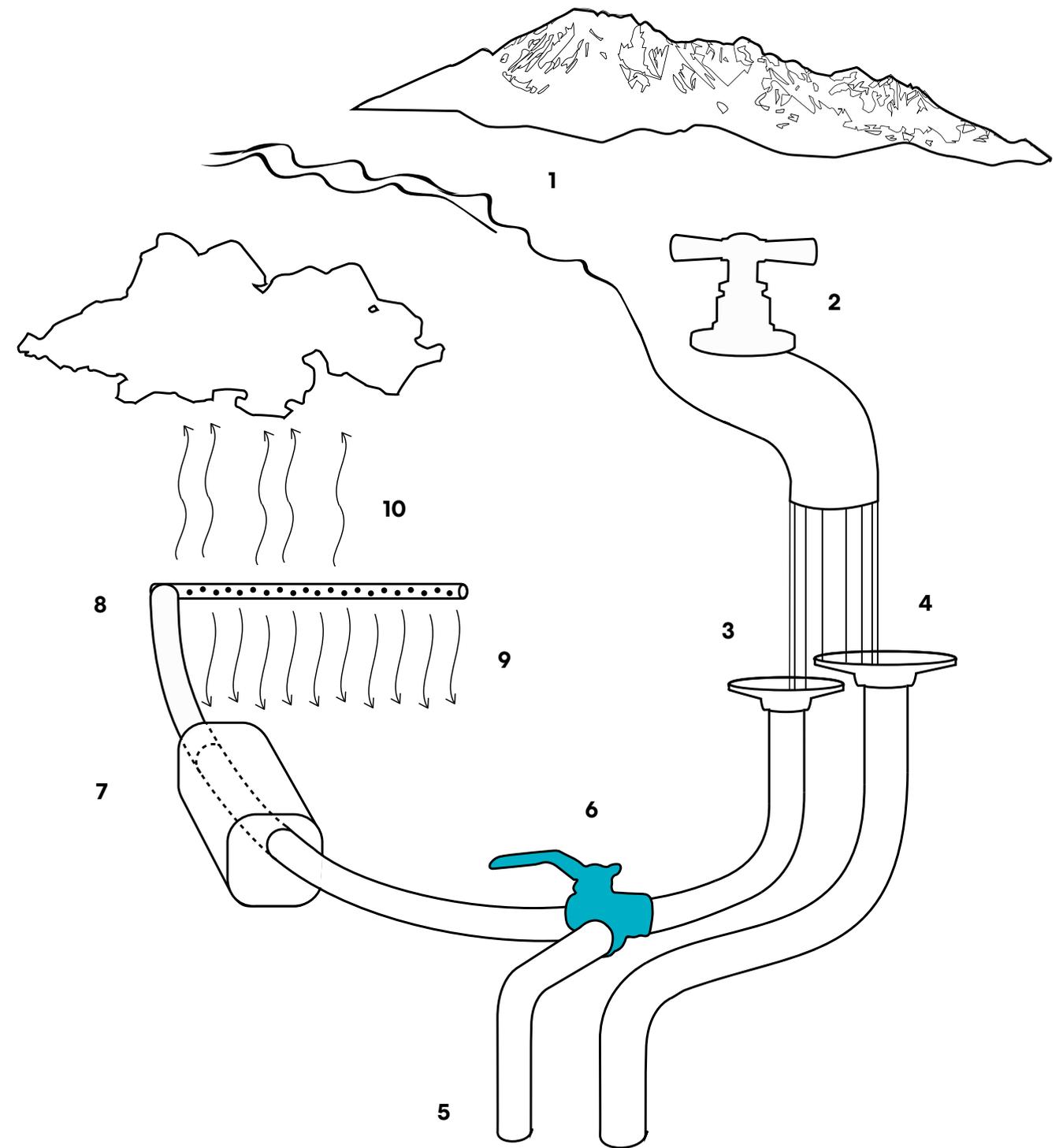


While the utility companies collaborate on a "One Water LA Plan" for 2040,

a rapid grassroots shift to simple greywater systems would be the least cost- and energy- intensive way to recycle wastewater for beneficial reuse in LA County.

Changing the Greywater Cycle

- 1 Sierra Nevada's snowpack, watershed of 5 states
- 2 DWP controls majority of the aqueducts to Los Angeles
- 3 Only laundry (and shower and bathroom sink water) is "greywater"
- 4 All other household uses of water
- 5 To sewage treatment, then Pacific Ocean
- 6 Manual diverter valve can direct laundry-to-landscape when no bleach or several other chemicals are used.
- 7 A filter may be installed but would require maintenance
- 8 Subsurface irrigation of trees and bushes
- 9 Recharge aquifer
- 10 Evapotranspiration



Experts consulted

Barry Lehrman created several Sankey maps of Los Angeles's watershed and is Associate Professor of Landscape Architecture at Cal Poly Pomona. He lectures on landscape futurism.

Laura Allen teaches a course on Greywater Fundamentals and is a co-founder of Greywater Action, an organization promoting greywater use. She is also an author of several books on the subject.

Sources

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2. http://www.publichealth.lacounty.gov/eh/EP/lu/lu_graywater.htm Los Angeles County website <https://data.lacounty.gov/Shape-Files/LA-County-Soil-Types/sz94-meiu>
3. Greywater Corps <https://greywatercorps.com/>
4. LA County Incorporated Areas Graphic outline <https://commons.wikimedia.org/w/index.php?curid=2258278> LA County Incorporated Areas Graphic outline
5. LA County Soil Types <https://data.lacounty.gov/Shape-Files/LA-County-Soil-Types/sz94-meiu>
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10. City of Berkeley Graywater Clothes Washer System: Laundry to Landscape https://www.cityofberkeley.info/Planning_and_Development/Energy_and_Sustainable_Development/Graywater_Laundry_to_Landscape.aspx
11. [https://www.ladbs.org/docs/default-source/forms/plan-check-2017/untreated-gray-water-correction-sheet-\(for-2017-codes\).pdf?sfvrsn=4a15fe53_6](https://www.ladbs.org/docs/default-source/forms/plan-check-2017/untreated-gray-water-correction-sheet-(for-2017-codes).pdf?sfvrsn=4a15fe53_6)
12. Allen, Laura. Greywater Green Landscape. Story Press, 2017
13. Greywater Action, a local non-profit providing training and resources. <https://greywateraction.org/>
14. California Plumbing Code <http://epubs.iapmo.org/CPC/#p=338> California Plumbing Code
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Greywater Business Model Canvas

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| <p>KEY PARTNERS</p> <p><u>Outsource activities to:</u> Greywater plumbing installers, Greywater filter maintenance companies, Greywater landscape installers, Designers</p> <p><u>Marketing outsourced to:</u> Greywater educators, Greywater companies.</p> <p><u>Acquired parts:</u> System component hardware vendors, Filter vendors</p> <p><u>Rebates could be offered by</u> DWP, LA Sanitation, Los Angeles City Planning Department, LA County Planning</p> | <p>KEY ACTIVITIES</p> <p><u>Problem-solving and production:</u> Assessing options, choosing system Hooking up greywater system Choosing which landscape area to irrigate on your property. Choosing high/low-maintenance systems. Filling out rebate applications.</p> | <p>VALUE PROPOSITION</p> <p><u>What value do we deliver to the customer? Which of the customer's problems are we helping to solve? Which needs are we satisfying? What bundles of products and services are we offering to each customer segment?</u></p> <p>Making an investment in the water infrastructure future of our city, one house at a time.</p> <p><u>Cost reduction:</u> smaller water bill. <u>Performance:</u> use your water twice. <u>Customization:</u> Greywater system to fit your scale, yard and habits. <u>Accessible, distributed, new</u> water source comparable to the LA River in volume.</p> <p>"Save your water from going into the sewer while irrigating your shade trees and recharging aquifer"</p> | <p>CUSTOMER RELATIONSHIPS</p> <p>Relationships established and maintained with each customer segment.</p> <p>I. Self- service II. Co-creation III. Dedicated personal assistance</p> | <p>CUSTOMER SEGMENTS</p> <p>A. Single-family owner-occupied residences that are not condos. (I, II, less III)</p> <p>B. Duplex owners and House + ADU owners that live on the premises and can check on the system regularly. (I, II, less III)</p> <p>C. Property managers of 2-unit or more residential properties. Especially properties where less than a certain number of gallons of laundry effluent produced, these properties might already be undergoing renovations. (II, III)</p> <p>D. Developers, builders, real-estate professionals and owners of planned future residences. (II, III)</p> |
| <p>COST STRUCTURE</p> <p><u>Cost-driven or value driven?</u> Cost driven issues: cost of tap water, cost of greywater system Value driven issues: quality of life improvements, getting around the cap on water usage, freedom, stewardship of resources, civic pride. Fixed costs - laundry will be required by residents, no matter what. Greywater simple hardware will have a fixed cost. Variable costs - installation/labor, filtration systems, permitting. Economies of scale - permit for larger projects only. Economies of scope - those wishing to save a lot of water with minimum investment would only do direct laundry to landscape.</p> | | <p>REVENUE STREAMS</p> <p><u>Revenue streams result from value propositions successfully offered to customers.</u> <u>Water:</u> currently, usage fee. Will be higher in the future. This is offsetting future costs. <u>Greywater system:</u> asset sale if direct laundry to landscape. <u>Greywater filter, if using:</u> could have a monthly maintenance subscription fee. Permitting is like a brokerage fee. This should be minimized within reason to prevent it being a barrier to adoption of greywater systems as long as they are safe. Advertising fees should be absorbed by the city and utility as it benefits both and they have the resources. Will water and sewage have fixed or dynamic pricing in the future Los Angeles? What if revenue were measured in future gallons of water diverted from LA Sanitation or the number of trees ensured permanent watering?</p> | | |