

BASINS OF RELATIONS

*A Citizen's Guide to
Protecting and Restoring Our Watersheds*



WATER INSTITUTE

OCCIDENTAL ARTS & ECOLOGY CENTER

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*A Citizen's Guide to
Protecting and Restoring Our Watersheds*

3rd Edition (2018)

By Brock Dolman and Kate Lundquist

Illustrations by Jim Coleman and Marcus Badgley

Thank you for picking up this publication and taking some of your precious time to learn more about water, watersheds, Conservation Hydrology, and how you can take action to ensure that we and all species enjoy pure and ample water for generations to come.



TABLE OF CONTENTS

Welcome to Planet Water	3
Doomed to Historical Repetition?	4
Future Thirst	5
Watersheds: Our Basins of Relations	6
Slow It, Spread It, Sink It, Store It, Share It	7
Four R's of Conservation Hydrology	8
The Role of Keystone Species in Watershed Health	10
What You Can Do:	14
Water Conservation	14
Organize Your Basins of Relations	18
Systemic Policy Change	21
Recommended Reading	23

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OAEC's WATER Institute develops innovative science-based solutions for communities and the environment to address the legacy of hydrologically destructive land-use practices and policies on California's watersheds, and the urgent need to address the impacts of climate change on the water cycle. For more information visit www.oaec.org/water.

The Occidental Arts & Ecology Center (OAEC) is an 80-acre research, demonstration, education, advocacy and community-organizing center in West Sonoma County, California that develops strategies for regional-scale community resilience and the restoration of biological and cultural diversity. For more information visit www.oaec.org

WELCOME TO PLANET WATER

THE COPIOUS PRESENCE of water on our blue and white planet is the fundamental expression of life's diversity and beauty. Water ripples out and within to touch every aspect of our lives. Now and in the future, nothing is or will be more valuable than pristine watersheds with abundant pure water supplies.



The ceaseless flowing and dynamic processes of water—the evaporation, condensation, transpiration, precipitation, and infiltration that together comprise the water cycle—are truly amazing. Covering more than 70% of Earth's surface, water can be solid ice that floats on its liquid self. It can evaporate into the atmosphere as a vaporous distilled gas and then return to earth, purified, as either solid snow or liquid rain. Without water, there would likely be no life on Planet Earth. From this perspective it might be more fitting to refer to our home as “Planet Water,” as biologist Lynn Margulis suggested.

97% of the world's water is held in the salty oceans and is thus undrinkable. Another 2% of global water is locked up in ice caps and glaciers. This leaves only 1% of the world's water available as freshwater in lakes, rivers and groundwater for shared use by humans and all other freshwater-dependent beings. As sea levels rise due to global warming, the melting polar ice caps and glaciers are increasing the percentage of water in the saline ocean. As we drain wetlands, clear-cut forests, plow soils, and pave our watersheds, we further reduce our available 1% of freshwater. Additionally, our widespread polluting of aquifers, rivers, lakes, and air dramatically reduces the quality of this critically limited freshwater.

We must learn how to equitably and sustainably share the small amount of available global freshwater for all agricultural, residential, manufacturing, energy, and personal needs, as well as the biological needs of all other terrestrial and aquatic life forms. Jacques Cousteau reminds us “not to forget that the water cycle and the life cycle are one.” Every drop of water is precious!

“The water cycle and the life cycle are one.”

— Jacques Cousteau



DOOMED TO HISTORICAL REPETITION?

“Those who cannot remember the past are condemned to repeat it.”

— *George Santayana, philosopher*

OURS IS NOT the first civilization to face such a self-created water crisis. Myriad historical accounts and widespread archeological evidence indicate that, over time, most centralized city-based societies have consistently destroyed the capacity of their water and land to support extended human settlement. The fall of numerous great civilizations is directly linked to their watershed mismanagement.

Throughout history, the removal of native vegetation through deforestation, over-grazing and plow agriculture has typically resulted in dramatic depletion and degradation of fertile topsoil and freshwater. Once you lose your soil and pollute your pure water, you have lost two of the most important resources necessary for the survival of any society. The vanished cultures of Easter Island and the Pre-Columbian Maya of Central America met this fate through unrelenting deforestation. Today the hills above Israel's Jordan Valley—described in the Bible as a “land flowing with milk and honey”—are highly degraded, supporting a scant human population as a result of historical agricultural and grazing practices.

Our modern civilization is not immune to this type of behavior. J. Russell Smith states in *Tree Crops: A Permanent Agriculture* that “In 1950 the U.S. Soil Conservation Service reported that the soil washed out and blown out of the fields of the United State each year would load a modern freight train long enough to stretch around the world eighteen times. If it ran twenty miles an hour continuously, it would take it nearly three years to pass your station.”



Ruins of one of the Hundred Dead Cities of Syria.
Between AD 610-638 this thriving city was invaded several times and the inhabitants, who over centuries had developed and practiced soil and water conservation measures, were driven off. With these techniques no longer in use, 3-6 feet of soil eroded away and the city and surrounds became an uninhabitable manmade desert.

— *Adapted from W.C. Lowdermilk's Conquest of the Land Through 7,000 Years, 1939, NRCS.*

FUTURE THIRST

SOME WILL ARGUE that water has never limited human growth and development, that humans have tenaciously applied their technological ingenuity to move water great distances and pump it from deep below the surface to fuel burgeoning growth. It has been said, “Simply bring the water and the people will come.” In the past few centuries, however, this command-and-control attitude towards water has begun to show signs of deepening failure.

In 2016 the World Health Organization stated that 663 million people do not have access to an “improved water supply” and 2.4 billion people do not have access to “improved sanitation.” According to the International Forum on Globalization’s 1999 report, *Blue Gold*, “Global consumption of water is doubling every 20 years, more than twice the rate of population growth.” Water-stressed populations will increasingly become a challenge for all civilized nations.

The much heralded agricultural “Green Revolution” of the 1960s & 70s, was primarily dependent on a silent “blue revolution” of irrigation for thirsty “high yielding” petro-chemical monocrops. Groundwater mining for irrigation, powered by fossil fuel, allowed the green revolution to proceed. In the short term there has been an increase in food production, yet in the long term this industrial agricultural model creates over-drafted and polluted ground and surface water, and dying rivers and coastal areas. In 2016 scientists identified 405 massive nitrate fertilizer-based “dead zones” in coastal river mouths worldwide. While researchers documented that the number of dead zones had doubled every decade from the 1960s until the early 2000s, this figure nearly tripled from the 150 dead zones identified in 2004.

Our societal addiction to the combustion of carbon-based fossil fuels for energy is now unequivocally understood to

cause global climate change due to excessive accumulation of “greenhouse” gases in the atmosphere. These gases thicken the atmosphere’s capacity to retain solar energy, leading to an increase in the planet’s average surface temperatures. Solid, liquid and gaseous phase changes by water are the thermal mechanisms through which the planet primarily attempts to regulate its human-induced “fever.” Water is manifesting some of the most dramatic expressions of this climate change, with melting polar ice and glaciers, arctic amplification, rising sea levels, coastal inundation, ocean acidification, warmer tropical water, slowing of the Gulf Stream, stronger hurricanes, and increased floods and droughts.

*“Just as water is
the foundation of life it must
also be the foundation of design
of the built environment”*

– Betsy Damon,
founder of Keepers of the Waters

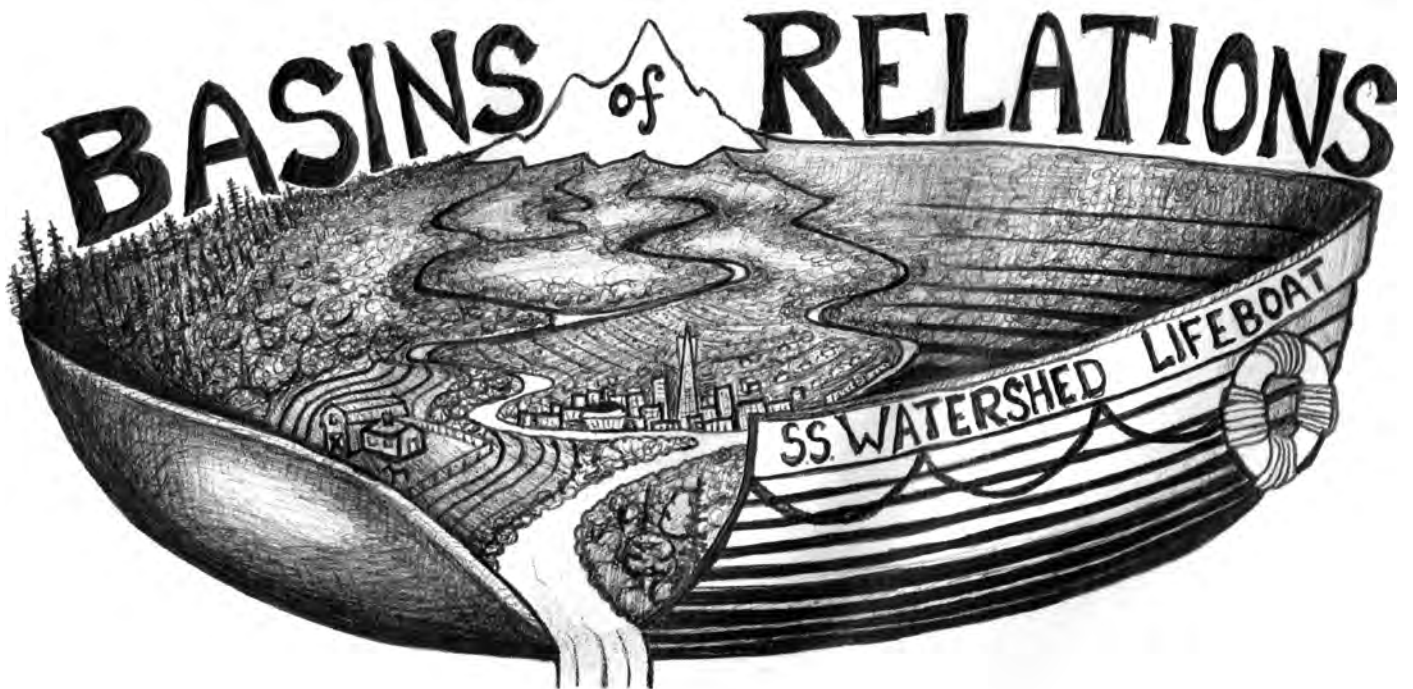
As we confront the burgeoning reality of “peak oil”—the knowledge that we are now approaching the halfway point of global petroleum production capacity—we also see a new crisis appearing on the horizon: “peak water,” which has deep implications for “peak food,” and consequently “peak population.”

Responding in a timely manner to this triangle of energy, water and food interdependence is one of our challenges. The difference between peak oil and peak water is that—while the total amount of water and oil on the planet is finite—water, unlike oil, cycles infinitely through our lives. While the advent of hydraulic fracking has temporarily increased the supply of natural gas, this has come at a huge cost as the extraction process increases the release of greenhouse gases and the incidence of earthquakes while permanently contaminating surface and ground water. As the Titanic of cheap energy sinks below the surface, a prudent option would be to perceive our watersheds as lifeboats and to use the principles of Conservation Hydrology to batten down the hatches of our “Basins of Relations” for the ensuing storm of changes.



WATERSHEDS: OUR BASINS OF RELATIONS

AT THE MOST basic level, a watershed encompasses all the land surface that collects and drains water down to a single exit point. The continual cycle of erosive water flowing over uplifting and weathering land has sculpted all landscapes into distinct cradle-like entities known as watersheds, basins, drainages, or catchments. Everyone on the planet lives in a watershed somewhere. Everything we do for work, play, school, shopping, farming, recreation, and so on occurs in a watershed. Watersheds can be as large as the Mississippi basin, the third largest in the world, which drains 41% of the lower 48 U.S. states into the Gulf of Mexico. Or, watersheds can be as small as all the land in your neighborhood that flows from your yard, roof, driveway, and streets to the storm drain and out to your local creek or lake.



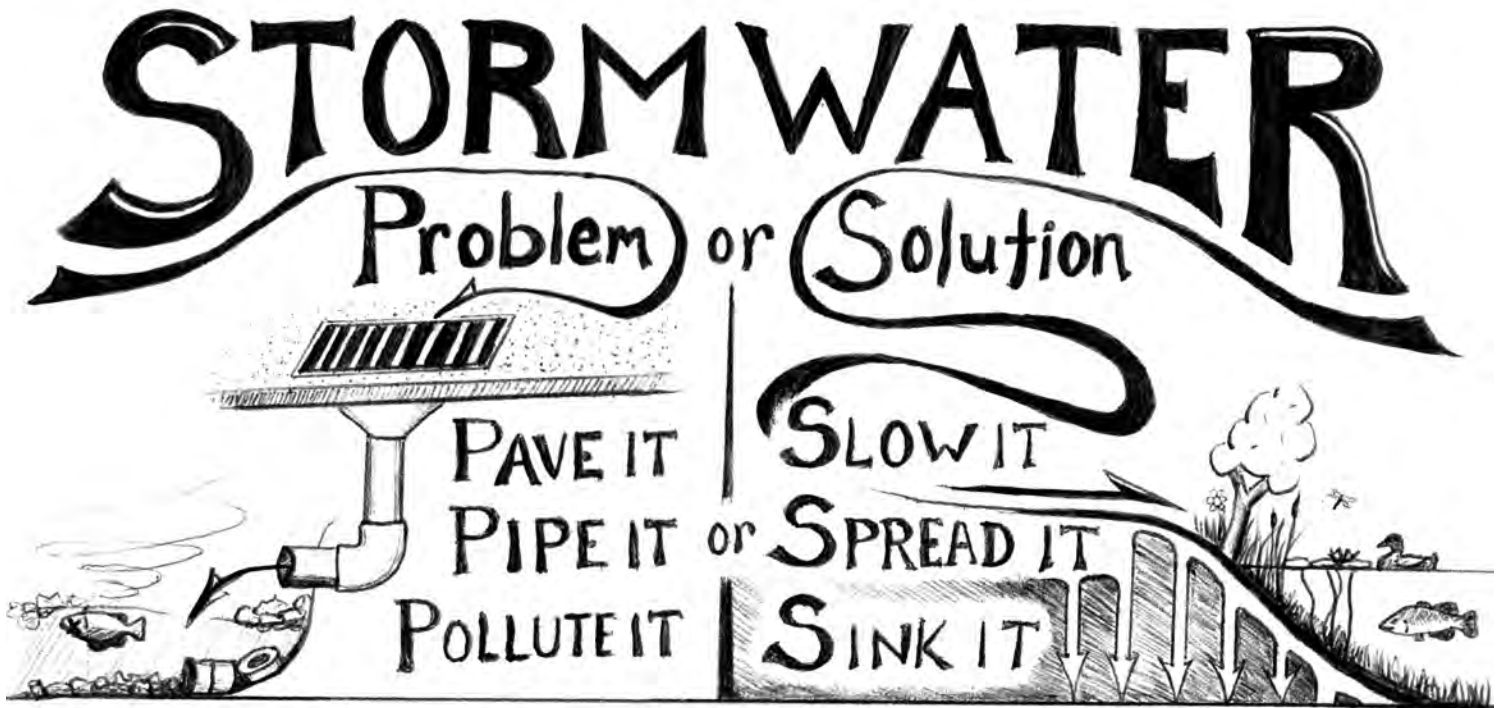
Watersheds at all scales are evolved living entities. Their state of health provides a comprehensive benchmark for judging the wisdom of our past and future land and water use. Watersheds literally underlie all human endeavors and form the foundation for all future human aspirations and survival. Watersheds topographically define community, and the health of your watershed depends on collaborative relations between neighbors in your shared basin.

CONSERVATION HYDROLOGY

AT THE WATER Institute we call our philosophical and practical responses to the water challenges and opportunities before us “Conservation Hydrology.” Conservation Hydrology utilizes the disciplines of ecology, population biology, biogeography, economics, anthropology, philosophy, planning, and history to guide community-based watershed literacy, planning, and action. Conservation Hydrology advocates that human development decisions must move from a “dehydration model” to a “rehydration model.” To achieve this goal we must retrofit existing development patterns with new ones based on the following principles.



SLOW IT, SPREAD IT, SINK IT, STORE IT, SHARE IT



WATER IS THE ultimate resource. Thankfully, the Clean Water Act now recognizes the “pave and pipe paradigm” as disastrously flawed and hydro-illiterate. These outmoded engineering practices capture, concentrate, and convey water away from a site as quickly as possible. The old drain-age is now being replaced by a new retain-age.

The WATER Institute advocates a new paradigm of stormwater management based on “waterspread” restoration, with a call to slow it, spread it, sink it, store it, share it: Slow the water down. Spread the water out. Sink the water into the land. Store the water in the aquifer. Share the water with all of life.

“The old drain-age is now being replaced by a new retain-age.”

Practical waterspread applications, such as bio-swales and raingardens serve to biologically filter stormwater, enhancing water quality. These applications can also enhance water quantity by optimizing groundwater recharge and reducing peak flood flows. If you live in a flood plain, these ideas may be more challenging to implement. You will need to evaluate the slope stability, soil porosity, storm event size, and run-off volumes of your site to determine which of these concepts are appropriate. When we learn to think like a watershed, we can implement development practices that will protect water quality and quantity.

FOUR R'S OF CONSERVATION HYDROLOGY

RECEIVE, RECHARGE, RETAIN, AND RELEASE

THE GOALS OF Conservation Hydrology can be expressed in terms of sound budget management. The four R's of a water budget are equivalent to income, deposit, savings, and expense. We want the water balance of our watersheds to run in the blue and not in the red. We want to insure that our liquid assets continually produce a high quality return on investment back into our Basins of Relations.

RECEIVE = INCOME

- Watersheds only receive water as snowfall, rainfall and fogfall. Annual precipitation is the only true source of income to re-supply our community's water budget allowance.
- Global climate changes are predicted to dramatically alter the frequency, intensity and type of precipitation events that watersheds can expect to receive.
- Conservation Hydrology advocates the adaptive management of watershed lands to optimize rehydration. We must implement and enforce land use patterns that enhance the receptive capacity of our watersheds in times of excess and in times of scarcity.

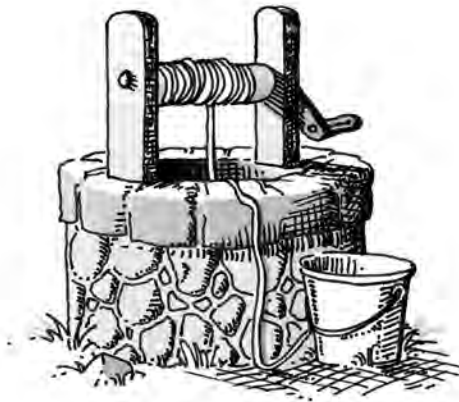


Contour Infiltration Ditch

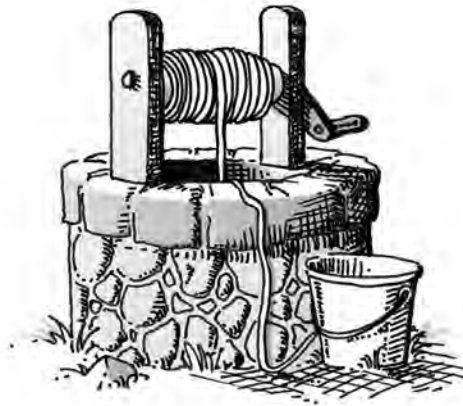
In one rainy season, this simple ditch collected and infiltrated the same amount of water that residents of this property withdrew in one year from their well, thus ensuring a balanced groundwater budget.

RECHARGE = DEPOSIT

- Recharge processes are critical for the water cycle to annually refresh itself via the deposit slip called infiltration. The capacity to make water deposits depends on the watershed's recharge potential. Precipitation received by our watershed must percolate and be absorbed, or else there is no replenishment of our water savings account.
- Recharge potential and functions are impaired by the hardening and paving over of natural recharge areas, the disconnection of rivers from their floodplains, the deforestation of native vegetation, and the draining of wetlands.
- To increase recharge, we must limit impervious surfaces and the wholesale conversion of native vegetation. We must implement stormwater techniques designed to slow it, spread it, and sink it, store it and share it as a deposit into the Earth. We must protect open space in known groundwater recharge areas. If site conditions are not conducive to recharge, then we must ensure proper bio-filtration of all surface waters prior to their discharge and deposit into rivers, wetlands, lakes, estuaries, and oceans.



Grandparents' Well



Parents' Well



Children's Well

RETAIN = SAVINGS

- The retention of recharged precipitation is a savings account asset. The storage of water is often the most challenging aspect of water supply management. Conservation Hydrology strategies should appropriately slow water down, increasing the residence time of water storage in our watersheds. This will optimize the amount of water available for local expense by living processes.
- We must avoid overdrafting and dewatering of our watersheds. Water should never be extracted out of storage in amounts greater than what is annually received and recharged. All sources of water must not be polluted by development, wastewater systems, agricultural runoff, petroleum extraction and industrial effluent.
- We must develop water budgets for all watersheds to ensure that extractions of water do not exceed inputs of water. We must implement groundwater and surface water management programs. We must ensure that surface and groundwater quantity and quality protection programs are funded, monitored and enforced. We must establish the public ownership of water as a public trust resource and resist the privatization of water.

RELEASE = EXPENSE

- Planet Water utilizes many ways to release its signature element naturally to the ocean, land and atmosphere in a process known as the water cycle. Through seasonally melting glaciers, groundwater springs and seeps, water is returned to creeks and rivers. Solar evaporation and the evapo-transpiration of plants help to form new clouds and feed the cycle anew. The infinite nature of this cycle is to continually flow and be in flux as the expense of one stage produces income for the next.
- Human development practices (creating impervious surfaces, channelizing stormwater, etc.) tend to increase the rate and volume of stormwater's return to the ocean via excessive runoff and heightened flood discharges. This directly reduces the landscape's ability to retain water and diminishes the amount of water available for later release during the dry season when it is most needed.
- The implementation of watershed-scale Conservation Hydrology practices will protect reception, amplify recharge, and thus optimize retention. These are the critical steps that can ensure optimal amounts of cold water will be available for future release.

“Do you live in a water scarce area or a storage scarce area?”

- Brock Dolman, Occidental Arts & Ecology Center's WATER Institute Founder and Co-Director



THE ROLE OF KEYSTONE SPECIES IN WATERSHED HEALTH

EVERY WATERSHED SUPPORTS a wide variety of flora and fauna. Some species disproportionately benefit those living in their midst. Biologists call these “keystone species” because if they were to be removed the ecosystem would change drastically. Citizens wanting to contribute to the health of their watersheds are wise to identify who the keystone species are in their basin and learn about the benefits, or “ecosystem services,” they provide. Supporting these contributors is a great way to help our watersheds thrive.

To better understand how we can steward these species it is important to learn about their current status and what threats, if any, they are facing. Acting to ensure the health of these species and removing barriers that prevent them from contributing their services is a cost effective way to enhance watershed function and even accelerate restoration.

Several of California’s Pacific coast lamprey and salmon function as keystone species due to their “anadromous” life cycle. This means they are born in freshwater, migrate to the ocean to mature and then return to freshwater to reproduce and die. Their carcasses provide an important source of marine derived nutrients that contribute to the health and productivity of those who eat them and the watersheds where they live. Invertebrates, birds and mammals eat and then distribute these minerals across the watershed. Without salmon and lamprey, many inland forests and their inhabitants would become deficient in these critical nutrients that are more abundant in marine ecosystems.

Pacific coast lamprey and salmon require clear, cold and copious fresh water to survive. These important fish are struggling to survive in California. We need to do everything we can to protect the ones we have left and restore our watersheds to support their recovery into the future.



Chinook Carcass in Dry Creek, Sonoma County, California

This salmon returned from the ocean, reproduced and then died, making its marine nutrients available to this freshwater ecosystem.

A NATIVE KEYSTONE species that could help bring salmon and Pacific coast lamprey back is the North American beaver (*Castor canadensis*). Once abundant across the continent, beaver were nearly hunted to extinction in the 1800s because their fur was used for making hats and coats. They are now making a slow comeback and warrant protection.

Beaver are wetland engineers who physically modify the environment more than any other non-human organism in the northern hemisphere. The dam complexes, bank burrows, canals and food caches they build have physical and biological effects on the watershed, changing how water flows across the landscape, and creating habitat for many rare, threatened and endangered species.

The dams they build spread and slow the flow of water across the landscape, reconnecting this water with the floodplain and encouraging it to rehydrate riparian corridors and their associated meadows and wetlands. When beaver dams spread the water out, creating wetter habitat, they also promote subterranean recharge and the release of water later in the season to enhance base flows. These benefits are especially important now that loss of snow pack and persistent drought are predicted to increase in frequency and intensity.

In addition to increasing the presence of water, beaver dams have the ability to enhance water quality by trapping sediment, excess nutrients and even contaminants. One or several dams on a creek or river can act as a buffer in high flows, reducing the intensity of floods. Beaver dams slow and redirect floodwaters across adjacent low lands, encouraging riparian vegetation, which also works to accumulate soil materials and hold existing soils in place. These beaver wetlands can help sequester carbon.



Beaver in Tulocay Creek, Napa County, California
This beaver is eating a willow shoot.

The landscape modifications beaver make create important habitat for a wide variety of plants, insects, amphibians, reptiles, birds and mammals. Bank burrows, lodges, food caches and dams provide cover for aquatic species. These wetlands are teeming with life and provide food and water for many threatened and endangered species such as the Red-legged frogs, Coho salmon and the Willow flycatcher.

While some landowners get frustrated with beaver modifications, there are many inexpensive solutions for mitigating potential damage. When you weigh the benefits, you soon learn that stewarding beaver can be a cost-effective way to increase biodiversity, enhance water quality and quantity and restore riparian and wetland ecosystems.

Humans have an enormous impact on the environment and, if given the proper tools can function as a keystone species as well. How we live our lives can have a huge effect on the watershed. Every day we have the opportunity to make choices that can either harm or benefit the earth's ecosystems. The next section of this publication will give you ideas about how to make better choices so you too can provide ecosystem services to those around you.

CONSERVATION HYDROLOGY: ADAPTING OUR WATER FOOTPRINT TOWARDS REGENERATIVE REHYDRATION

CONDENSATION

SNOW

RAIN

FOG

RECEIVE

NOW ENTERING
YOUR
WATERSHED

BIOSWALE

GREYWATER

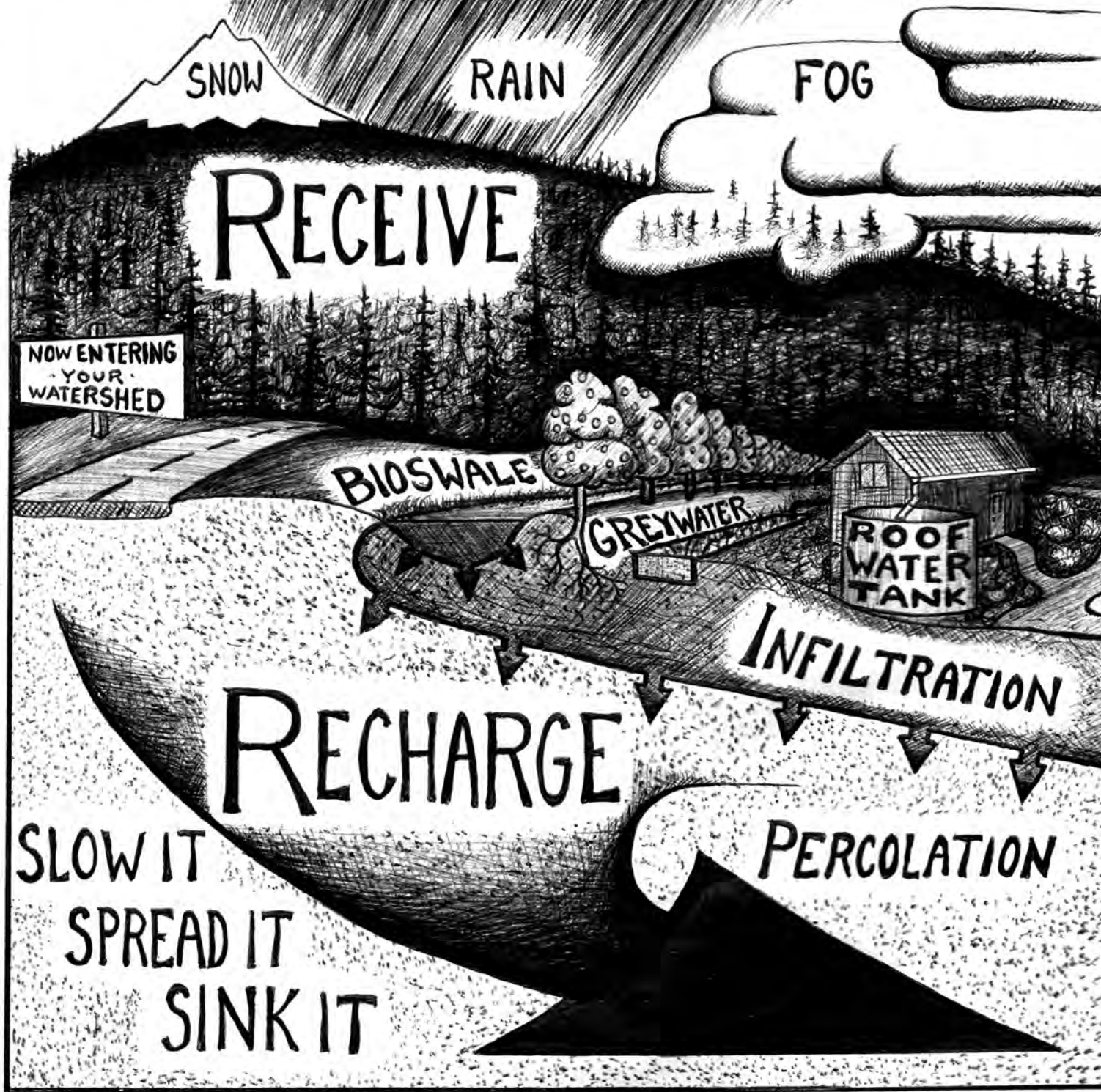
ROOF
WATER
TANK

INFILTRATION

RECHARGE

SLOW IT
SPREAD IT
SINK IT

PERCOLATION

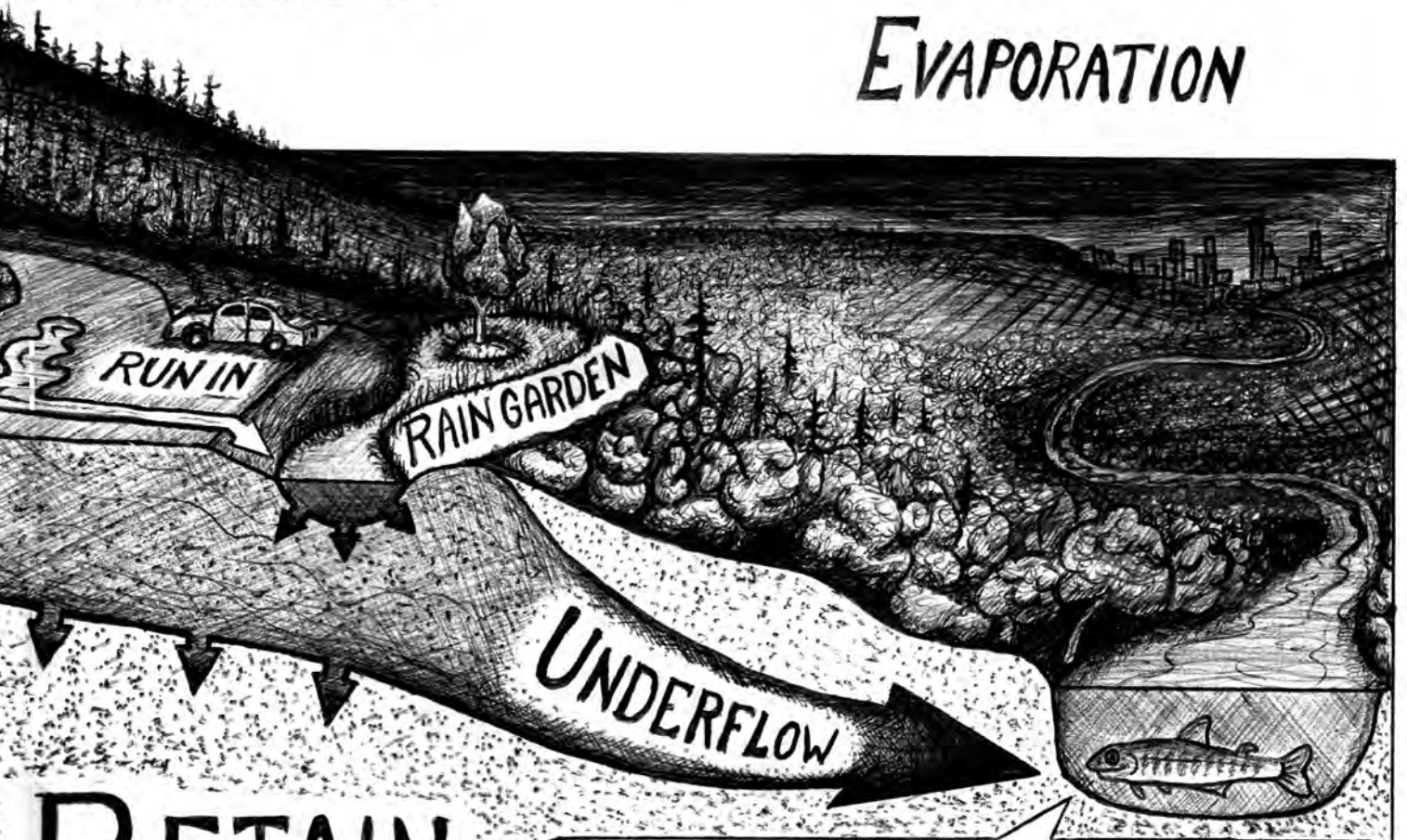


WATERSHED
AWARENESS
DON'T LIVE WITHOUT IT!

RELEASE

TRANSPIRATION

EVAPORATION



RETAIN

LET'S KEEP THE CREEK
CLEAR, COLD AND COPIOUS...DUDE

WHAT YOU CAN DO: WORKING ON WATER SOLUTIONS AT DIFFERENT SCALES

WATERSHED ISSUES PROVIDE us with many avenues to become involved at multiple levels and over multiple time scales. Some solutions are small and only require making different choices as an individual or family. These can be done today in your home or yard. Other solutions are more complex, requiring behavioral changes in neighborhoods, communities or cities, with broad-based participation over some years. In order to catalyze changes in water security for future generations, we must implement a whole class of democratic opportunities for social policy change at the county, state and national levels.

This section offers ideas for how to strategically increase your participation with water security at the home, community and national levels. For a more exhaustive listing of resources and updated web links, please visit our website at oaec.org/water.

WATER CONSERVATION: CHOOSE NOT TO USE!

PRACTICING WATER CONSERVATION by reducing our demands for water is one of our most powerful acts, individually and collectively. Water conservation has a cascade of positive effects and can influence the overall quantity and quality of available freshwater. Every gallon of water you choose not to use equals one gallon not taken from your river or aquifer. It means the system does not need that gallon's worth of electricity to pump it, nor the chemicals to make it potable. It means that one gallon is not being degraded into “waste” water, which would require additional electricity to pump it again, treat it, and dispose of it in our environment. Choosing not to use water saves water quantity and quality. It saves energy and money. It helps reduce demands on our watersheds. And it helps to mitigate climate change-induced water stresses by reducing the collective water footprint of humankind.

INDOOR WATER CONSERVATION

PROBLEM: Wasteful Fixtures and Appliances

SOLUTION: Retrofit with Efficient Appliances.

Numerous studies and reports have conclusively demonstrated that the most cost-effective and water-conservative action you can take over time is to retrofit your home with modern water- and energy-saving fixtures and appliances. Municipalities all over the country offer programs to subsidize or provide low-flow or dual-flush toilets, low-flow shower heads, and water/energy-efficient washing machines, water heaters, dishwashers, etc.

RESOURCES: saveourwater.com; h2oconserve.org; watersavingtips.org/act/indoor-water-tips

PROBLEM: Household Chemicals

SOLUTION: Cease Use and Choose Alternatives.

Excessive use of toxic indoor household chemicals—such as pesticide bug sprays, cleaners, chlorine bleach, oil paints, and solvents—is known to contaminate surface and groundwater, pollute indoor air quality, and harm wildlife. Dramatically reduce or entirely cease use of these toxic products. Many effective less toxic and nontoxic products are available and are healthier for you, your family and the watershed.

RESOURCES: ewg.org/guides/cleaners; toxicfreefuture.org/healthy-living/healthy-homes

PROBLEM: Flush Toilets Waste Potable Water and Keep Carbon From Returning to the Soil

SOLUTION: Use Waterless Composting Toilets.

Waterless composting toilets can save billions of gallons of water annually and help cities comply with mandatory conservation measures for drought. These toilets safely process pathogens and ensure public health. They can improve water quality by decreasing pollution of drinking water. Waterless composting toilets are a great replacement for failing septic systems and outdated wastewater infrastructure and help meet greenhouse gas reduction goals by reducing energy used for water transport and treatment. These affordable, natural alternatives to chemical “porta-potties” build topsoil through nutrient capture and application of clean compost to living soil ecosystems. These systems sequester carbon and help mitigate climate change.

RESOURCES: oaec.org/our-work/projects-and-partnerships/compost-toilet-project; greywateraction.org/content-about-composting-toilets; recodenow.org/composting-toilets-in-oregon

“Water is the most critical resource issue of our lifetime and of our children's lifetime. The health of our waters is the principal measure of how we live on the land.”

*– Luna Leopold,
hydrologist and professor, UC Berkeley*

CALIFORNIA CAN'T AFFORD TO FLUSH WATER ENERGY SOIL DOWN THE TOILET

WATER
We're in a drought. Yet the average Californian flushes 16 to 24 gallons of clean drinking water down the toilet every day! And that doesn't include the countless gallons lost through leaky pipes & outdated infrastructure.

ENERGY
20% of California's energy is used for water related uses, including transport and treatment. So when we waste water, we waste energy. When we waste energy, we contribute to greenhouse gas emissions and climate change.

SOIL
Deforestation, industrial agriculture, and over-development have broken the natural carbon cycle by polluting, paving over, and eroding California's precious topsoils without putting anything back in return. Aging centralized wastewater treatment facilities are inefficient & ineffective at removing contaminants and degrade the soil nutrient cycle rather than restoring it.

DOWN THE TOILET

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PROBLEM: Pharmaceuticals and Personal Care Products

SOLUTION: Choose Alternatives and Dispose of Properly.

A critical area of national concern is the dramatic rise of “emerging” compounds or endocrine-disrupting chemicals in our waters. These pollutants primarily originate through our ingestion of pharmaceuticals and beverages and our use of body care products. We unwittingly pass these products through to our wastewater treatment plants, which are not designed to treat these chemicals. Because wastewater discharge/disposal processes deliver treated waste water to our rivers, bays and oceans, these new toxic cocktails are being found at high concentrations in waterways. They have an alarming effect on wildlife. Never flush unused prescriptions or harsh chemicals down the drain or toilet. Most localities have toxics roundups and some towns offer programs for the legal disposal of unused prescriptions. Use safer and less toxic soaps, biodegradable liquid laundry soaps, non-chlorine bleach, shampoo, etc.

RESOURCES: toxicfreefuture.org/healthy-living/healthy-bodies; ewg.org/skindeep; storyofstuff.org/movies/story-of-cosmetics; blog.thinkdirtyapp.com; calrecycle.ca.gov/homehazwaste/medications/household.htm; productstewardship.us/page/GoToGuide

OUTDOOR WATER CONSERVATION

PROBLEM: Dependence on Off-Site Sources of Water

SOLUTION: Harvest Roofwater.

Another opportunity to augment your water budget is to think of your roof as an "above-ground" well. You can harvest significant amounts of water from your roof. One way to estimate this is to consider that for every inch of rainfall on 100 square feet of roof surface, your "above-ground" well yields approximately 55 gallons of water. Safe roofing materials, storage tank size and type, location, conveyance, filtration, and overall costs require careful consideration for this technology to work well. Yet, in most climates it is possible to actually capture, store and provide for all or most of your potable water needs from the high quality rain that falls directly on your roof for free.



Roofwater Harvesting System

This system provides enough water for the needs of a family of four. See www.rwh.in for details.

RESOURCES: arcsa.org; harvestingrainwater.com; oasisdesign.net/water/rainharvesting; oaec.org/publications/roof-water-harvesting-for-a-low-impact-water-supply; oaec.org/wp-content/uploads/2014/09/Low-costroofwater.pdf



El Cerrito City Hall, CA

This landscape combines xeriscaping with a stormwater-harvesting raingarden planted with California natives.

PROBLEM: Lawns and Thirsty Landscapes

SOLUTION: Reduce Lawn Size and Choose Drought-Tolerant Xeriscapes.

During the dry season over 50% of the potable water used by the typical California home is for outdoor use, primarily irrigation for landscapes. Reducing landscape water demand provides a critical opportunity for home water conservation. The best place to start is with reducing the total area of lawn in your landscape. Just the right amount of lawn is great for small-scale lounging and play areas, but as a general groundcover, lawns are highly wasteful. Lawn care requires exorbitant amounts of irrigation water, energy, surface water-polluting nitrogen fertilizers and herbicides, air- and sound-polluting equipment, and significant maintenance time and money. Instead, select winter rain- and summer drought-adapted and native plants for your beautiful new water-saving, edible, butterfly- and hummingbird-friendly xeriscape. Choose and maintain a highly efficient drip irrigation system for those plants that need some supplemental irrigation.

RESOURCES: calrecycle.ca.gov/organics/xeriscaping;
stopwaste.org/preventing-waste/residents/gardening;
saveourwaterrebates.com/turf-replacement-rebates.html;
surfrider.org/programs/ocean-friendly-gardens;
foodnotlawns.com

PROBLEM: Pesticides, Herbicides and Fertilizers

SOLUTION: Cease Use and Choose Safer Alternatives.

Excessive mis-use of toxic fertilizers, herbicides and pesticides is known to cause harm to human and watershed health. Reduce or eliminate the use of these toxic garden products. To help insure the safety of your family and watershed, choose from the many products that allow your landscape to be maintained organically.

RESOURCES: pesticide.org; beyondpesticides.org;
panna.org



Storm Drain Signage

These signs help citizens make the connection between stormwater run-off and the health of bodies of water.

PROBLEM: Irrigation with Potable Water

SOLUTION: On-Site Residential Greywater.

Use of residential greywater generated on-site is legal in California, although each county and city has its own permitting process. Whether you use a Laundry To Landscape or Branched Drain system, on-site greywater irrigation reduces the demand on potable water for irrigation. It also reduces the overall amount of wastewater and the electricity needed to pump it away for centralized treatment and then pump it back to you as "recycled wastewater" in a purple pipe.

RESOURCES: oasisdesign.net/greywater;
greywateraction.org; oaec.org/publications/legal-graywater-design-for-small-scale-applications-in-california

PROBLEM: Dehydrated Landscapes

SOLUTION: Build Raingardens and Bio-Swales

Think of your home and yard as your own watershed. Numerous opportunities exist in your landscape to design and implement stormwater harvesting systems—known as raingardens, bio-swales, contour infiltration ditches, natural drainage networks, and so forth. The use of these structures will allow you to offset the impact of impervious surfaces on your land. After your roofwater cistern, the best place to store water is in the soil. If your soils are not appropriate for infiltration, a biofiltration design will ensure that the water leaving your yard will not be a source of pollution or contribute to flood flows. The stormwater harvesting structures should be designed to store winter rain in the soils, so that it is available in the dry season as sub-surface irrigation for your native, wildlife-friendly, edible landscape. In the long term it will be ideal to not only live and eat within your edible landscape, but also to live and drink within your potable landscape.

RESOURCES: raingardennetwork.com;
timberpress.com/books/creating_rain_gardens/woelfle-erskine/9781604692402; harvestingrainwater.com;
timberpress.com/books/9780881928266



Glencoe Raingarden, Portland, Oregon

This vegetated infiltration basin works to store, recharge and filter street runoff of stormwater pollutants.

“Water links us to our neighbor in a way more profound and complex than any other.”

— John Thorson, author, Indian Water Rights

YOU CAN ORGANIZE YOUR BASIN OF RELATIONS

WE ARE PERCHED on the tipping point of a "watershed moment." From the global scale to the local scale, we are faced with a multitude of issues and decisions that will determine the future our children will inherit. The time is now for our communities to come together, setting in motion the plans and processes to ensure that our watersheds remain healthy in perpetuity. Viewing your watershed as a shared "basin of relations" allows you and your neighbors to truly define the boundaries of your community and organize around meaningful issues of true and lasting local social security. Each process, like every watershed and its associated community, is unique. Oftentimes you will find that certain local, city, county, state, and federal jurisdictions are ready and waiting to collaborate with these efforts. In the absence of support from the local community, it is often impossible to achieve measurable objectives and resource management goals, especially in areas where the majority of the land is in private ownership.

PROBLEM: Disconnected Watershed Communities

SOLUTION: Form a Watershed Group

Nationally, one of the great unrecognized environmental movements is the dramatic growth of community-based watershed health groups. River Keeper organizations, Friends of Creeks groups and watershed councils are springing up all over the country. Some are homespun at the kitchen table and some are top-down, large-scale and include all levels of bureaucracy with a multi-stakeholder approach. Quite possibly one of these already exists in your area. If not, then you can initiate a dialogue in your community about starting such an effort.

RESOURCES: epa.gov/nps/watershed-capacity-building;
ucanr.edu/sites/watershedslavventura/A_Toolbox_for_Watershed_Management;
cfpub.epa.gov/surf/locate/index.cfm

PROBLEM: Lack of Watershed Literacy and Ecological Literacy

SOLUTION: Work within the Community to Offer Diverse Educational Opportunities.

Educational programs are great ways to involve and build participation in a newly started watershed group. There are many ways to improve the state of knowledge about water in your community. Invite knowledgeable watershed people to publicly address your neighborhood association, social club, congregation, public schools, or city council. To help interpret the condition of your local area, organize watershed walks with community members who have specific knowledge. Host a storm-drain stencil party. Make and publicly display maps of your watershed. Implement a watershed and creek road signage program to improve watershed literacy, as people are much more likely to relate more strongly to watersheds and creeks they can name. Increase your ecological literacy and learn who lives in your watershed by participating in Christmas Bird Counts, iNaturalist Bio-Blitzes or becoming a Master Naturalist.

RESOURCES: water-ed.org; thewatershedproject.org;
watereducation.org/project-wet; inaturalist.org;
oaec.org/publications/beaver-in-california;
audubon.org/conservation/science/christmas-bird-count;
wildlifegardeners.org/forum/stewardship/2580-list-state-naturalist-master-naturalist-programs.html



Seasonal Watershed Signs, Occidental, CA
The WATER Institute co-created these signs to inspire better watershed stewardship.



WATER Institute Basins of Relations Training - Students learn about salmon habitat restoration techniques.

PROBLEM: Beaver are Considered a Nuisance

SOLUTION: Share Beaver Stewardship Strategies with Landowners and Agencies.

Many people are not aware of the ecosystem services beavers can provide. This lack of awareness often leads to mismanagement, to the detriment of sensitive species recovery and water supply security for humans and wildlife. There is a great need to share this information, especially with those communities living with beaver, the agencies that work in these areas and the decision makers who dictate how these beaver are managed. To ensure greater stewardship, educate yourself further about beaver; host a talk or screen a movie about beavers in your community; share the WATER Institute's beaver stewardship guidebook; let people know that beaver advocates are available to offer advice, site visits and provide resources to implement non-lethal strategies; convene meetings for stakeholders to express their concerns and explore options for beaver co-existence; talk to decision makers and resource agencies about how to co-exist with beaver; or start a beaver festival to celebrate the importance of this keystone species.

RESOURCES: oaec.org/beaver; oaec.org/publications/beaver-in-california; swiftwaterdesign.com; sierrawildlife.org; martinezbeavers.org; scottriverwatershedcouncil.com/; [youtube.com/watch?v=aHBCQ_EQ0v0](https://www.youtube.com/watch?v=aHBCQ_EQ0v0); [youtube.com/watch?v=PLyBZ1mdg2c](https://www.youtube.com/watch?v=PLyBZ1mdg2c)

PROBLEM: Lack of Knowledge about Your Watershed's State of Health

SOLUTION: Prioritize Systematic and Standardized Watershed Assessments.

Once a community has self-identified their intention to work collaboratively on behalf of their watershed and thus themselves, it is critical to understand the overall state of the health of the watershed. There are a number of watershed assessment approaches. The greater the community knowledge of their watershed, the more strategic they can be in targeting high priority issues. Watershed assessments help insure that investments of community time and money towards watershed restoration will yield the highest return possible.

RESOURCES: cwam.ucdavis.edu; cwp.org; water.usgs.gov/wsc/assessment.html



North American Beaver

PROBLEM: Municipal Use of Potable Water

SOLUTION: Localize and Augment Water Sources through Conservation, Reuse and Harvest.

Irrigating with high quality and precious potable water is a poor use of this energy-intensive, limited resource. More and more municipalities are providing recycled or treated wastewater via “purple pipe” systems, to prevent wasting our highest quality potable water for landscape irrigation. Find out if your municipality is recycling its water and if not talk to your city staff about what it would take to implement such a program. Work with your water district to develop more localized water conservation, reuse and augmentation program.

RESOURCES: cowa.org; whollyh2o.org; waterboards.ca.gov/water_issues/programs/index.shtml#waterrecycling; oaec.org/our-work/projects-and-partnerships/ca-decentralized-water-policy-council



Russian River First Flush

Water quality sampling equipment.

PROBLEM: Degraded Water Quality

SOLUTION: Support or Start Water-Quality Monitoring Programs.

Citizen-based water-quality monitoring is an accessible and meaningful way to understand the health of your waterways. These surveys can pinpoint and prioritize pollution-source problems that should be addressed. If a standardized water quality or First Flush program already exists in your watershed, then volunteer to participate. If no program exists, consider working with your neighbors and the appropriate technical/regulatory agencies to develop a water-quality monitoring program. If you desire to use the results of your monitoring to actualize restorative changes, it is critical that your sampling protocols are standardized for quality control and assurance. Water monitoring can be a great way to get outside and do something hands-on. There are a number of easily replicable models for water monitoring and the process of implementation is often a highly empowering practice for people. Organizing an afternoon creek cleanup program is another way to entice neighbors to participate in improving water quality.

RESOURCES: waterboards.ca.gov/water_issues/programs/swamp/cwt_volunteer.shtml; epa.gov/nps/nonpoint-source-volunteer-monitoring; epa.gov/nps/watershed-approach



YOU CAN WORK FOR SYSTEMIC POLICY CHANGES FOR WATER SECURITY

CONSIDERING THE IMPORTANCE of water, it is essential to involve yourself in the politics of water resources. Do you know the members of your local, city, county, or regional water board? Or of your irrigation district, planning commission, board of supervisors, or city council? How about your state and federal legislators? How do they make decisions? Have you participated in the democratic process of helping them make decisions? Have you ever thought about running for a local office yourself?

Ultimately, lasting change will have to occur via the arenas of politics and democratic decision making. We the People are responsible for sane water policies and laws through our legislative, executive and judicial branches. Metaphorically, you could conceive of these three branches as expressions of social watersheds. At the confluence of these three watersheds, the health of the “mainstream” is only as good as the health of each contributing watershed branch. It is our collective responsibility to make sure each branch of our democratic structure crafts adequate supportive conditions to care for our collective water resources.

PROBLEM: Land Use Planning that is Water-Illiterate

SOLUTION: Participation of Watershed Citizens in Land Use Planning at All Levels.

The General Plan for a city or county is the “land use constitution” of that jurisdiction. It is therefore imperative that whenever your city or county updates your General Plan, watershed citizens must participate. The process of deciding and designating which land uses will be allowed where in the watershed is a critical point of participation. These decisions will determine the future development of your watershed. Support and promote legislation that would require all city and county General Plans to have a stand-alone Water Element, which consolidates all things water-related into one section of the plan. A short list of arenas to be considered includes water supply, wastewater disposal/reuse, surface and groundwater management, streamside setbacks, fisheries recovery, flood protection, import and export issues, dams and reservoirs, water conservation, development of water budgets, and watershed planning.

RESOURCES: treepeople.org; lgc.org/water-guidebook; sierranevadaalliance.com/wp-content/uploads/2014/02/PlanningforWaterWiseDevelopment.pdf; solano.com/processxml.asp?tid=WL&StyleSheet=title.xsl (Water and Land Use by Johnson & Loux); lowimpactdevelopment.org

PROBLEM: Industrial Agriculture Using and Polluting the Majority of Our Water

SOLUTION: Implement On-Farm Water Conservation and Protection Programs.

In California, agriculture uses an estimated 60-80% of the state's developed water supply. We recognize the critical importance of agriculture as an economically viable producer of food. By the same token, agriculture must bear a proportionate level of responsibility to ensure that our water is used wisely and not degraded. It is critically important to participate with your elected representatives in framing the water-related language of our national Farm Bill. Many sectors of the agriculture community have effectively implemented creative approaches to water conservation and protection, yet much work still remains. Selection of dryland climate-appropriate crop choices is important. Advanced erosion-control practices, tailwater management, dramatic reduction in the use of toxic fertilizers and pesticides, and highly efficient irrigation technologies are all urgently needed.

RESOURCES: agwaterstewards.org; ucanr.edu/sites/farmwaterquality; nrca.usda.gov/programs; eco-farm.org/water-stewardship; aginnovations.org/project/california-roundtable-on-water-and-food-supply; calclimateag.org

PROBLEM: Groundwater Depletion and Degradation

SOLUTION: Enforce the Management and Protection of All Groundwater.

Unlike many other western states, California did not regulate the withdrawal of groundwater until it passed the California Sustainable Groundwater Act in 2014. This long overdue act was passed in response to numerous groundwater basins experiencing overdraft resulting in serious decline in water tables and water quality. The recognition that surface water and groundwater are not separate resources is critically important to the health of watersheds overall.

RESOURCES: water.ca.gov/groundwater; groundwater.org; pubs.usgs.gov/circ/circ1139/pdf/circ1139.pdf



PROBLEM: Reduced Flows in Streams and Rivers Limiting Aquatic Life

SOLUTION: Implement Programs to Ensure Minimum Flows for All Waterways.

We must require and support the enforcement of programs such as the Policy for Maintaining Instream Flows in Northern California Streams to protect the instream flow regimes of all waterways. The California State Water Resources Control Board must be more proactive in their application process for water rights, supporting a timely process for applicants. Yet we also must ensure that watersheds are not over allocated to the detriment of healthy instream flows. Statewide, we need programs that create the conditions for water conservation, reuse and augmentation programs. These must mandate environmental water reserves, keeping water in the environment and unavailable as a vector of growth inducement. We need to develop creative programs to store winter water and acquire seasonal water rights, with forbearance agreements to prevent excessive dry season withdrawals and ensure adequate water supply. Exported water should be limited and not allowed to leave a watershed until all human and environmental needs are satisfied there.

RESOURCES: wildlife.ca.gov/Conservation/Watersheds/Instream-Flow; instreamflowcouncil.org; sanctuaryforest.org/programs/water-stewardship/tanks-forbearance-program/; cohpartnership.org

PROBLEM: Corporate Privatization of Water

SOLUTION: Manage Watershed for Local Control and Protection of Water Resources.

Increasingly, communities are becoming dependent on bottled water and multi-national corporations that provide municipal water services. Water must be considered a human right. It is a shared common wealth resource, not a corporate commodity to be sold to the highest bidder. Ironically, in many cases—as a result of watershed mismanagement and clever corporate marketing—communities distrust their local water supplies and become dependent on expensive filtered and bottled water instead of their own tap water. The best way to secure an economically sustainable source of pure water for your community will always be to properly protect and manage your watershed.

RESOURCES: foodandwaterwatch.org/insight/water-privatization-facts-and-figures; citizen.org/documents/Top10-ReasonsToOpposeWaterPrivatization.pdf



RECOMMENDED BOOKS TO START YOUR NEW WATER LIBRARY:

Fresh Water

E. C. Pielou, 1998.
University of Chicago Press, Chicago, IL.

Introduction to Water in California

David Carle, 2004.
University of California Press, Berkeley and Los Angeles, CA.

Rainwater Harvesting for Drylands: Volume 1 and 2

Brad Lancaster, 2006 and 2008
Rainsource Press, Tucson AZ.

Totem Salmon: Life Lessons From Another Species

Freeman House, 1999.
Beacon Press, Boston, MA.

Water: A Natural History

Alice Outwater, 1997.
Basic Books, New York, NY.

Water In Plain Sight: Hope for a Thirsty World

Judith D. Schwartz, 2016.
St. Martin's Press, New York, NY.

Watersheds:

A Practical Handbook for Healthy Water

Clive Dobson & Gregor Gilpin Beck, 1999.
Firefly Books, Buffalo, NY.

The Water-Wise Home:

How to Conserve, Capture, and Reuse Water in Your Home and Landscape

Laura Allen, 2015.
Storey Press, North Adams, MA.

*“It makes better sense to reshape ourselves to fit a finite planet
than to attempt to reshape the planet to fit our infinite wants.”*

– David Orr, author and professor, Oberlin College

IS YOUR WATER BUDGET BALANCED?

For a moment, consider water in budgetary terms. Successful businesses must account for income and expenses in order to ensure profitability. Yet how many cities or counties actually have balanced income and expense budgets for their water resources? In simple fiscal terms, most municipalities are operating deeply in the "red" with ecologically and socially damaging hydrological deficits. Typically the demand or expense side of their water budgets far exceeds their income streams. Impervious surfaces such as roads, parking lots and compacted fields impede water's ability to make deposits that could recharge groundwater savings accounts.

Ever-increasing reliance on overdrafted groundwater accounts will leave our grandchildren with unrecoverable and undrinkable debts, as many of the world's watersheds verge on hydrological bankruptcy. Unlike corporations and people, our watersheds cannot file Chapter 11 and then just re-organize. Direct deposits of freshly distilled rain and snow are the annual allowance—the only real renewable income source on Planet Water.

Expenditure of our groundwater trust reserves should be limited to the annual earned interest income of infiltration, with the principle left untapped. All life forms are shareholders with a fixed interest in ensuring that our watershed economies remain viable and continue to operate in the Blue.



DO YOU KNOW WHERE YOUR WATERSHED IS TONIGHT?



What watershed supplies your water? What watershed do you live in?

Are they the same? What do you use water for?

How safe do you believe your water supply to be?

Where do you get your drinking water?

How long have you been dependent on bottled water?

Would you like to restore your own local drinking water supply?

For more information and additional copies of this publication please contact:



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OCcidental ARTS & ECOLOGY CENTER

15290 Coleman Valley Road, Occidental CA 95465

(707) 874-1557 • www.oaec.org/water