WATER LA | 2018 REPORT

Water LA

capture · conserve · reuse

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A REPORT BY THE RIVER PROJECT

FEBRUARY 2018

EXECUTIVE SUMMARY

Los Angeles faces critical challenges to ensure water security and climate resilience. Long, seasonal dry periods and droughts, as well as short periods of heavy rainfall, characterize our Mediterranean climate. Climate change is creating more extreme conditions, leading to longer dry periods and more intense storms.

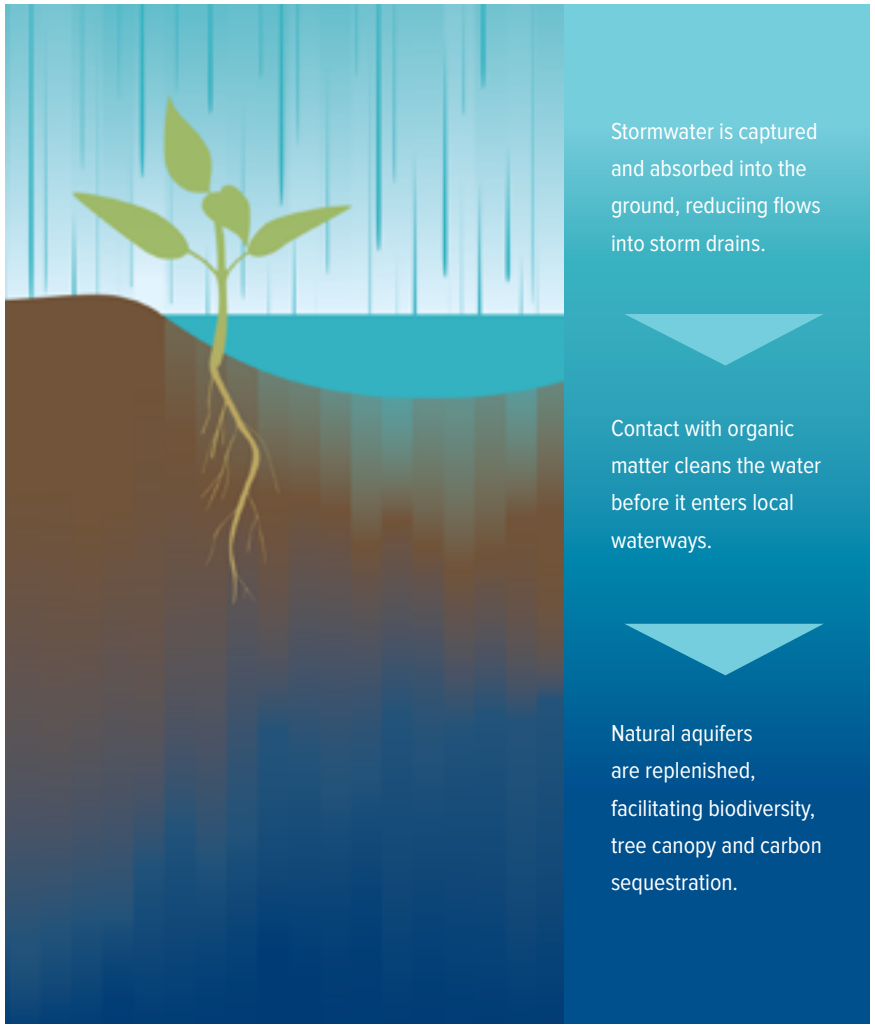
At the same time, the urban landscape has been designed to drain rainwater and dry weather flows into the ocean as quickly as possible, failing to treat water as a precious resource. Engineers have long focused on large infrastructure projects to meet our flooding challenges and potable water needs. But we no longer have the luxury of relying on these large projects that allow us to be inefficient with the rest of our land and water. We must create a new normal that capitalizes on our invaluable local water supplies and embraces nature's services.

This report explores the opportunities for and challenges of building a resilient region by making small, distributed changes to the urban landscape. The Water LA program serves as an example of this approach. Working with small, nature-based solutions—and streamlining practices and policies to support scaling up implementation—is a critical path for a sustainable future.

> In cities across the globe, much of the urban landscape is dedicated to housing. In Los Angeles, residential property comprises 60% of the developed landscape.

Even so, this space is rarely considered in plans for addressing urban environmental challenges that affect all residents. In a time of rapid climate change, this omission represents a massive missed opportunity for cities grappling with increasing environmental pressure.

NATURE-BASED SOLUTIONS



> Nature-based solutions maximize vegetation, soils, and other elements and practices to restore some of the natural processes required to manage water and create healthier urban environments.

Through a case study of a parcel-scale water management project in the City of Los Angeles, we explore the social, environmental, and economic impacts of retrofitting residential property into spaces of water capture, conservation, and reuse. These interventions transform parcels into spaces that help heal and improve the urban environment and improve quality of life. To highlight the targeted, small-scale nature of these strategies, we refer to this approach as "urban acupuncture."

THE HOMES RETROFITTED BY WATER LA:

- Reduced water use by an **average 25%**
- In a year with average rainfall, they capture and treat an estimated **1.2 million gallons** of water.
- Provide **18,175 square feet** of native plants and trees for habitat, shade, air quality enhancements, carbon sequestration, and aesthetic benefits
- Cost an average **$5,200 per household** in labor and materials

The initial outcomes indicate that if parcel-based techniques were adopted across the region, Los Angeles could reduce the rate of potable water consumption, reduce flood risk, clean streams, and increase local water supply. Hydrologic modeling data indicates that the reworked properties absorb a substantial amount of rainwater into the ground, decreasing pollution in the region's waterways and recharging the underground aquifers.

The Water LA program and collaborative was launched with funding from the Coastal Conservancy, LADWP and the Rose Foundation, in conjunction with local agencies and partners.

22 households in the San Fernando Valley neighborhood of Panorama City were retrofitted. Participants could draw on any of combination of six small-scale, low-cost, low-tech strategies.

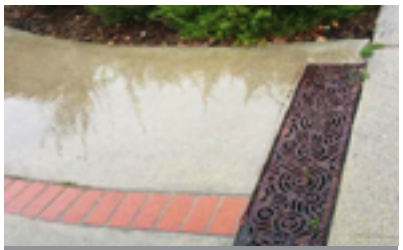

RAIN TANKS $-$$$


RAIN GRADING/RAIN GARDENS $-$$


PARKWAY RETROFITS $$-$$$


PERMEABLE PAVING $$-$$$$

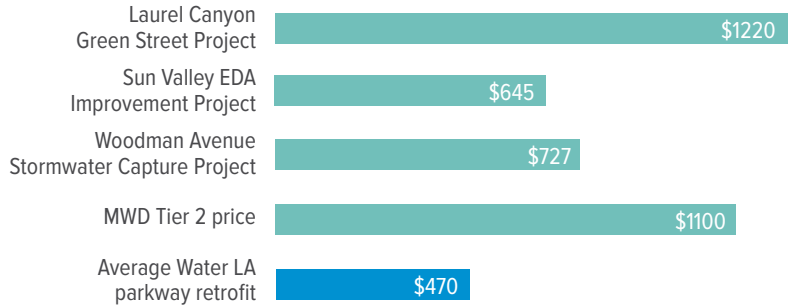

GREYWATER SYSTEMS $-$$$


INFILTRATION TRENCHES $$-$$$$

Of key significance: given the small-scale, relatively low-tech nature of the projects, a substantive rollout of the program could likely be carried out more quickly and cost-effectively than a more-engineered green streets program. In contrast to an approach that requires digging up streets and building underground chambers for water storage, the techniques we deployed can be adopted by residents with minimal assistance from municipal agencies. Many property owners already spend significant time and money on landscape care and maintenance. Education, incentives, and readily available materials can support residents in making massive impacts on resource conservation without increasing municipal expenditures, and potentially even saving money.

This point is particularly salient given the high rates of parcel-based green infrastructure adoption that local policy documents—such as the Enhanced Watershed Management Programs (EWMPs) and Stormwater Capture Master Plan—require to meet their water quality and infiltration targets. Relying on simple retrofits carried out on private land and stewarded by everyday Angelenos offers a pathway to meet these ambitious targets without threatening municipal budgets.

LADWP STORMWATER PROJECT COSTS (per acre-foot of water)



"I love the way the neighborhood is looking with all the projects, I hope more neighborhoods do the same thing..."

Program participants also reported an increased interest in environmental issues and great affection for the increased beauty of their properties. Allowing residents to customize a set of urban acupuncture strategies for their properties created substantial community buy-in for the program, even though the new landscapes represented a marked departure from longtime local landscape design norms.

> Participants' embrace of the retrofits, along with the notable environmental benefits achieved through the project, suggest that if this approach becomes the norm across the region, it has the potential to help local cities attain ecological resilience.

OUR KEY FINDINGS EXPLORE THE FOLLOWING AREAS:

- Parcel-scale stormwater management is effective.
- Urban acupuncture can take on many styles and forms.
- Demand exists but a support system is needed.
- Site assessment is challenging but technology can help.
- Long-term maintenance requires access to materials.
- LA needs a pool of trained urban acupuncture practitioners.
- Local code barriers are surmountable, with persistence.

Over the course of the Water LA project, our team was able to amend a number of restrictive building codes, developing a streamlined greywater system permitting process, legalizing a range of permeable paving materials for driveways, and developing new city-wide standards for parkway basins.

We also discovered barriers that, if left unaddressed, will limit the expansion of a parcel-based approach to environmental management.

IN RESPONSE, THIS REPORT ANALYZES CHALLENGES AND OFFERS THE FOLLOWING POLICY RECOMMENDATIONS:

- Further modify building, planning, and landscaping codes, as well as other guidelines
- Facilitate ongoing, localized support for adopting and maintaining retrofits
- Foster career paths in nature-based climate adaptation.
- Improve incentives and rebates for residents.

Given the city's environmental challenges, LA must be dynamic and proactive, leveraging the people, professionals, and collective government resources available to realize work at all levels—from regional capital projects to neighborhood-scale green streets and park improvements, down to parcel levels with nature-based solutions. As the Water LA collaborative develops, we continue to build pathways to partnerships between agencies, non-government organizations, and the private sector.

Many of our recommendations are targeted at improving the particular conditions within LA. But the threats and barriers we detail here are common in many urban areas, and becoming even more so as the 21st century progresses. Numerous cities struggle with the heavy burden of long-term infrastructural maintenance. As such, the analysis and recommendations here will be of use to practitioners well beyond LA's borders.

INTRODUCTION

Powerful droughts. Flash floods. Fire. Erosion. Urban heat island effect. Aging and outmoded infrastructure. Polluted rivers. As in urban areas across the globe, the list of threats to LA's local environment is long, and expected to grow as global climate change progresses. To address these challenges and achieve resilience, our region must quickly implement a range of infrastructural, ecological, institutional, and behavioral responses in the years to come.

IN THIS SECTION

- PROJECT BACKGROUND: LOCAL WATER POLICY
- NATURE-BASED SOLUTIONS
- WATER LA PROGRAM GENESIS

INTRODUCTION

This report assesses the benefits of and barriers to incorporating residential landscapes into the work of urban environmental management. In the past, most programs to manage LA's environment have been undertaken on a far grander scale, in the form of massive, centralized, single-purpose grey infrastructure. Most of our water supply travels over mountains and across deserts through aqueducts to reach our taps, and our namesake river and its tributaries were paved over in concrete with the intention of controlling floods. For a century LA has poured resources and energy into big infrastructural projects like these. Only recently has there been focus and action at the neighborhood-scale with green streets and park improvements.

Here, we examine what we can do on individual properties to help create the environmental security and resiliency that we will need in the decades to come. The Water LA program was developed to explore the possibilities of LA residents playing a substantial role in managing the region's stormwater. Intended to maximize water capture, conservation, and reuse on individual properties, the pilot offered a model for how to design sustainable home landscapes. For example, the City of Los Angeles' 585,738 single-family residential properties comprise 60% of the city's developed land area, representing a huge sustainability opportunity.

> What would it look like to remake LA's landscape into a space where distributed, nature-based infrastructure manages stormwater? How could local communities play a leading role, and benefit from this infrastructure? And what challenges—legal, regulatory, economic, and social—need to be addressed for us to scale up the implementation of these techniques?

Water LA provides a case study of a parcel-based retrofits carried out in LA's San Fernando Valley. Detailing the program's successes and hurdles, we aim to provide actionable information for urban stakeholders seeking to implement parcel-scale, nature-based solutions across their cities in a widespread, systematic manner.

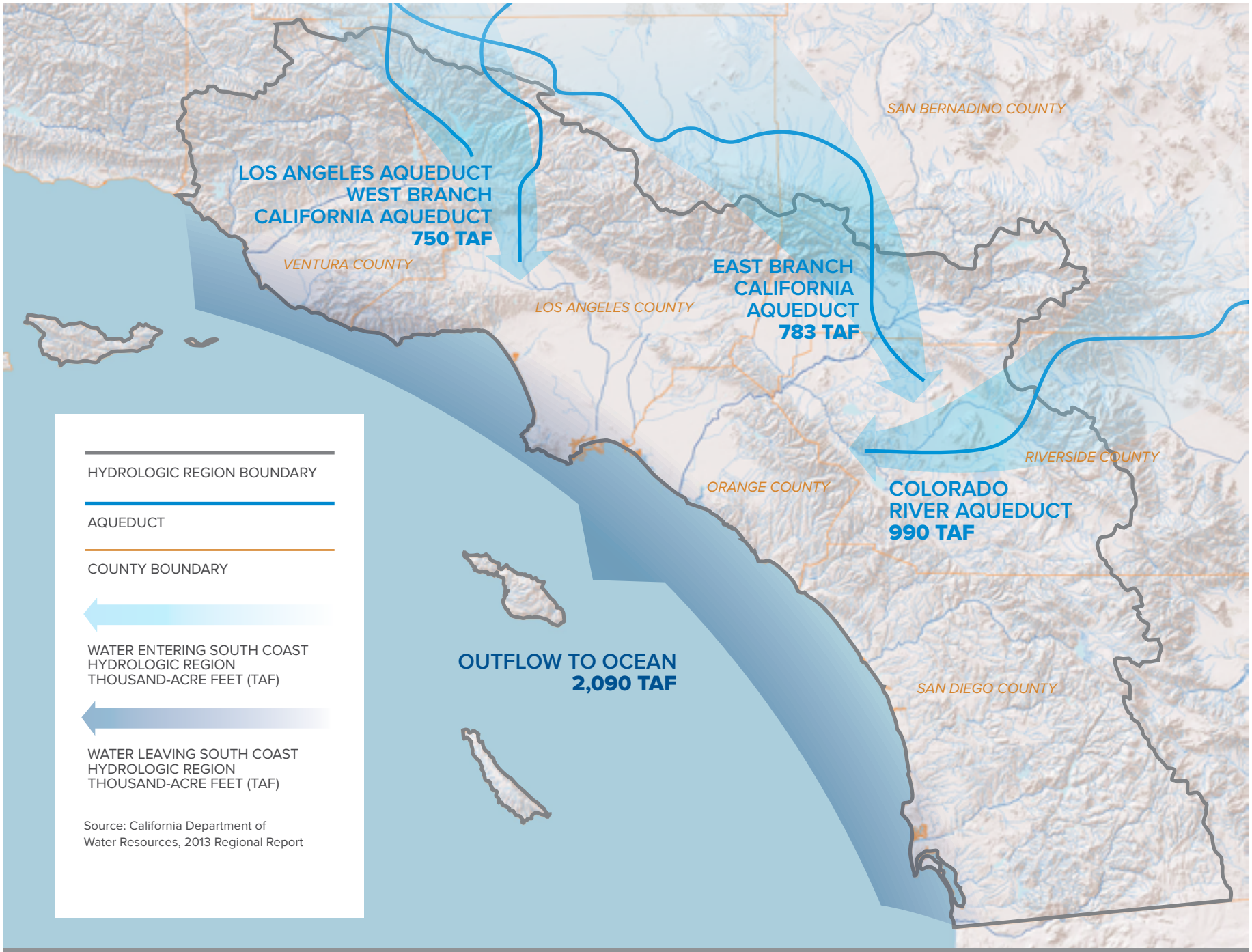
PROJECT BACKGROUND: LOCAL WATER & POLICY CONTEXT

Contrary to popular myth, Los Angeles was not built in a desert. When Spanish colonizers initially encountered the landscape, they described it as a riot of wildflowers, wild grapes, sage, rose bushes, and sycamore trees. “A very lush and pleasing spot, in every respect,” Father Juan Crespi of wrote in his journal of the lands surrounding the Los Angeles River in 1769. “To (the) southward there is a great extent of soil, all very green, so that really it can be said to be a most beautiful garden.”

In more prosaic terms, the LA geological basin is characterized by a Mediterranean climate with seasonal rains, concentrated between October and March. Average annual rainfall amounts to approximately 12” a year near the coast and 15” around downtown. Local mountains receive 35” or more. While significant, wet periods are punctuated by dry periods, and sometimes years-long droughts. In this respect, Los Angeles is equipped with a valuable natural resource: the geology below the basin includes large underground storage areas for water. Much of the basin is capable of infiltrating stormwater directly into these groundwater aquifers. Based on the soil survey updated by the US Natural Resources Conservation Service (NRCS) in 2017, most soils absorb and infiltrate rain at a rate of several to dozens of inches per hour.

LA’s namesake river basin supported local indigenous groups for millennia, and supplied sufficient water for the Spanish missions and Mexican and Anglo ranchers and farmers of the 18th and 19th centuries. However, the contemporary city relies primarily on water imported from other regions, rather than on its local water sources. In the early 20th century, concerned that access to water supplies could limit the metropolis’s expansion, city leaders acquired the rights to water in the Owens Valley. An aqueduct transporting that water hundreds of miles south into the San Fernando Valley was completed in 1913, and the City of LA has been dependent on water from beyond its borders for the majority of its supply ever since. In 1928, the city became a founding member of the Metropolitan Water District, a regional water wholesaler that built a pipeline to bring Colorado River water to Southern California in 1939. Additional aqueducts followed. Today, roughly 90% of the City of LA’s water supply is imported from another region. Local groundwater and recycled wastewater supply the rest.

The Santa Clara River offers a glimpse of a native Southern California landscape.
Photo: Lynne Plambeck



Imported water nearly equals the amount of water outflow to the ocean, highlighting inefficiency in current water management.

Most of the city's stormwater is managed through an extensive network of concrete street gutters, storm drains, and flood control channels, the flows directed out to the Pacific Ocean. This network of "grey infrastructure" was established in response to early 20th century floods, which severely damaged property adjacent to the LA River and its tributary streams. The aftermath of these storms raised concerns about the viability of future development within the floodplain, spurring a protracted assessment of flood management options within the county.

The 1936 Flood Control Act enabled the city to draw on federal funding and the aid of the Army Corps of Engineers, which led the way in paving over many of the city's watercourses, including most of the LA River. Over time, this network of grey infrastructure led to the serious reduction of natural groundwater recharge. Meanwhile, models suggest that precipitation within the region will likely become flashier, heightening flood risk.

These conditions were exacerbated by the extensive urbanization that took place across the county during the second half of the 20th century, replacing water-absorbing landscape with impervious surfaces like concrete, asphalt, and turf grass.

> Studies suggest that, through the early 1960s, more than 80% of the region's rainfall was absorbed into the ground or evaporated. Now, this figure is less than 50%. In short: a lot of the rainwater that falls on the region flows quickly out to sea.

In addition to a reduction in groundwater levels, this approach aggravated pollution in local waterways, as urban runoff carries trash, bacteria, and heavy metals with it when it moves through city streets and into streams. Given that 95% of Los Angeles' waterways are impaired for at least one pollutant, the federal Clean Water Act requires LA to address the pollution problems within its waterways

Concrete flood control channels direct stormwater to the Pacific Ocean.

over the next three decades. The groundwater basins have also been plagued by contamination problems, caused largely by the disposal of industrial solvents in cesspools. Though the LADWP has begun efforts to remediate the San Fernando Valley Groundwater Basin, at present dozens of groundwater pumping wells cannot operate safely due to this pollution.

Today, LA's water management and aging infrastructure are considered increasingly precarious, due to a number of environmental, legal, and political stressors. Climate modelers predict that the imported water sources on which the region relies will become less dependable in the decades to come. Ongoing regulatory controversy and political wrangling over Northern California's Bay-Delta region may also limit supplies. And competing claims over water allocations along the Colorado River threaten to exacerbate conflict over those resources, particularly during drought periods, which scientists predict will lengthen and worsen in the years to come.

NATURE-BASED SOLUTIONS

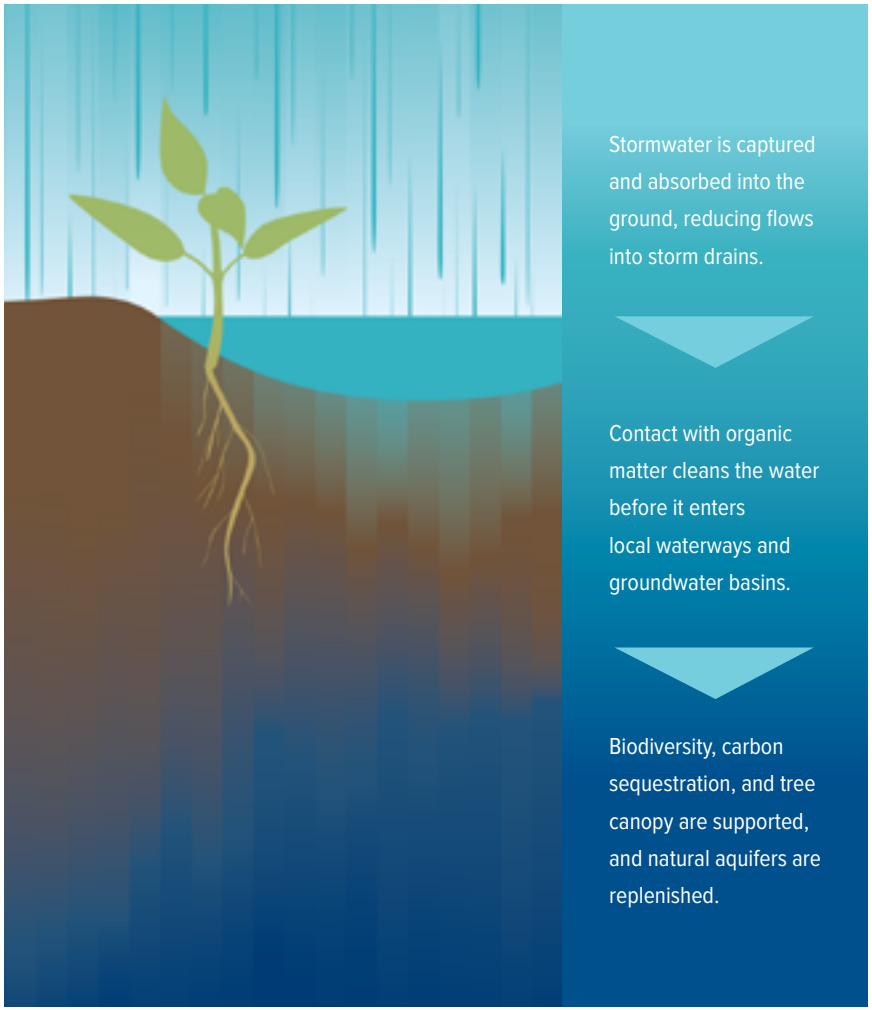
Nature-based solutions use organic materials to facilitate natural processes. In terms of stormwater, rain is absorbed where it falls, reducing flows to storm drains. Contact with healthy soils and root systems accelerates infiltration, cleans storm water before it enters groundwater basins and local waterways, and drives interconnected processes that support biodiversity, tree canopy, and carbon sequestration.

Experts increasingly consider nature-based solutions to be important components of an effective response to urban water challenges like LA's. The US EPA, which encourages cities to consider the approach, defines green infrastructure:

> "Green infrastructure uses vegetation, soils, and other elements and practices to restore some of the natural processes required to manage water and create healthier urban environments. At the city or county scale, green infrastructure is a patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the neighborhood or site scale, stormwater management systems that mimic nature soak up and store water." (EPA 2016)

This approach has come to be recognized as an ecologically and economically efficient response to urban environmental threats, capable of providing multiple benefits to local communities. Among many experts, it is seen as key to adapting to the impacts of global climate change. Capturing water, increasing tree canopy, expanding biodiversity, and absorbing greenhouse gases by building soil carbon all increase resilience to extreme conditions. Government entities and influential NGO initiatives currently promote nature-based solutions for urban regions, including the U.S. EPA and the Rockefeller Foundation's 100 Resilient Cities Challenge.

NATURE-BASED STORMWATER MANAGEMENT



Nature-based solutions is a term for low-impact green infrastructure, emphasizing natural materials and ecosystem functions. We refer to the small-scale, distributed versions of nature-based solutions as "**urban acupuncture**," highlighting the cumulative value of such targeted micro-interventions.

Native plants and healthy soil are foundational for climate resilience. A diverse structure of plants—from ground covers to shrubs and trees—absorb compounds toxic to humans as nutrients and can reduce localized concentrations of nitrogen dioxide by as much as 40% and particulate matter by as much as 60%.

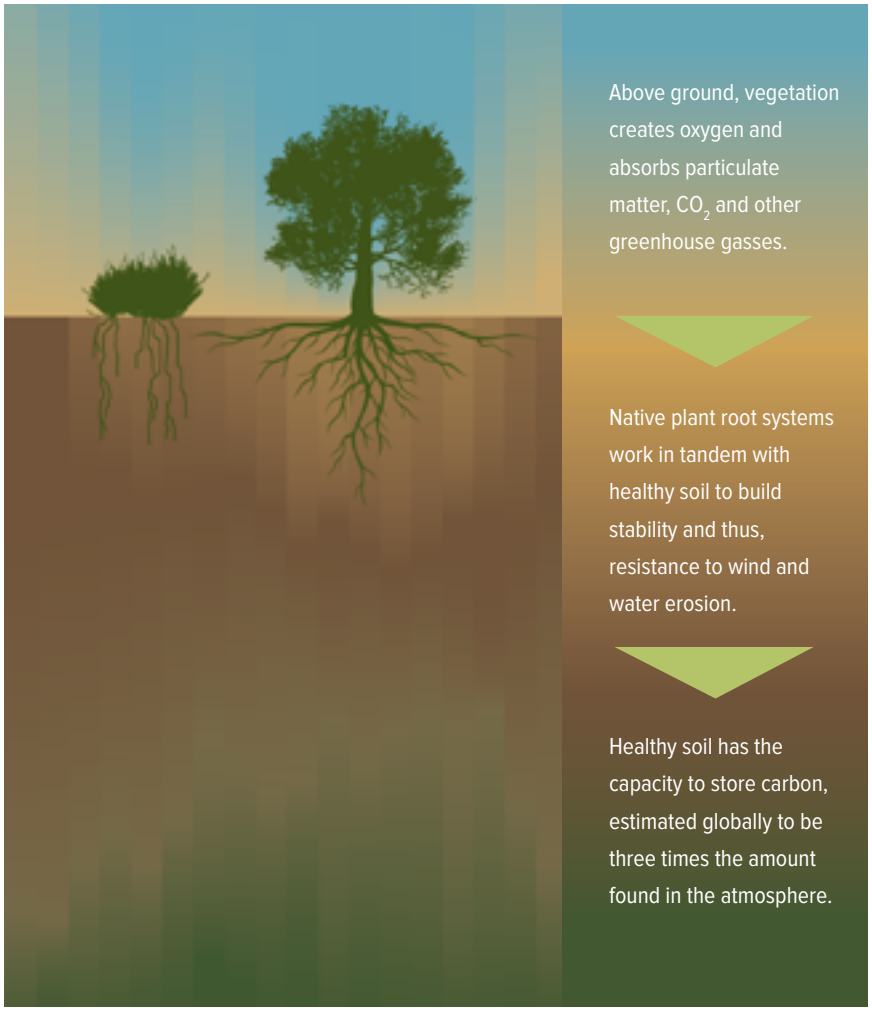
Diverse native plant communities also build soil structure and stability, creating resistance to wind and water erosion. Healthy soil can increase water infiltration and hold up to 20 times its weight in water, significant factors in minimizing flood impacts. Increasing soil's organic matter can increase its available water-holding capacity. Soil also absorbs carbon. The world's soils store on the order of 2,500 gigatons of carbon, approximately 75% of the carbon pool on land—three times the amount in the atmosphere.

> "We're in a new era. The idea of your nice little green grass getting lots of water every day, that's going to be a thing of the past."
>
> —Governor Jerry Brown, 2015

Native plant landscapes use on average 80% less water than traditional gardens, do not require fertilizers or soil amendments, and most native wildlife—such as birds and pollinators—depend upon them. Once established, well-selected native plants require little maintenance, and arrangements can accommodate aesthetic benefits such as aroma, color, and seasonal interest.

Early outdoor water-conservation efforts encouraging "xeriscape" were not well received in the region, in part due to the erroneous assumption that options were limited to cacti and succulents. However, with more than 6,000 plant species native to California, there is variety for any situation.

NATURE-BASED CARBON SEQUESTRATION



Native plants and microorganisms in soil form the interconnected systems that support mechanisms through which complex life can exist—generating food, materials, shelter, and the cultural benefits of thriving outdoor spaces.

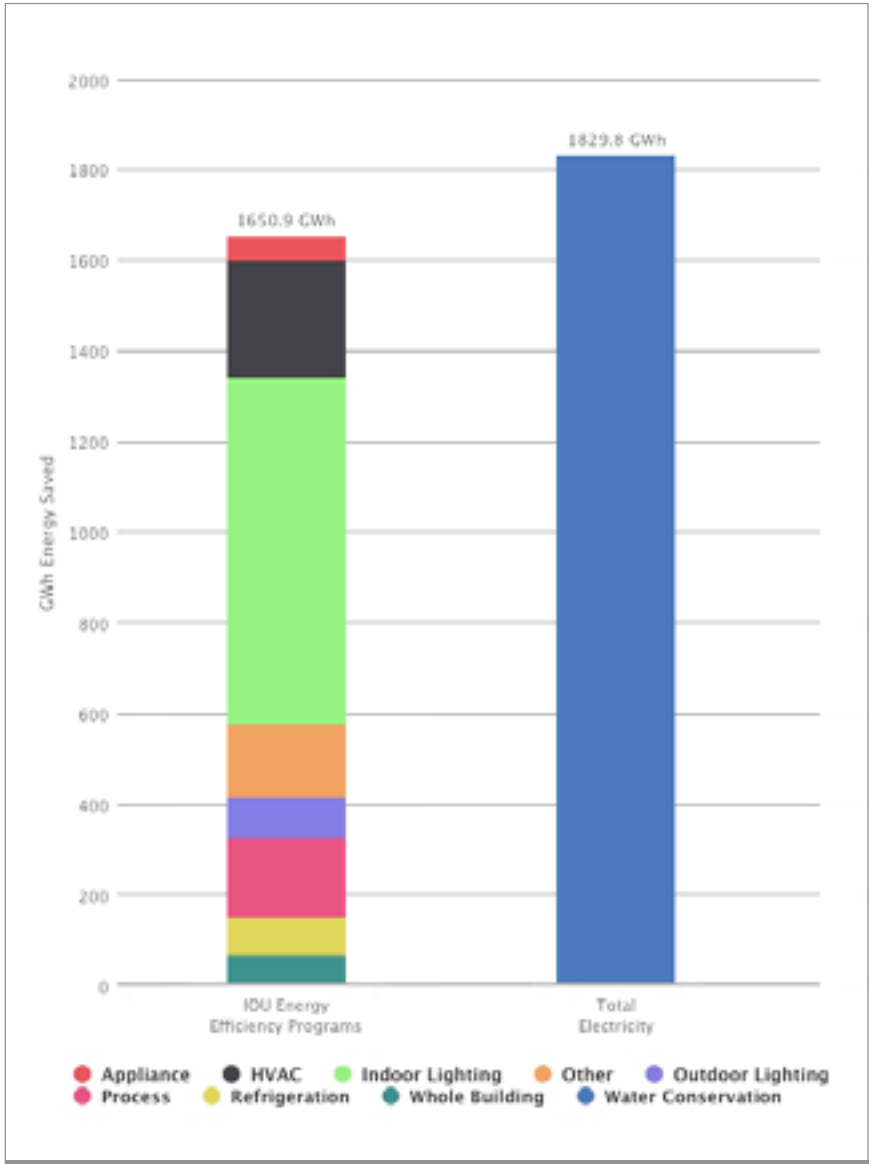
For the past 50 years, residential users have consumed the majority of water supplies in Los Angeles. In 1969, each person was using an average of 189 gallons per day. Since then, programs offering low-flow toilets, shower heads, faucet aerators, and water-smart appliances have contributed to measurable reductions in indoor use. In 2014/2015, LADWP found the average to be 113 gallons a day. However, although efficiency indoors has increased, the majority of potable water is used outdoors.

In California, our extensive water system uses about 19% of the state's electricity and 33% of its natural gas. The amount of energy required to transport, pump, treat, and deliverwater varies by region, but overall—and especially around Los Angeles—the amount is quite high. Reducing the network's energy footprint is crucial to meeting California's climate goals.

The Center for Water-Energy Efficiency at University of California, Davis recently published a study exploring how much electricity has been saved through aggressive water conservation measures. The analysis showed that the electricity saved statewide through reducing urban water use by 25% in 2015 was roughly equivalent to the electricity saved by all of the energy efficiency programs in that same year.

Taken together, the threats of climate change and environmental factors suggest the need for the region to consider a substantively different, climate-resilient approach to managing water for its residents. A renewed focus and aggressive investments in nature-based solutions—actions that simultaneously build local water security, reduce greenhouse gas emissions, and sequester carbon—offer a cost-effective, multi-benefit approach to moving quickly to meet climate goals.

ELECTRICITY SAVINGS FROM STATE-WIDE WATER CONSERVATION VS. TOTAL FIRST-YEAR ELECTRICITY SAVINGS FROM INVESTOR-OWNED ENERGY UTILITY (IOU) EFFICIENCY PROGRAMS



Source: Center for Water-Energy Efficiency at University of California, Davis

COMPARING GREY, GREY-GREEN, AND NATURE-BASED STREETS

For terms and definitions see Appendix A.

	CONVENTIONAL STREET (GREY INFRASTRUCTURE)	GREEN STREET (GREY-GREEN INFRASTRUCTURE)	PARCEL-BASED RETROFITS (NATURE-BASED SOLUTIONS)
	Runoff from all parcels is directed to asphalt streets and concrete gutters leading to storm drains.	Asphalt is removed, perforated pipeline or detention chambers are added beneath street level to capture stormwater. The street is then repaved and landscape features added.	Property owners reduce runoff to street by capturing and infiltrating stormwater on-site. Existing street is adapted with curb cuts and parkway basins.
Cost of construction	$$	$$$	$
Minimal carbon footprint (materials/construction/maintenance)	○	◔	●
Mitigates flood risk	◕	◕	◕
Captures/conserves water	○	●	●
Replenishes groundwater/aquifers	○	◕	●
Reduces pollutants from runoff	○	●	●
Sequesters carbon (via tree canopy/plants/mulch)	○	◔	●
Improves air quality	○	◔	●
Restores habitat	○	◔	●
Improves neighborhood aesthetic and quality of life	○	◑	●

WATER LA PROGRAM GENESIS

LA-area environmentalists have recognized the possibilities of nature-based solutions for addressing the region's water challenges for some time. In the early 1990s, the late Dorothy Green, a longtime leader in the region's activist community, formed a group called "Unpave LA" to explore the possibilities of replacing some of the region's hardscape with natural materials. Green and her colleagues believed that by increasing the perviousness of the region's watersheds, the Los Angeles could achieve a range of benefits. "Unpave LA" was a short-lived group, but its approach—focused on these small-scale urban landscape transformations—has become increasingly popular among both local NGOs and water management agencies in the years that followed.

Sustained pressure from the environmental community pushed the Flood Control District, the Bureau of Sanitation, and the Department of Water and Power to incorporate green infrastructure into their portfolios. Many engineers cite the 1998 "Hall House" demonstration project as a turning point in this process.

Three recently completed agency planning documents—the Department of Water and Power's Stormwater Capture Master Plan (2015), the Bureau of Sanitation-led Upper LA River Enhanced Watershed Management Program (2016), and the LA County Flood Control District/Bureau of Reclamation's Basin Study for Conservation (2016)—prominently feature distributed grey-green infrastructure and parcel-based solutions, an indication of acceptance of these approaches among the region's water managers.

The "Hall House" included a cistern system, capturing stormwater from the roof.

Santa Monica's garden\garden study compared sustainable and traditional landscaping practices.

Low-impact development and green infrastructure as featured in the 2010 Groundwater Augmentation Study

1993
Dorothy Green formed a group called "Unpave LA" to explore the possibilities of replacing some of the region's hardscape with natural materials.

1998
TreePeople, a local NGO, retrofit a single-family home in South LA (Hall House), enabling the property to capture virtually all rain that falls on the property.

2004-2013
Numerous plans for the region's subwatersheds, (Tujunga-Pacoima, Arroyo Seco, Ballona, and Compton Creek) as well as Santa Monica's garden\garden study provided further analyses of and plans for incorporating distributed green infrastructure.

2010
The Groundwater Augmentation Study, funded by the federal Bureau of Reclamation and led by the Los Angeles & San Gabriel Rivers Watershed Council, offers an extensive assessment of the opportunities available for stormwater capture and infiltration.

2012-2014
The Water LA Pilot demonstrates the benefits, cost-effectiveness, and scalability of distributed nature-based solutions.

2015-2016
The DWP's Stormwater Capture Master Plan (2015), the Bureau of Sanitation-led Upper LA River Enhanced Watershed Management Program (2016), and the LA County Flood Control District/ Bureau of Reclamation's Basin Study (2016) prominently feature grey-green infrastructure and parcel-based solutions.

The Elmer Avenue retrofit was completed in 2010. Perforated pipeline to capture grey water was added beneath the street. New sidewalks, curbs and bioswales were added.

Notably, both the Stormwater Capture Master Plan and the LA Enhanced Watershed Management Program assume a substantial rate of adoption for distributed green infrastructure. The SCMP assumes an annual adoption rate of 1.4% (conservative scenario) or 4.4% (aggressive scenario) for rainwater-capturing retrofits among residential properties across the city, while the EWMP assumes a 1% annual adoption rate within its watershed boundaries. Both plans, however, lack a clear plan for funding these retrofits. The agencies' limited budgets and the high price of previous green infrastructure pilot projects within the city—such as the Hall House demonstration project and the Elmer Avenue street retrofit project—suggests the importance of developing lower-cost nature-based solutions.

Regional challenges, constrained space, and limited funding underscore the value of incorporating residential property owners into these efforts, supporting homeowners to install and maintain their own nature-based solutions.

The Water LA neighborhood retrofit program was developed to explore the possibilities of LA residents playing a substantial role in managing the city's stormwater. Intended to maximize water capture, conservation, and reuse on individual properties, the pilot offered a simple, cost-effective alternative model for how to design and implement nature-based strategies for home landscapes and infrastructures. The program was developed using a collaborative model, drawing on expertise from a range of local NGOs and green businesses. The project was led by The River Project, a small local NGO with a long-term commitment to facilitating sustainable watershed management in LA.

WATER LA PILOT RETROFIT COLLABORATION

LED BY: The River Project

PARTNERS: Surfrider Foundation, Theodore Payne Foundation, North East Trees, Greywater Corps, Hey! Tanks LA, La Loma Development, Seed Library of Los Angeles

TECHNICAL ADVISORY COMMITTEE: Staff from City of LA Water and Power (LADWP), Sanitation, Planning, Street Services, and Building & Safety; and Brad Lancaster/ Rainwater Harvesting for Drylands & Beyond

FUNDED BY: Prop 84 (State Water Board grant from the California Coastal Conservancy, IRWM grant from the California Department of Water Resources), the Regional Water Quality Control Board, and LADWP

SCOPE & PROCESS

The Water LA pilot program involved three main phases: community engagement; strategy selection, site assessment and design; and project implementation and stewardship. Throughout all phases, the Water LA team drew on their experiences working in the pilot neighborhood to advocate for water-smart changes to city and regional codes and plans.

IN THIS SECTION

- COMMUNITY ENGAGEMENT
- STRATEGY SELECTION
- SITE ASSESSMENT
- IMPLENTATION + STEWARDSHIP

SCOPE & PROCESS SUMMARY

The chart below represents a summary of the Water LA program.

SUITABILITY ANALYSIS + NEIGHBORHOOD SELECTION

The Water LA team begins by digitally mapping to determine ideal program locations. Factors that are considered: soil that can quickly infiltrate water, slope, access to groundwater basins, urban canopy density, social need, water quality impairments, local flooding, community interest, and available space, such as average width of parkways.

COMMUNITY OUTREACH + ENGAGEMENT

With the neighborhood determined, the Water LA team employs a range of strategies to enlist participants, including posting fliers, attending neighborhood watch meetings, participating in local community events, and door-to-door outreach.

All participants sign a set of binding agreements, committing to attend workshops, participate in project labor, waive liability, and grant the Water LA team access to their LADWP billing records.

SITE ASSESSMENT

Understanding existing conditions, why they matter and how to use this information, is the foundation of the Water LA program. Each household conducts a series of measurements to assess the volume and flow path of rainwater on roofs, hardscapes, and planted areas. They determine their current rate of water use, and assess their plumbing arrangements.

Analyzing this collective data, the Water LA team helps participants devise a plan tailored to their properties, aesthetics and lifestyles, drawing on any combination of Water LA's set strategies.

INSTALLATION + STEWARDSHIP

The retrofits are completed through a series of hands-on workshops covering each strategy, regularly scheduled neighbor labor days, and ongoing installations with the Water LA team. Program staff monitor household water use and assist with landscape maintenance, fielding questions from participants.

Participants commit to maintaining the retrofits for at least three years after completion. This component of the program is intended to both support lasting success and inform Water LA of factors that could stymie widespread adoption of nature-based solutions.

STRATEGY DEVELOPMENT

In 2008, The River Project's Tujunga-Pacoima Watershed Plan assessed the opportunities for new water management infrastructure in the San Fernando Valley.

The LADWP and The River Project began collaborating on the Woodman Median retrofit in 2011, a municipal green infrastructure project identified in the Watershed Plan. The project built familiarity with water management techniques within the neighborhood of Panorama City.

The Water LA team began developing a set of affordable, accessible strategies that residents could implement without the need for complex approvals and permits.

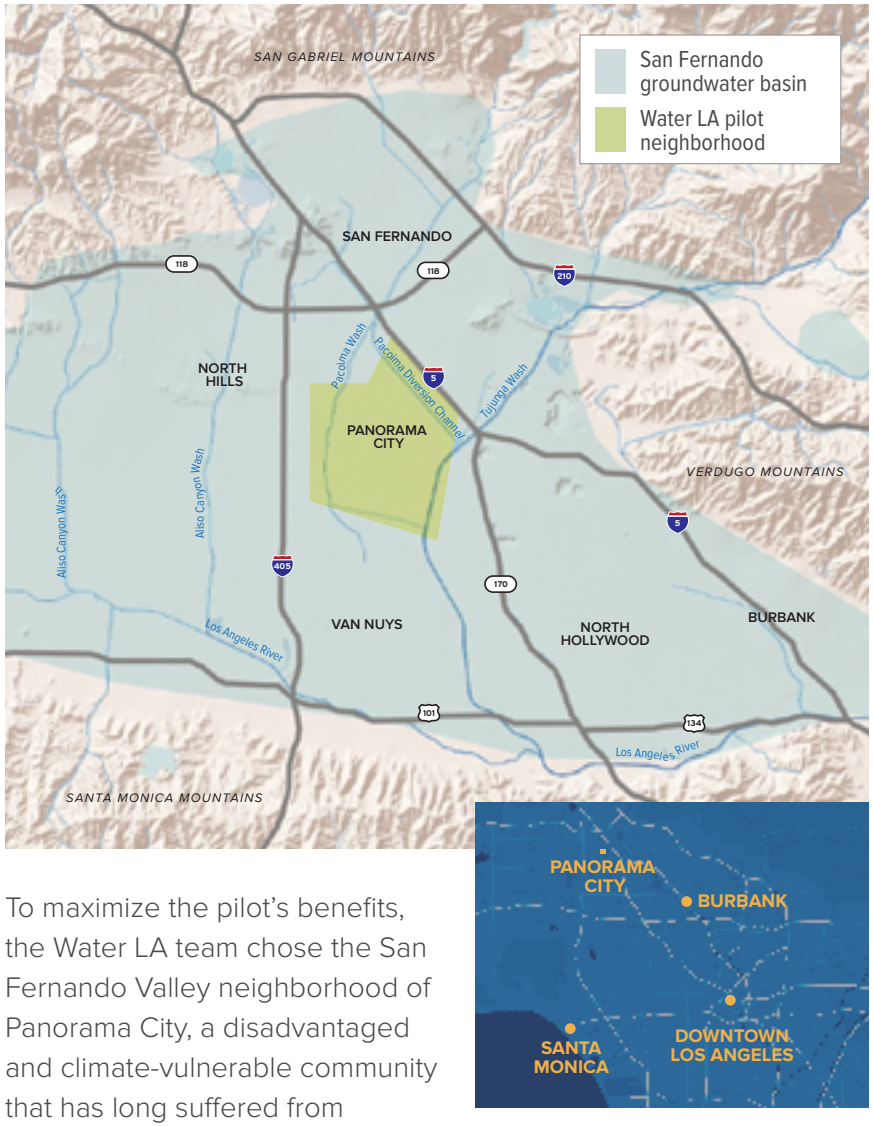
The team encouraged feedback from homeowners, which informed the strategy plans and how-to guides. Together with input from a technical advisory committee made up of city representatives, and with expert consultants from leaders in the field, the Water LA team has advanced and continues to develop these materials.

POLICY ADVANCEMENT

The Water LA project team has identified challenges and barriers in local policy and a building code prohibitive to capturing, conserving, and reusing water on-site. Through sustained engagement with local public agencies, many of these have proved surmountable.

The work continues today, as Water LA team members engage LA City and County agencies to improve on standards and policies, streamline permitting and application processes, and inform plan development and decision-making across the region.

COMMUNITY ENGAGEMENT



To maximize the pilot's benefits, the Water LA team chose the San Fernando Valley neighborhood of Panorama City, a disadvantaged and climate-vulnerable community that has long suffered from localized flooding, as their first neighborhood. Situated above the San Fernando Groundwater Basin within the historic floodplain of the Tujunga Wash, the neighborhood also served as a site to model groundwater recharge, in addition to the other benefits.

Panorama City is a diverse neighborhood, and program participants represented a spectrum of racial, ethnic, and socioeconomic groups. Water LA team members went door-to-door in the neighborhood, speaking directly with homeowners. Through this process, the team learned that local residents were often wary of solicitors, and began using other techniques to spread the word about the project, such as posting fliers, attending neighborhood watch meetings, and participating in events at the local elementary school. In the end, a total of 24 households signed up to participate in the pilot program.

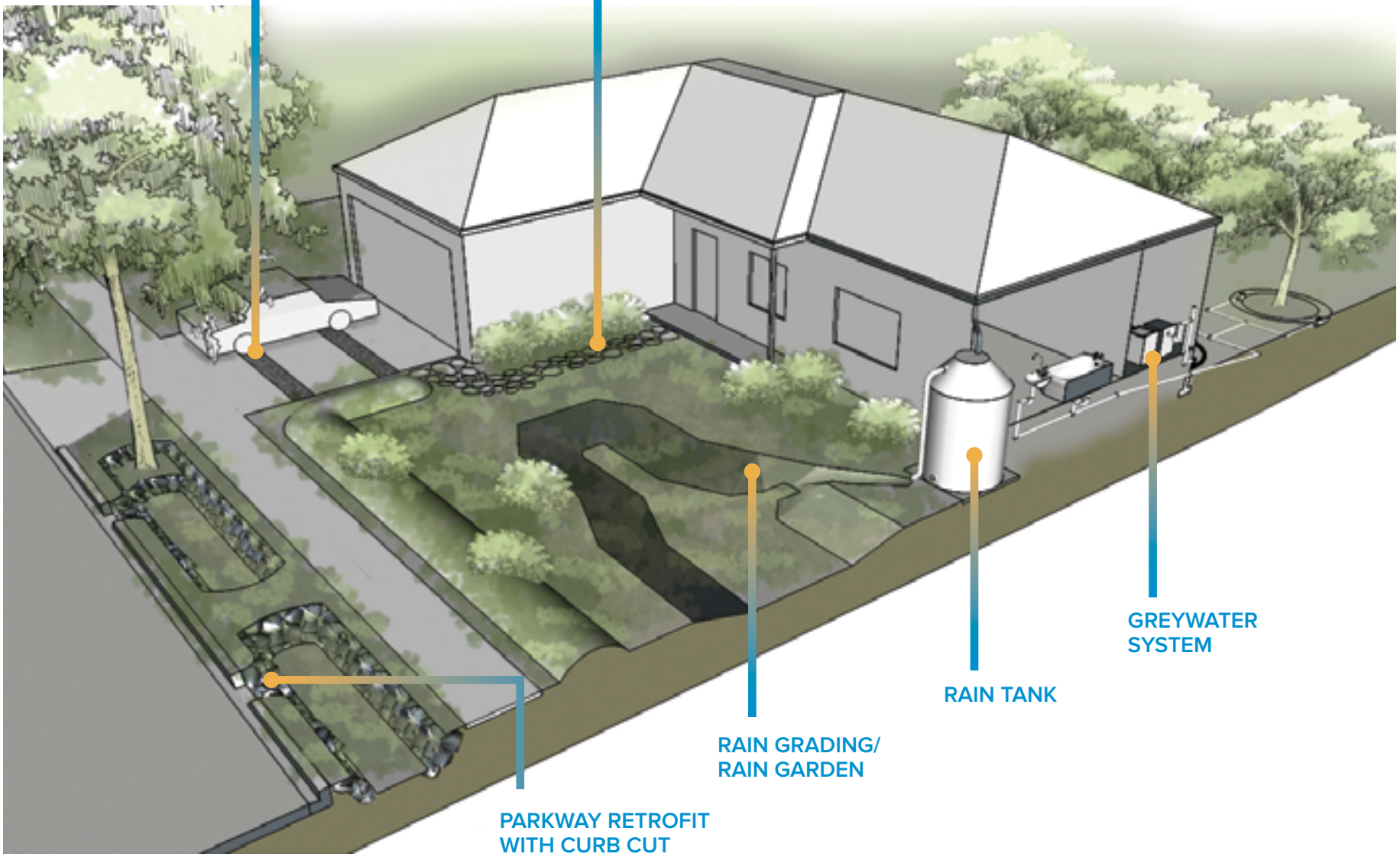
The families expressed many different reasons for joining the program. Some were motivated by economic concerns, keen to redesign their yards in a manner that would require less city water to maintain, lowering their water costs. Others expressed more environmental worries, citing concerns over the sustainability of LA's water provision system, or interest in capturing stormwater to help prevent future flood-related disruptions. And some were compelled by the idea of living within a different kind of home landscape, one dominated by plants other than standard suburban grass. Many expressed a mix of motivations, citing several of the issues listed above.

All participants signed a set of binding agreements, committing to attend a series of hands-on workshops, participate in project labor, waive liability, grant the Water LA team access to their LADWP billing records, and maintain their projects for three years. Given the scale of the commitment involved, recruitment for participation required thoughtful, targeted community engagement.

After signing up to participate in the program, Water LA households attended an orientation workshop to learn about the history of the region's water management, our local geography and climate challenges, and the rationale behind the program. This initial workshop also introduced them to the parcel-based water management techniques the program was piloting.

STRATEGY SELECTION

In designing retrofits, participants could draw on any combination of Water LA's six strategies.



RAIN TANKS $–$$$

These water-holding vessels receive rain flows from rooftop downspouts, filtered through a mesh inlet. Rain tanks not only reduce storm runoff during a downpour, but provide a standing reserve of irrigation water for the dry season. While 55-gallon “rain barrels” have been promoted by water agencies, the Water LA program used only bigger tanks, with volumes ranging from 205-660 gallons. Given LA’s seasonal rainfall and flashy storm patterns, utilizing tanks rather than barrels is a more cost-efficient option for water capture and storage. Further, holding a substantial volume of reserve water, the tanks become a potentially valuable resource in the case of emergency circumstances, such as earthquakes, that could cut off potable water supplies. While subterranean cisterns also offer these benefits, Water LA wanted to test the effectiveness of lower-cost, above-ground tanks as a more plausible technology for broad adoption within the region.

RAIN GRADING/RAIN GARDENS $–$$

This strategy uses the shape of the land itself to keep the water on property. Flat, water-thirsty lawns are replaced with absorbent, soil-building mulch and climate-appropriate plants. Berms (high points) help guide flows to swales and basins (low points) for absorption into the ground. As the low points receive concentrated volumes of water during storm periods, a different, thirstier plant palette can be used in these spaces without requiring large inputs of potable water. They are far less water-intensive than a standard lawn, and are usually far more visually interesting. Shovels and muscles are the only mandatory equipment for rain grading, making this one of the simplest, most cost-effective techniques available for capturing stormwater on residential properties. They are also highly customizable, and can take on many different forms depending on the available space and aesthetic proclivities of a homeowner.

PARKWAY RETROFITS $$–$$$

Parkway retrofits transform the strip of land between the curb and the sidewalk from an empty, unused space into multi-benefit nature-based infrastructure. Turf is removed and the soil beneath is dug out to create a swale that captures water flowing over the sidewalk. Native riparian vegetation—plants comfortable with heavy seasonal rainfall—are then planted in the space. For a slightly more complex strategy that captures even more water, the curb adjoining the street is cut, allowing the parkway to siphon in water flowing through street's gutter. These parkway basins capture an enormous volume of water while beautifying a barren space.

Parkway retrofits are an effective technique for improving water quality and the health of local streams. If properly designed and distributed within a neighborhood, they can also decrease flood risk. They also offer an efficient method of sustaining street trees that provide shade and neighborhood cooling in a manner that prevents root creep and sidewalk disruption.

PERMEABLE PAVING $$–$$$$

Permeable paving is another effective technique for paved spaces. Highlighted in LADWP's Stormwater Capture Master Plan, this strategy replaces concrete on driveways, walkways, or patios with more pervious materials and allows these spaces to function as rainwater sinks. For instance, surfacing a driveway or patio area with gravel rather than asphalt or concrete can maximize the water infiltration on those sites without losing any functionality. Alternatively, the "Hollywood driveway," which incorporates strips of permeable, planted material into the parking area, offers a stylish option for maintaining functionality while capturing runoff. Residents might also use specially designed permeable pavers. These approaches can also be applied to patios and pathways, or simply break up small sections of a path to slow water flows.

GREYWATER SYSTEMS $-$$$

Home greywater systems are designed to recycle lightly used wastewater (the flows from washing machines, showers, and bathroom sinks) by directing it to targeted outdoor spaces. The systems can be quite simple, relying on gravity or the internal pump of another appliance (such as a washing machine) to move the water through the landscape, or more complex, relying on carefully calibrated system pumps. As such, their cost varies considerably, from relatively cheap to somewhat pricey. The systems' regular flows make them an excellent source of irrigation water for plants that require frequent watering, like hedgerows, vegetable gardens, or fruit trees. They present a sustainable way to irrigate an edible garden while minimizing household water consumption.

INFILTRATION TRENCHES $$-$$$$

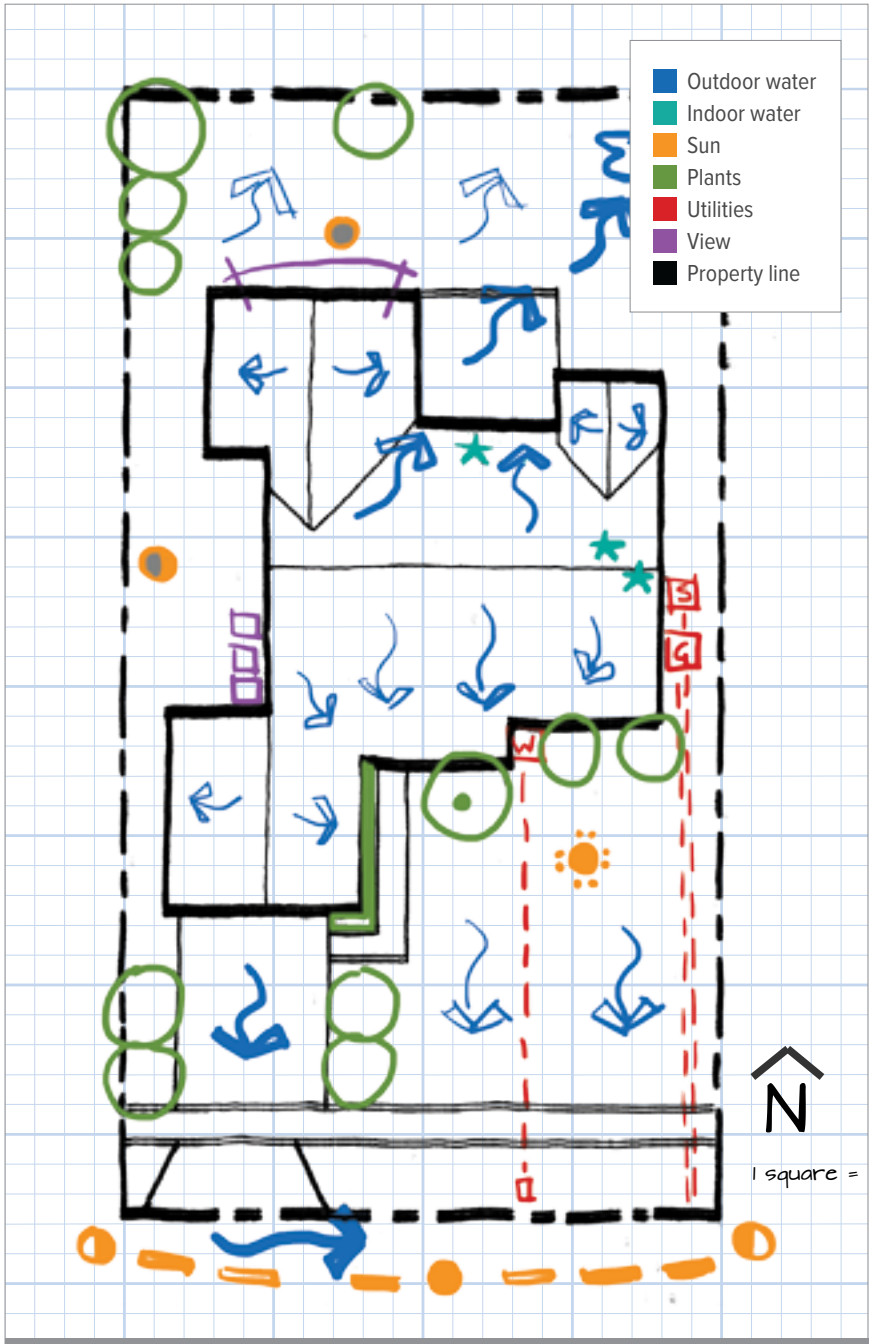
Infiltration trenches are gravel-lined trenches made to make space to capture, infiltrate, or redirect water runoff. These strategies are typically most effective where there is puddling water in areas with lots of hardscape. These can make open spaces in impermeable paving to help slow and sink water into the ground. These are particularly effective for small or narrow areas within a property, and can take many forms. Simple trenches can be dug and filled with permeable material such as gravel, or with pre-fab crates that create extra detention space. They can be covered with stylish, aesthetically pleasing grates (as pictured above).

SITE ASSESSMENT

After participating households were introduced to the Water LA strategies, they were guided through the process of choosing and designing the best set of retrofits for their properties.

To select the best combination of these strategies for each property, participants needed to analyze the opportunities and limitations of their home landscapes. Carrying out a careful site assessment for each property was one of the earliest and most important steps in the design process. To determine which of the program's solutions would work best on an individual property, participants first had to develop an understanding of how water moved through their structures and yards.

With assistance from the Water LA team, each household conducted a series of measurements to assess the volume and flow path of rainwater on roofs, hardscapes, and planted areas. They looked up data on their soil type, micro-climate, slope, potential water quality impairments, tree canopy need, and level of local flood risk. They also studied their DWP bills to determine their current rate of water usage, and assessed their plumbing arrangements to see if installing a greywater system would be possible. Analyzing these data all together, the Water LA team was able to help program participants devise a set of strategies tailored to their properties, aesthetic preferences, and lifestyles. This approach also allows residents to design and distribute solutions on their properties in a manner that maximizes the capture, conservation, and reuse of water.



Site assessments determined the volume and flow of stormwater and resusable greywater.

IMPLEMENTATION + STEWARDSHIP

Each of the Water LA strategies was taught at a hands-on workshop at a different participant's property. Participants learned how to remove a lawn and build healthy soil, break up and replace impermeable hardscapes, and to grade for rainwater capture. The workshops covered installations for rain tanks, greywater systems, drip irrigation, parkway basins, and infiltration trenches. They learned how to select and plant natives and edible gardens, as well as how to maintain their new landscapes. Open to the public, people from surrounding areas often attended, seeking more information.

The Water LA participation agreement required households to contribute a set amount of "neighbor labor," hours of work on the projects built on their neighbors' properties. Intended to help build participants' comfort and familiarity with the workings of the retrofit techniques, the policy also help build stronger bonds between participants. Many people reported a stronger sense of community within the neighborhood after the program's conclusion than they observed before its start, suggesting that the value of such retrofits can go well beyond the obvious benefits of water capture.

Participants also committed to maintaining the retrofits on their properties for three years after the project's completion. This component of the program was intended to serve as the basis for analyzing factors that could stymie long-term maintenance of distributed water management. Among public water agencies operating with limited resources, concerns over maintenance are among the most frequently cited reasons for avoiding a full-blown rollout of the technique. By having participants commit to a program of maintenance with support and monitoring the from the Water LA team, we aimed to understand how residents' stewardship on their properties can reduce public agencies' O&M burden.

Hands-on workshops covered such tasks as "How to kill your lawn" and native plant selection and placement. Enthusiasm for Water LA workshops and installations drew neighbors from areas well outside of the project boundaries.

Household members of all ages participated in installation and stewardship.

RESULTS

The final Water LA retrofits were completed in 2014. Throughout 2014 and 2015, program staff monitored household water use and assisted with landscape maintenance, fielding questions from participants. Despite severe drought conditions, modeling data shows that participants reduced water consumption, captured and infiltrated a significant amount of rainwater, and improved water quality in our local streams.

IN THIS SECTION

PROPERTY PROFILE:

THE BROOKS HOUSEHOLD

Brooks family wanted to take action, but were unsure if urban acupuncture strategies could work for them, as their house is surrounded by concrete and a spa. After consulting with the Water LA team, the Brookses were able to select appropriate strategies for their space, including a rain tank, an edible garden, a greywater system, and the biggest infiltration trenches and longest parkway retrofit in the neighborhood. The household participated in Water LA workshops to learn how to assess their property for all of the possible strategies. They volunteered at work parties, brought food dishes made from their edible garden, and are committed stewards of their garden and projects. The edible garden and fruit trees watered by their greywater system help them grow their own food, and have also helped to inspire healthier living. With the implementation of the six Water LA strategies, the Brooks family is saving up to 87,000 gallons of water and more than $550 on their water bill every year!

Completed residence

Parkway retrofit with native plants

Infiltration trench

QUICK STATS

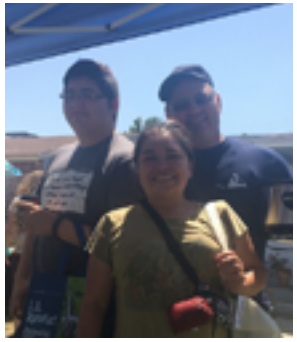
Property size	8,600 square feet
Strategies employed	Rain tank Rain grading Parkway retrofit Permeable paving Greywater system Infiltration trench
Material and installation costs	$6,400
Water savings	87,000 gallons/year
Annual savings	$550/year

Brooks residence prior to retrofit

Parkway retrofit

PROPERTY PROFILE:

THE VASQUEZ HOUSEHOLD



After seeing Water LA work in their neighborhood, the Vazquez family engaged the program to make similar changes at their property. The workshops that the family attended helped them start an edible garden, reuse their greywater to irrigate their property hedge, and install a parkway retrofit with a curb cut to capture rainwater. With the implementation of these strategies, the Vazquez family is saving up to 37,000 gallons of water and more than $230 on their water bill every year. The family members have been excellent stewards of their urban acupuncture projects, attending all of the workshops, volunteering at work parties, and learning about how to plan, design, and install Water LA strategies. Santos Vasquez runs a landscaping business called The Plant Specialist, and has incorporated several urban acupuncture solutions into his professional repertoire. Water LA also contracted his company to help with turf removals and parkway basins. His son, Jaden, joined the Water LA crew and worked with the team to implement Water LA strategies throughout the neighborhood.

Edible garden

Parkway retrofit in progress

QUICK STATS

Property size	8,600 square feet
Strategies employed	Greywater system Infiltration trench Parkway retrofit Curb cut
Material and installation costs	$3,500
Water savings	37,000 gallons/year
Annual savings	$230/year

Vasquez parkway prior to retrofit

Parkway retrofit

PROPERTY PROFILE:

THE FERNANDEZ HOUSEHOLD

The Fernandezes, from Guatemala, met the Water LA team during our door-to-door outreach program. After learning about the program, they agreed to partner with Water LA to transform their home into a water capturing, saving, and reusing powerhouse by implementing all of the strategies offered. The household created a site assessment of their property, involving the whole family in the process. They decided to expand on their edible garden by using a greywater watering system, adding two rain tanks, creating both a parkway garden and infiltration trench to capture and infiltrate water into the groundwater table, and adding gutters to their home. The Fernandez family donated their time to work on two other houses, planting an edible garden and creating a swale. With the implementation of the six Water LA strategies, the Fernandez family is saving up to 132,400 gallons of water and more than $800 on their water bill every year.

Completed residence

Native plants

Downspout/rain tanks

QUICK STATS

Property size	8,500 square feet
Strategies employed	Rain tanks Greywater system Parkway retrofit Infiltration trench
Material and installation costs	$9,100
Water savings	132,400 gallons/year
Annual savings	$800/year

Fernandez residence prior to retrofit

Rain grading in progress

PROPERTY PROFILE:

THE HOPKINS HOUSEHOLD

Rick Hopkins has been enthusiastic about Water LA since the first time he learned about the program. A plumber by trade, Rick was well aware of how often water is wasted in and around Southern California homes. Excited to sign up for the program, he had only one big question for the staff: would he be allowed to keep his beautiful lawn? The answer was yes, and Water LA worked with Rick to design a home landscape that fit his tastes and needs. Rick went above and beyond on his neighbor labor, always ready to offer his expertise or host a block party. Today Rick's property boasts a greywater system, an edible garden with fruit trees, a rain tank, rain grading, a permeable driveway, and a parkway basin. He has cut his water use by 93,100 gallons per year, saving $670 annually—and he still enjoys a beautiful patch of green grass.

Completed residence

Edible garden

Parkway retrofit

QUICK STATS

Property size	7,000 square feet
Strategies employed	Rain tanks Rain grading/garden Parkway retrofit Permeable paving Greywater system
Material and installation costs	$9,700
Water savings	93,100 gallons/year
Annual savings	$670/year

Hopkins residence prior to retrofit

Permeable driveway in progress

COMMUNITY RESPONSE:

IMPROVED AESTHETICS

Many participants expressed delight in the appearance of their own homes and other Water LA properties following the retrofits. Some recalled initial hesitance about how the strategies would look when installed, given their divergence from Southern California landscaping conventions. But as participants grew familiar with this alternative approach to arranging a yard, they reported great appreciation for the beauty of their properties. Many also began to question the desirability and attractiveness of the "default" aesthetic of a green lawn.

"Made our neighborhood prettier. No longer just looking at a dead lawn or dirt, now you have these pretty rain gardens with the rocks and the native plants...mulch in yards are prettier than looking at dead grass or brown grass."

"I love the way the neighborhood is looking with all the projects, I hope more neighborhoods do the same thing...the neighborhood looks good, I love the cutouts and the parkways."

"It's like going hiking, every day outside my house...It's exciting when I see white sage or black sage or the California sunflowers in my yard, exciting to know that I have a little piece of Mother Nature."

"It's helping the neighborhood, improving the homes in the neighborhood."

"I'm more conscious about what I'd want to plant... definitely more conscious about thinking about alternative ways of landscaping, whether it's indigenous or low water or even an edible garden."

"Now you get a little peeved when you see lush green lawn. Do you know how much water you're using to keep that alive?"

COMMUNITY RESPONSE:

INCREASED WATER AND ENVIRONMENTAL CONSCIOUSNESS

Water LA households also reported that participating in the program had changed the way they thought about water, in addition to changing the way it moved through their properties. Retrofitting their homes and maintaining the new landscapes made participants both more conscious of their own water use, and aware of alternatives to conventional, water-intensive lifestyles. Many expressed pleasure in this deeper level of consciousness, and a desire to spread the word to others.

For many, the Water LA program brought an awareness and appreciation of local environmental challenges beyond those directly related to water consumption. Tending retrofitted landscapes built concern for the health of LA's urban ecology, including its soil and fauna.

"The program has made me think more about how I use the water, same with my whole family—we're a bit more water conscious. I have a gardening business, and now I try to educate my clients."

"We actively listen now, if the kids are in bathroom brushing their teeth—why is the water still on? ...We've cut back, we're more aware."

"Being part of the program has changed how we use water... when you're not aware of things, then you don't mentally do it... a lot of it's being given the tools, the rain tanks to water the edible garden, having those tools in the first place has helped us change our water use."

"It's brought a lot of native insects into our yard, butterflies, native hummingbirds, ladybugs, honeybee... make you feel good, like you're doing something, because we didn't have that before."

"You're helping out Mother Nature and the environment... and also, helping with the soil. Soil's really hard and not a healthy thing, planting and the mulching, you're giving it oxygen and waking it up."

COMMUNITY RESPONSE:

STRENGTHENED NEIGHBORHOOD BONDS

Participants also reported a strengthened sense of community connection and cohesion in their neighborhood as a result of the Water LA program. The project's structure—emphasizing community engagement through educational workshops and "neighbor labor"—brought residents together and improved the overall character of the neighborhood.

"I think it's made our community stronger because we've met new people that we wouldn't have met...Water LA drew the community together, I met people from all over our neighborhood, helped people out on their projects...found common interests, working towards the same goals."

"We've made friendships with our neighbors, talk to our neighbors even more...because everyone was working on someone else's house, got to know each other in the neighborhood a little more and made friendship and talk about it. Something that really brought us together. Very, very positive effect. Would definitely recommend it to outside people."

WATER BENEFIT CALCULATIONS

The Water LA team worked with city agencies and experts on effective methods to quantify and measure the impact of pilot program installations on water challenges.

THE PRIMARY AREAS OF STUDY WERE:

1. Water conservation
2. Water capture and infiltration
3. Water quality improvement
4. Flood mitigation through stormwater capture

Water conservation

The Water LA team used billing records from the LADWP to track household water consumption before, during, and after the home retrofit process. During the four years preceding the start of the project, average water consumption for Water LA participating households was 73 gallons per capita per day. For reference, average single-family residential consumption in Los Angeles was 113 gpcpd in 2015.

AVERAGE PARTICIPANT WATER CONSUMPTION (per capita)

PRIOR TO PROJECT (2009-2013):
73 GALLONS per day

AFTER COMPLETED RETROFITS (2015)
54.7 GALLONS per day

In 2015, the year following the completion of the retrofits, participant consumption averaged 54.7 gallons per capita per day, a 25% decline. If the anticipated pattern holds, we expect long-term water consumption to be even lower.

As part of the program, many homes significantly increased the number of plants in their yards. New plantings are typically associated with a spike in water use, as they require more water until established, a period of about three years. Based on Water LA's staff interactions with participants, we believe that heightened awareness of water consumption, built through the program's educational component, contributed to the initial 25% reduction. Overall water use is generally expected to decline further following the establishment period, which falls outside of the pilot project window.

Calculating groundwater recharge and water quality improvement

Capturing and infiltrating runoff are among the most important goals of the Water LA pilot. By absorbing runoff into the ground, the groundwater basin recharges and pollutants are kept out of local streams. Modeling the project's strategies indicates that the pilot was extremely effective at achieving goals in a cost-effective manner, supporting the achievement of the targets of both the city's Stormwater Capture Master Plan and the Upper LA River Enhanced Watershed Management Program.

Notably, while both of these plans anticipate a substantial uptake of residential parcels employing urban acupuncture strategies, they calculate the benefits of these retrofits in terms of aggregate value, rather than value per property or per strategy. This gap is largely due to a lack of available models of and data on parcel-scale installations. As such, the Water LA pilot provided an opportunity to improve on how to quantify the strategies' benefits.

The project team worked with engineers at the LADWP to assess the groundwater recharge and water quality impact of the retrofits. The collaborators used the LA County Department of Public Works Hydrology Manual and the Modified Rational Method to calculate these benefits. Two different storm sizes were modeled using LA County's Hydrocalc modeling program: .55 inches over 24 hours (median storm) and 1.1 inches over 24 hours (85th percentile storm).

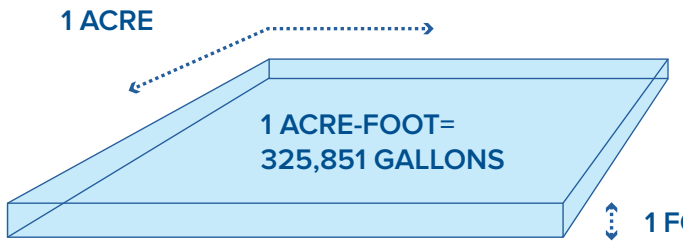
Modeling storm sizes is a standard method to evaluate anticipated water runoff and water capture. Specific rainfall amounts are determined by historic records which differ from location to location. Median and 85th percentile storms were modeled because they represent the most common rainstorms observed around Los Angeles. The amount of stormwater captured by each strategy (such as a completed parkway basin) was determined by the amount of runoff draining to the basin, the basin's storage volume, and the local soil infiltration rate. For further discussion of this methodology and underlying assumptions, please see Appendix C.

Water capture and infiltration

The modeling numbers developed with LADWP engineers indicate that the approach is promising in terms of both the volume of stormwater infiltrated and the cost of capturing it.

> Volumetric capture estimates indicate that the combined strategies implemented through the Water LA pilot in Panorama City capture and infiltrate about 3.8 acre-feet of runoff per year. Assuming a 30-year project life, the collective retrofits will capture roughly 113 acre-feet of stormwater.

WHAT'S AN ACRE-FOOT?

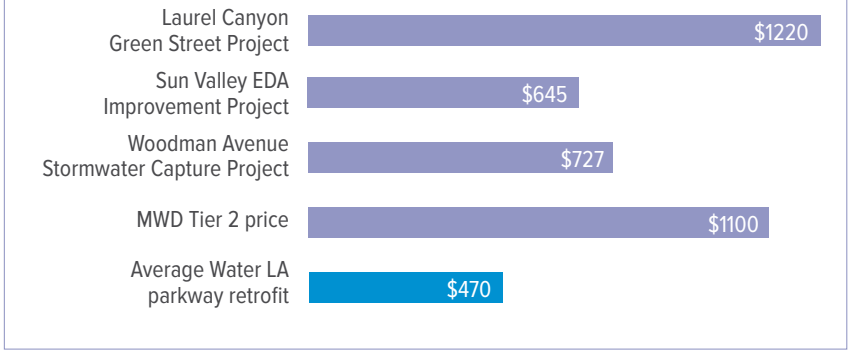


An acre-foot is defined by the volume of water necessary to cover one acre of surface area, roughly the size of a football field, to a depth of one foot.

Broken down further, the data suggests that a parkway basin with a curb cut in Panorama City will capture 6.4 acre-feet of water during this period. The average cost for materials and labor for one of these installations was about $3000. So, over its 30-year lifespan, the cost per acre-foot of water for this strategy is $470.

Few Angelenos think about water in terms of acre-feet, so the significance of these figures may not be immediately obvious. Comparing the Water LA numbers with those from other LADWP stormwater projects suggests that the urban acupuncture strategies compare favorably with many larger, more complex stormwater capture installations. These numbers suggest that, if rolled out across the region, urban acupuncture strategies make a significant contribution to meeting the region's stormwater capture targets.

LADWP STORMWATER PROJECT COSTS (per acre-foot of water)



Captured water also passively irrigates landscapes, and together with climate-appropriate plantings and mulch significantly reduces the amount of water necessary for thriving gardens. This offsets potable water use, resulting in substantial cost savings in both water and supporting infrastructure. An average 30 x 40-foot lawn typically requires 62,000 gallons of water per year. After establishment, the same Water LA space requires less than 10% of that amount to maintain flourishing plants.

Water quality improvement

Total Maximum Daily Loads (TMDLs), adopted in compliance with the federal Clean Water Act, set limits on the amounts of several different pollutants in local waterways. TMDLs signal a range of different risks to the local environment, for example:

- Trash is associated with a range of environmental challenges, including ingestion and entanglement of wildlife.
- Nitrates are associated with algal blooms and correlated conditions that suffocate life in waterways.
- Copper, zinc, and lead are toxic to aquatic life at high concentrations.
- Fecal indicator bacteria help to identify the potential presence of pathogens that may cause illness.

Today, the concentrations of all of these substances commonly exceed the levels deemed acceptable under the Clean Water Act, and need to be reduced to achieve compliance with the law.

Modeling suggests that the Water LA retrofits will contribute substantively to meeting this goal. Assuming 85th percentile storm equivalents for an average year, the table below shows the annual estimated load reduction resulting from these projects.

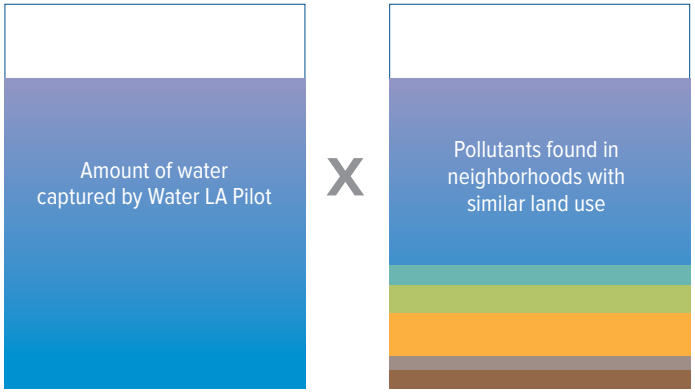
KEY POLLUTANTS REMOVED BY WATER LA PILOT
Estimated based on 85th percentile storm

TRASH	NITRATE	COPPER	LEAD	ZINC	FECAL COLIFORM
36.00 cf/year	0.32 Kg/year	30.08 Kg/year	20.48 Kg/year	232.96 Kg/year	660,992,000.00 MPN/year

MODELING WATER QUALITY BENEFITS

Our modeling data is based on 85th percentile storms. Generally speaking, this is a storm that produces about 1” rainfall in 24 hours, an amount great enough to wash significant pollutants down streets, into drains and to the ocean. Historic records show this size storm occurs commonly every year.

CALCULATING WATER QUALITY BENEFITS



LADWP calculated the volume of runoff captured by the retrofits. We multiplied this figure by the concentration of pollutants found in neighborhoods with similar land uses.

Storm water brings significant trash and pollutants downstream to the beaches and ocean. The retrofits were effective in capturing this debris before it entered local waterways.

Naturally occurring processes in plants and healthy soils have demonstrated impressive capacity to clean pollutants. The retrofits are also effective in capturing trash, providing opportunities to remove debris in accessible, manageable quantities before it enters waterways and sensitive environments. While the performance demonstrated by conventional modeling is encouraging, the underlying processes are not yet fully understood, and do not represent many complex factors such as the impact of plants and soil biology over time, capillary action, and structural composition. Given the impressive water capture rates incidentally observed, higher rates may be expected and in situ study is recommended.

Recognizing the significant potential of these distributed strategies to address Los Angeles' Clean Water Act goals, Water LA was studied by State Water Board staff as they developed a new framework for water quality compliance in California. This new "STORMS" program and new municipal stormwater permit (MS4) embraces distributed nature-based strategies such as Water LA's berms and swales and healthy soils. Water LA is also referenced as a critical tool in the Upper LA River Enhanced Watershed Management Plan. Please see Appendix C for a more detailed analysis of the technical data.

Flood mitigation through stormwater capture

The potential to capture runoff also translates to potential for reducing flood flows from large storms or a series of small storms. Storms are typically not consistent but rather have a series of peaks and lows when more or less rain is falling at any given time and place. The biggest impact from flood events stems from peak flows.

Distributed nature-based solutions slow, spread, and sink these flows. Considered in aggregate and with widespread adoption over time, the volume of stormwater absorbed by retrofitted landscapes can significantly reduce peak flows. Lower peak flows can, in turn, reduce the need for flood channel capacity across the region, creating potential for floodplain reclamation.

In contrast with grey flood infrastructure, floodplain reclamation mitigates flood risk while providing a host of benefits including water capture and conservation. The LA Basin Study rated it one of the most cost-effective strategies for the Los Angeles region.

Climate change models consistently predict more infrequent, more intense storms. With 432,815 housing units already at risk in the region's 100-year flood zone, significantly more property is at risk. The USGS projects an ARkStorm scenario like that of 1861 could generate losses three times greater than the largest possible earthquake, and has an equal probability of occurring. NOAA estimates that climate-related disasters cost the US $306B in 2017.

Proactive management is key. The National Institute of Building Sciences 2017 study evaluated 23 years of federally funded mitigation grants and found that the nation can save $6 in future disaster costs for every $1 spent on hazard mitigation.

The performance of Water LA strategies suggests that further study is warranted to evaluate their collective long-term potential for beneficial flood management across the region.

CONCLUSIONS

Water LA is as much about realizing work on the ground as it is about creating a path to a more resilient future. Planning, design, policy, and highlighting areas for further research and development are informed by work in the program.

IN THIS SECTION

KEY FINDINGS

Completed retrofit with rain garden, native plants and permeable walkway

Parcel-scale stormwater management is effective.
The Water LA pilot confirms that managing rainwater in a distributed, parcel-scale fashion is both a technically efficacious and cost-effective approach to meeting watershed management and climate resilience targets. By reducing water use and increasing rainwater capture and absorption into the landscape through our six strategies, we are addressing multiple environmental concerns at once. While this approach represents a substantive departure from LA's traditional techniques for water management, our results suggest that this new direction holds great promise.

Such results reinforce the experiences of groups that have piloted urban acupuncture stormwater projects, such as the Watershed Management Group in Tucson, Arizona, as well as the findings of scholars who have studied socio-ecological systems that rely on distributed rainwater harvesting, like Dr. Michael Evenari's on the Negev Desert. These studies also suggest the value of small-scale strategies for managing flood risk, which our results also support.

The Water LA program belies a common misconception: that it would take longer to implement distributed stormwater capture strategies because of the community/private land use component.

> Given the small-scale, relatively low-tech nature of the projects, it is likely that a substantive rollout of the program could be carried out more cost-effectively than could a more-engineered regional-scale green streets program.

This point is particularly salient given the high rates of distributed infrastructure adoption that the Enhanced Watershed Management Program, the Los Angeles Basin Study, and the Stormwater Capture Master Plan require to meet their respective targets. Relying on and facilitating simple retrofits carried out on private land and stewarded by everyday Angelenos offers a pathway to meet these targets without threatening municipal budgets.

Rain grading requires no technical equipment or expertise.

Water-absorbing landscapes can suit a wide variety of tastes.

Fielder residence, design and photo by Nick Dean Gardens

Urban acupuncture can take on many styles and forms.
There are many different configurations and aesthetic approaches for parcel-scale stormwater strategies—from formal to informal—all of which can be effective. A water-absorbing home landscape can be designed to suit a wide range of lifestyle preferences, aesthetic tastes, levels of DIY ability, budgets, and dedication to yard maintenance. Program participants selected many different arrangements, and no one-size-fits-all approach was necessary to realize benefits.

This finding offers an important counter-example to another low-cost, water-saving landscaping approach that gained popularity during LA's most recent drought. Private companies used the recent $3.75/square foot turf removal rebate to convert thousands of yards across the City of LA into landscapes of either rocks or mulch with few plants. Environmentalists and researchers criticized this approach, noting how the extensive use of weed barriers and rocks actually serve to undermine LA's efforts to reduce urban heat island effect and capture rainwater. But even more residents have criticized the monotonous, pre-fab look of these landscapes. The range of styles available show there are many options for a water-smart yard.

Demand exists but a support system is needed.
As evidenced by participant feedback, people are prepared to play an active role in climate adaptation and resilience efforts. Through the pilot program, they came to appreciate the beauty of our native landscapes, developing a stronger relationship to water and the natural environment, and realizing a sense of agency and purpose. Many residents from outside the pilot neighborhood were regular workshop attendees, eager to have the program made available to their communities. As a result, over a dozen neighborhood councils passed motions requesting of the Mayor that the Water LA Program expand to their neighborhoods.

Moreover, as awareness of the drought took hold and enhanced incentives for turf removal were made available, our team was inundated with requests for assistance and expert recommendations.

Effectively meeting widespread demand is beyond the capacity of any one entity. As such, the Water LA Collaborative was established as a logical structure to provide the scale of coordinated technical, social, and material support required in a large metropolitan area. Leveraging the collective expertise of leading local NGOs whose relationships extend throughout the region's diverse communities, the Collaborative is well positioned to facilitate a network to serve these needs. For more information on the Water LA Collaborative, see Appendix E.

Site assessment is challenging but technology can help. Accurate site assessments are a critical tool used to determine potential water conservation and infiltration amounts as well as to develop target goals. Agencies offering incentives for urban acupuncture installation would require quantitative data to determine return on investment.

Participants' challenges in carrying out detailed site assessments on their properties suggested to the Water LA team that, for parcel-scale retrofits to expand, it will be important to develop additional materials to aid in this process. In the pilot program, the Water LA team brought participants together to carry out this work. The process was collaborative and, for many participants, even fun. Discovering just how much rain runs off their property even in dry years was surprising and enlightening. Gathering data on one's home and designing a configuration of water-capturing strategies brought many residents great pleasure. However, for participants who missed the group workshop and had to conduct the assessment without assistance, the work proved onerous, particularly in terms of quantifying and analyzing the way water flows through a property.

Carrying out site assessments could be streamlined through a digital platform.

Such challenges could prove a substantial barrier to widespread adoption and acceptance of these techniques.

The team concluded that the assessment process could be made considerably easier if standardized inputs—gathered from water bills and GIS data—could be aggregated on a digital platform.

> A web-based site assessment tool would assist residents in quantifying their water use and their property runoff, help them analyze their specific opportunities and constraints, and support them in planning appropriate retrofits.

The River Project secured funding from the LADWP to develop such a tool. This tool will enable participants to maximize water capture, conservation, and reuse through these retrofits, and ultimately to share their metrics with local water agencies. Please see Appendix F for more details on this process.

Mulch is a critical component to deploying Water LA's strategies.

Long-term maintenance requires access to materials.
The Water LA team supported residents in maintaining their retrofitted properties through the end of 2015, fielding inquiries and providing additional materials and labor when requested. For some, the experience of carrying out project maintenance work was satisfying and inspiring, much like accounts of Victory Gardens during World War II. Even so, success maintaining the retrofits varied between households. Some residents were fastidious in keeping up their new infrastructures. Others, however—including some who expressed great enthusiasm for the program and for their new landscapes—struggled with maintaining these new and different strategies, primarily due to a lack of time or skill.

Challenges with accessing high quality mulch to build healthy soil and sustain new plants were frequently cited as a hurdle by residents. While the City of LA converts a portion of its green waste into mulch that residents can pick up for free, program participants struggled with the inconvenient locations and hours of the mulch repositories. Further, those without easy access to a pickup truck struggled to transport an adequate volume of mulch from the sites to their homes. The Water LA team also observed that the quality of mulch available to residents through the city varied greatly, and was unacceptably low at times. Given the critical role mulch plays in fostering soil health, capturing water, and sequestering carbon in the landscape, it is clear that by upgrading its mulch program—providing a higher quality product and consistent distribution services—the city could achieve many climate resilience benefits. In addition, residents would be better positioned to succeed at long-term maintenance of these water-capture strategies.

Residents also need easy access to educational materials as well as tools, parts, and plants. This diversity of needs suggests the value of developing a local network of resource centers. Recognizing this need, local NGOs are working together to provide ongoing educational and material support for these retrofits. Please see Appendix H for more details on this process.

LA needs a pool of trained urban acupuncture practitioners.
In cases where residents have little time to design, construct, and maintain these strategies and can afford assistance, the ability to call on trained workers could further support the ongoing functionality of these retrofits. Such help can also be invaluable for those with less physical strength or technical skill.

> At present, there are very few companies that have the training or experience required to offer these services, and even fewer that can provide a prospective client with any kind of certification of competency.

This suggests the value of establishing a training and certification program in these techniques to spread their prevalence. Such training would provide an excellent opportunity for local youth and an avenue to redirect the workforce of landscape maintenance workers currently employed across the region for simple grass mowing and leaf blowing. Teaching these workers new skills would allow them to adapt to changing aesthetic and water-use norms likely to emerge as climate change progresses, creating a sustainable, reliable set of "green" companies and jobs in the process. These training options can also support education and capacity-building for residents looking to do the work themselves.

Recognizing this need, the Water LA team developed the framework for such a curriculum, which would be offered through local technical or community colleges. Please see Appendix G for more details on this potential program.

Local code barriers are surmountable, with persistence. Carrying out the pilot program, the Water LA project team identified challenges and barriers in local policy and a building code prohibitive to capturing, conserving, and reusing water on-site. Our building codes are designed to move water off our properties, rather than to absorb it in place. The good news: many of these proved surmountable through sustained engagement with local public agencies.

The story of streamlining greywater permitting is a telling example of this pattern. At the outset of the pilot program, any greywater system using water from an outlet other than a clothes washer had to apply for an individualized permit through both the city's Department of Building & Safety (DBS) and the County Health Department, a slow and expensive process. In response, the Water LA team and DBS worked collaboratively with the County to develop a more streamlined permit for branched drain greywater systems, making the process far faster and cheaper to complete.

> Before the change, the permitting process for these greywater systems cost $1350 and took up to six months. Now, it takes roughly two weeks and costs $105.

Notably, at the start of the Water LA program, building a parkway basin with a curb cut was illegal within the city. The project team worked with staff from the Bureau of Sanitation to pilot these strategies, then collaborated with staff from the Bureau of Engineering to develop a city-approved standard plan, codifying the technique. Although discussions about acceptable methods and materials for this strategy are ongoing, gaining acceptance for this high-performing, multi-benefit strategy represents a significant step forward.

Water LA is working with the city's Bureau of Sanitation and Bureau of Engineering to adopt standard plans for Water LA strategies such as parkway retrofits with curb cuts.

This work continues today, as Water LA team members collaborate with the city's Bureau of Sanitation and Bureau of Engineering to adopt standardized plans and guidance for all of the Water LA strategies, a move that will ease the process of implementing these infrastructures quickly in the future. For more information on our work to change building codes, please see Appendix D.

POLICY RECOMMENDATIONS

Incentivizing Water LA parkway planting standards would realize local and regional plan goals.

Further modify building, plumbing, and landscaping codes and other guidelines

As discussed previously, the Water LA team encountered myriad code barriers to urban acupuncture projects through the process of carrying out the pilot program. While some of these roadblocks have been removed, thanks to the Water LA team's persistent advocacy, substantive hurdles remain. These barriers need to be addressed if the region is to attain widespread adoption of these water management strategies. These hurdles suggest the value of ongoing efforts to reassess and modernize a range of longstanding city codes and regulations. Some key issues to address:

- City of LA Residential Parkway Landscaping Guidelines: Updated in 2015, these rules severely circumscribe the plants allowed in parkway strips. Many effective parkway basin configurations are technically illegal due to these rules, a serious hindrance for a strategy that addresses water quality, water supply, flooding, tree canopy, and carbon sequestration issues within the region.

- City of LA Department of Building and Safety's "approved drainage facilities" definitions, While these were amended in 2014 with input from the Water LA team, resulting in reduced setback requirements from structures and property lines, these should be further adjusted to allow un-mortared stone to be considered a "non-erosive device" for directing stormwater away from building foundations, remove the requirement for burying downspouts, and eliminate the restriction that prohibits overflow from rain gardens and tanks to flow across the sidewalk area. These needs can be addressed with a simple "Information Bulletin" defining the Water LA strategies as "approved drainage facilities."

- City and County of Los Angeles Low Impact Development (LID) Ordinance: Water LA's urban acupuncture strategies should be adopted as an amendment to LA's LID ordinances, providing clear and consistent guidance to property owners not subject to ordinance requirements who wish to voluntarily implement these beneficial strategies.

Also, while somewhat more obscure than direct code modifications, important changes must be made to the supporting data that agencies use to determine the legality of certain interventions. Some important examples:

- State Liquefaction Zone Classificatory Map: Our research suggests that this map inaccurately classifies many areas of the region as unsafe for infiltration. A reassessment of the data is necessary.

- National Resource Conservation Service (NRCS) Soils Data: Updated, far more accurate data on LA's soils has recently been released by the NRCS. This precise source data should be incorporated in the datasets that underlay the Stormwater Capture Master Plan and the Enhanced Watershed Management Programs, as well as the LA County Hydrology Manual.

- Soil Infiltration Rates: Current accepted methodologies for calculating the rate of water absorption by vegetated soils does not account for changes to the infiltration capacity over time associated with plants and mulch. Observation suggests that these processes increase absorptive capacities far beyond those modeled, indicating the need for calculations that take into account these variables.

The modifications we suggest here are particular to the City of LA For practitioners, they also suggest the importance of assessing codes in other cities, as rules buried deep within a technical code can prove prohibitive to the adoption of these valuable strategies.

Facilitate ongoing, localized support for adopting and maintaining retrofits

The Water LA program experience suggests the critical role of ongoing educational support and easy access to materials. We do not believe that it would be appropriate for government agencies to build or maintain projects within residential landscapes. Such involvement would be expensive and laborious for the agencies, and may likely be seen as unwanted interference by residents. However, we believe that agencies could use targeted investments of resources to enable local NGOs and green businesses to step into such a support role. We have two concrete policy recommendations for creating programs and centers that support adopting and maintaining these programs.

THE WATER LA COLLABORATIVE

The first is for the region to support the work of the Water LA Collaborative. As noted previously, all of Los Angeles' current water plans depend on getting between 1–4.4% of the region's residential property owners to adopt urban acupuncture strategies every year. No single entity can successfully provide the range of technical assistance and support necessary to accomplish these goals. The need for sustained collaboration among non-profits, community groups, and local businesses was foremost among the Water LA team's takeaways from the pilot project.

The Water LA Collaborative, described in the Basin Study and comprised of six local NGOs, has the collective capacity and expertise to deliver an effective program of awareness, education, empowerment, and support. By working cooperatively, we can facilitate a grassroots transformation in water and land use practices. The SCMP and the City's One Water plan recognize this need to develop effective partnerships between public agencies and NGOs to support such a program.

Proposed resilience hubs would function as local sources of materials and expertise.

The second is for cities to fund the establishment of local "resilience hubs"—sites stocked with necessary materials and resources as well as relevant, community-centric expertise. The idea for establishing such hubs was sparked during the Water LA pilot project, due to gaps in access to necessary materials (rain tanks, greywater parts, mulch, native plants) which led to project slowdowns and maintenance snafus.

Once the projects were completed, it was clear that even the most enthusiastic homeowners will benefit from the confidence that comes with continued guidance from experts. Dedicated spaces that can reliably host workshops or refresher classes would contribute to raising the visibility of the program.

> Establishing hubs—easily accessible spaces where residents can speak with experts and find all necessary parts and materials in a single space—would ease all of these issues.

Cities could utilize surplus properties to provide space and partner with local businesses and NGOs to stock and staff these establishments. The City of Los Angeles is already moving toward a similar model through its resilience planning, developing neighborhood hubs envisioned as earthquake response centers. Further functions—like providing materials for urban acupuncture projects—could be incorporated into these planned spaces. See Appendix H for further information about these proposals.

Foster career paths in nature-based climate adaptation
Investments in distributed nature-based infrastructure will provide local water security and urban environmental resilience.

> Recent studies by the Los Angeles Economic Roundtable (2011) and the Pacific Institute (2013) suggest that they can also spur substantial economic development and lead to new green jobs, a key target in LA's Sustainability pLAn (2015).

Given this, development of a training and certification program for urban acupuncture professionals, designed to maximize local environmental and economic benefits through a targeted investment in technical training in on-site water management techniques is a high priority. Like existing solar PVC training certification courses, such a program would increase small businesses staffed by trained professionals with specialized expertise. An equitable program would be affordable, accessible and bi-lingual. This would benefit workers by facilitating entry into a rapidly expanding new market, while providing consumers more access to these essential services. Legitimizing a new trade in the critical work of water capture, conservation and reuse could also provide a pathway to municipal green jobs. Such a program would foster sustainable green jobs and expand the region's pool of workers capable designing and maintaining effective nature-based infrastructure. Please see Appendix G for further details on the envisioned training program.

Improve incentives and rebates for residents
Over the past three decades, providing residents with incentives and rebates for adopting water-saving technologies on their properties has become standard practice across Southern California. Low-flow toilets, evaporation-eliminating pool covers, and even the removal of turf on residential properties have been subsidized by funds from local water agencies. To meet LA's water challenges, agencies must provide new financial incentives to encourage the adoption of urban acupuncture strategies.

The City of LA has taken an important step in this direction by modifying the conditions of its turf rebate to align them with the water-capture goals of its Stormwater Capture Master Plan. The LADWP now provides rebates for rain tanks as well as rain grading through the turf removal rebate, policies for which the Water LA project team advocated persistently. A similar rebate should be established for home greywater systems.

However, the city may wish to consider the benefits of moving toward a volumetric approach that rewards residents for capturing and infiltrating more water on their properties. In particular, tiered incentives would most effectively assist disadvantaged communities.

> LA County is now considering the adoption of a water resilience fee, a new parcel tax. A fee based on how much stormwater runoff a property creates would encourage homeowners to manage rainwater as a resource.

Property owners who elect to also implement parkway basins that assist municipalities in managing street runoff could have the fee waived entirely. This important policy would provide a powerful incentive for residents to adopt and steward effective rainwater capture strategies. Further, a portion of revenues generated could help to fund the critical work of the Collaborative to educate and support communities in adopting these strategies, and support local agencies in offering enhanced incentive programs for residents. See Appendix I for excerpt from financial incentives whitepaper by Coalition for Our Water Future.

IN SUMMARY

LA's century of relying on large-scale, centralized infrastructures to manage its water has created both opportunities and challenges. Some have suggested plans to address the resulting challenges that rely on more and bigger engineering. Others propose new networks of hybrid grey-green infrastructures on public land. But these are not the only or inevitable paths available to the region.

As the Water LA pilot program illustrates, approaching the residential urban landscape as an opportunity space offers a viable method and scale for managing our land and water resources with numerous environmental benefits. The experience further suggests that these retrofits can be carried out more quickly and cost-effectively than traditional programs of large-scale infrastructure development. By harnessing the energy and efforts of NGOs and residents, urban acupuncture offers an approach that can spread across the region at great speed. But barriers related to codes, funding, and expertise must be addressed to realize this water-smart future for the region. Tactical, targeted investments in education, training, and incentives must be considered by public agencies for Angelenos to transform and steward their homes into sites of water management.

While this report has focused on the particular challenges and opportunities of the LA context, we believe that the urban acupuncture approach has great potential to address urban water problems in cities across the globe. We believe that stakeholders well beyond Los Angeles can build on and adapt our work to fit their context. We have a need to retool the urban environment to survive the climate of the 21st century. Urban acupuncture can be the new, resilient normal for cities across the globe.

Photo: Hughes Hall

APPENDICES

IN THIS SECTION

APPENDIX A: CLASSIFICATION OF STORMWATER APPROACHES

Nature can be leveraged to do a lot of work people need while also sustaining and regenerating for generations to come. There are different terms to describe the amount of nature harnessed in different water management strategies, and also the scale at which strategies may be applied. These shorthand terms are useful for addressing challenges and discussing preferred outcomes.

The US Environmental Protection Agency, which encourages cities to consider the approach, defines green infrastructure as using:

> "*vegetation, soils, and other elements and practices to restore some of the natural processes required to manage water and create healthier urban environments. At the city or county scale, green infrastructure is a patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the neighborhood or site scale, stormwater management systems that mimic nature soak up and store water.*"

INFRASTRUCTURE TERMS

Grey infrastructure: Projects that rely on human engineered and operated infrastructure and conventional piped drainage, and water treatment systems using primarily inert, impermeable materials such as steel and concrete. These make up most urban systems including paved streets, dams, drains, flood channels, and dry wells.

Grey-green infrastructure: Projects that are a combination of green and grey infrastructure composed and managed to realize benefits of green infrastructure within a framework of more conventional development. These are combinations of structures engineered for specific controls which include green streets, spreading grounds, dry wells, infiltration trenches, greywater, and planted areas with underground water storage chambers. With regard to water management this is sometimes also known as "blue infrastructure."

Green infrastructure/nature-based solutions: Projects that rely predominantly on soils and vegetation to restore the natural ecosystem processes required to slow, detain, and absorb water, infiltrate water to aquifers, filter pollutants out of water and air, sequester carbon, support biodiversity, provide shade, and aesthetically enrich environments. Where feasible these may have the biggest long-term benefits for costs. Sometimes this is known as "blue-green infrastructure," specifically referring to water management. These include strategically undeveloped mountains and floodplains, wetlands, rain grading, mulch, soil building, tree and vegetation planting, and parkway basins.

Low-impact development (LID): Projects inclusive of both grey-green infrastructure and nature-based solutions.

Multi-benefit stormwater project: A project that maximizes or enhances stormwater capture, conservation or infiltration, in addition to five or more of the following examples: water and air quality improvements, greenhouse gas reductions, carbon sequestration, flood hazard mitigation, habitat protection and biodiversity, heat-island reductions, recreation opportunities and open space, community health and safety improvements, or any combination.

Streets, cool: Cool streets incorporate elements that cool the local microclimate and mitigate urban heat island impacts. These include trees and vegetation that shades and evapotranspirates (releasing water by essentially breathing and sweating), and also high albedo materials that reflect sunlight.

Streets, complete: Complete streets are designed to accommodate traffic needs of cars, trucks, pedestrians and bicyclists. Added benefits can include more livable communities and attractive streetscapes that connect business districts, neighborhoods, parks and schools.

Streets, living: A comprehensive combination of cool, complete, and green streets.

Streets, green: Green Streets are regional street-oriented projects that manage stormwater runoff close to source. They can incorporate landscaped streetside planters or swales to allow water to soak into soil and vegetation, infiltration chambers or drywells to recharge aquifers and reduce peak flows.

MANAGING SCALE

Scale of implementation is a major factor in considering a range of approaches integrating nature. Large projects are critical in ensuring a sustainable future, from the San Gabriel Mountains—originally conserved for water resources—to the many dams and spreading grounds that help to manage water flows and infiltrate for local water supply, and the treatment plants and associated infrastructure managing urban wastewater. However, based on recent assessments in regional plans—including Department of Water and Power's Stormwater Capture Master Plan (2015), the region's Enhanced Watershed Management Programs (2016), and the LA County Flood Control District/Bureau of Reclamation's Basin Study for Conservation (2016)—even if all large, centralized project opportunities were built out in the LA region we would still be far short of regional goals for local water supply, management, and quality. Implementations of different sizes creatively adapted to diverse conditions are key, from the regional out to distributed parcel-based interventions.

Centralized: Projects that are located on large parcels in key locations in the county, which have an average annual capture potential of more than 100 acre-feet per year per project and manage stormwater concentrations which are often downstream from the point of runoff generation. Dams, spreading grounds, treatment plants, and areas specifically protected for resource conservation such as the mountains of the upper watersheds, floodplains, and large coastal wetlands.

Neighborhood (regional): Projects that are located on or impact either large or multiple parcels, which have an average annual capture potential of less than 100 acre-feet per project. Often these are located on public rights-of-way, which may include parks, streets, greenways, schools, and other significant public infrastructure.

Distributed (parcel-scale): Projects that are simple and replicable enough that they can be spread widely and abundantly. These are public and private landscape-based projects that property owners can reasonably make and manage. Micro interventions such as rain gardens and swales, parkway basins, mulching, soil health building, vegetation and tree planting, permeable paving, infiltration trenches, and rain tanks may be included as parts of larger projects, or as stand-alone improvements.

EXAMPLES OF INFRASTRUCTURE

	GREEN/ NATURE BASED	GREY	GREY/GREEN
DISTRIBUTED SCALE	Rain grading (swales, berms, rain gardens), curb cuts with parkway basins, infiltration trenches, soil health building, vegetation and tree planting	Small low-flow diversions, drainage pipes	Cisterns, rain tanks, permeable pavement, infiltration trenches, greywater, systems, bioswales, green roofs, planter bump-outs, tree wells
REGIONAL/ NEIGHBORHOOD SCALE	Wetlands, park grading, stream daylighting/restoration	Street gutters, storm drains, drain filters, injection wells, large storage tanks, large low flow diversions/drainage, drywells	Living/green streets, parks with large underground chambers, small engineered treatment wetlands
CENTRALIZED SCALE	Floodplain reclamation, large wetland conservation, mountain and upper watershed conservation	Dams, water and waste treatment plants, pipelines, reservoirs	Spreading grounds, large engineered treatment wetlands

Nature-based solutions

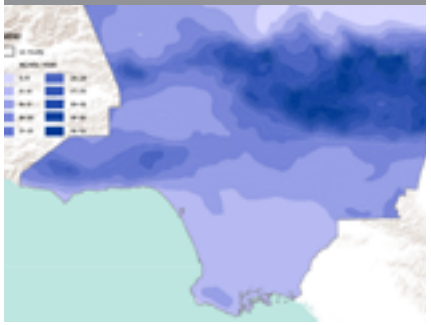
Natural systems are inherently regenerative. Natural forces such as chemical reactions and gravity move mountains, beaches, rivers, oceans, and sky. Living organisms do a lot of work in the processes of growing and sustaining life: cycling water, air, and nutrients including carbon and volatile compounds; opening up soil; and creating materials that nourish, shade, cleanse, and enrich the world around us. When space is made to leverage these forces and support life, work is constantly ongoing that humans otherwise need to input time and resources to do: producing and manufacturing materials and components; conveying water by pipes, pumps, gutters, and channels; transferring sediment and debris; and fabricating and installing increasingly sophisticated components out of expensive, labor-intensive materials and methods requiring ongoing operations and maintenance over time. All of this extra work generates waste, greenhouse gasses, and impacts the capacity of natural systems

APPENDIX B: GEOPHYSICAL MAPS

Geospatial data is instrumental in developing an understanding of our world, and for assessing and forming solutions to both social and environmental challenges. This data includes many physical and social factors collected from research, monitoring, modeling, civic documentation, and social inventories such as census information collected by the US Census Bureau. The maps on the following pages highlight some of the key data evaluated in both forming the Water LA program, and in ongoing assessments to determine critical target areas for urban acupuncture.

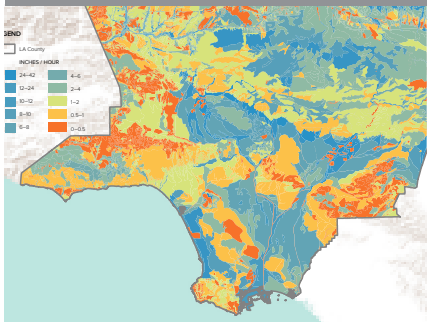
WATERSHEDS AND WATERWAYS

PRECIPITATION

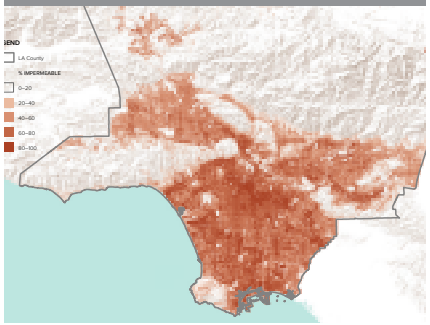


GROUNDWATER BASINS

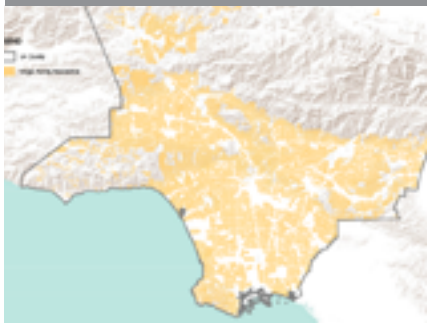
SOIL INFILTRATION



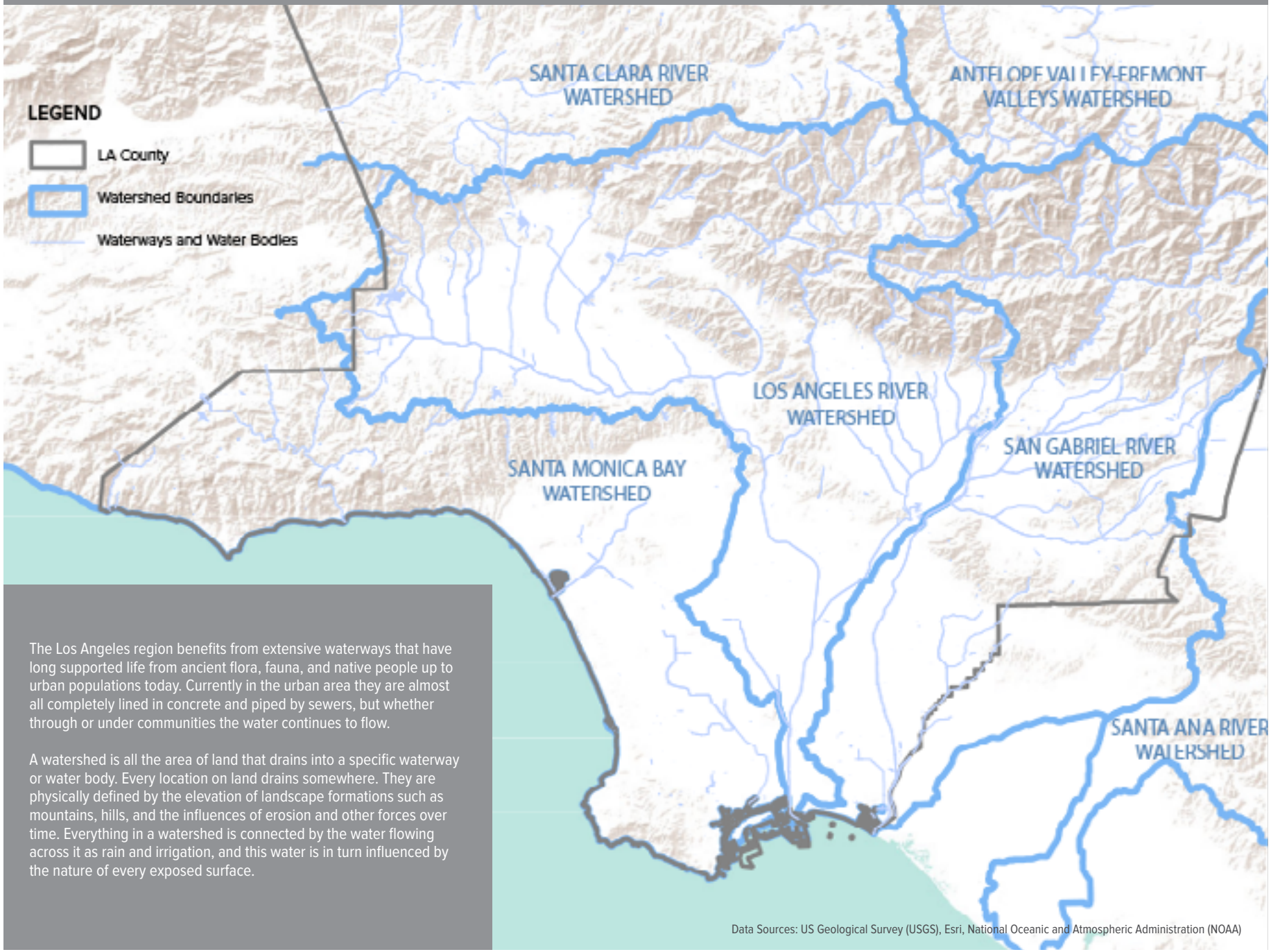
IMPERMEABILITY



LAND USE: RESIDENTIAL



WATERSHEDS AND WATERWAYS

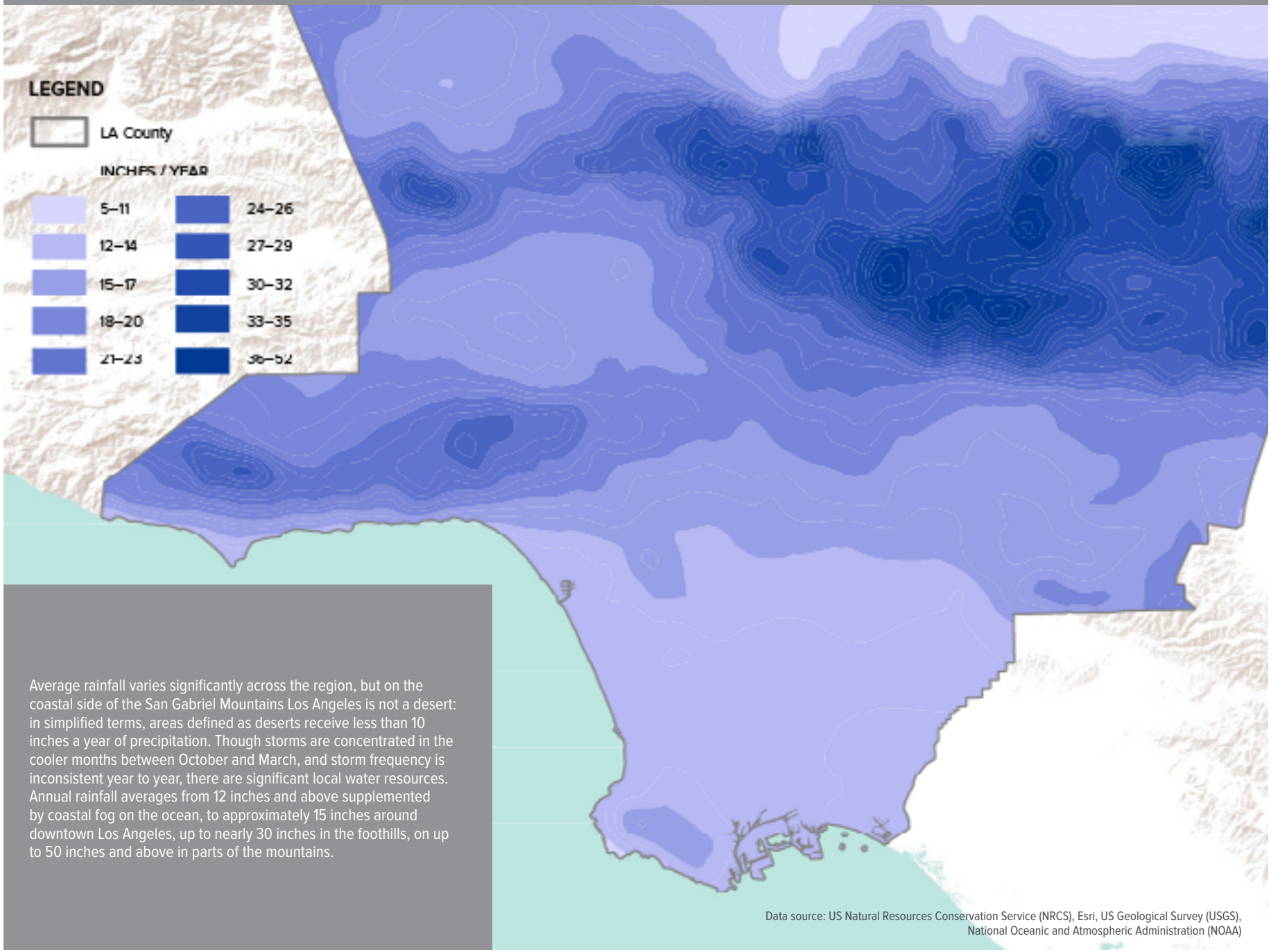


The Los Angeles region benefits from extensive waterways that have long supported life from ancient flora, fauna, and native people up to urban populations today. Currently in the urban area they are almost all completely lined in concrete and piped by sewers, but whether through or under communities the water continues to flow.

A watershed is all the area of land that drains into a specific waterway or water body. Every location on land drains somewhere. They are physically defined by the elevation of landscape formations such as mountains, hills, and the influences of erosion and other forces over time. Everything in a watershed is connected by the water flowing across it as rain and irrigation, and this water is in turn influenced by the nature of every exposed surface.

Data Sources: US Geological Survey (USGS), Esri, National Oceanic and Atmospheric Administration (NOAA)

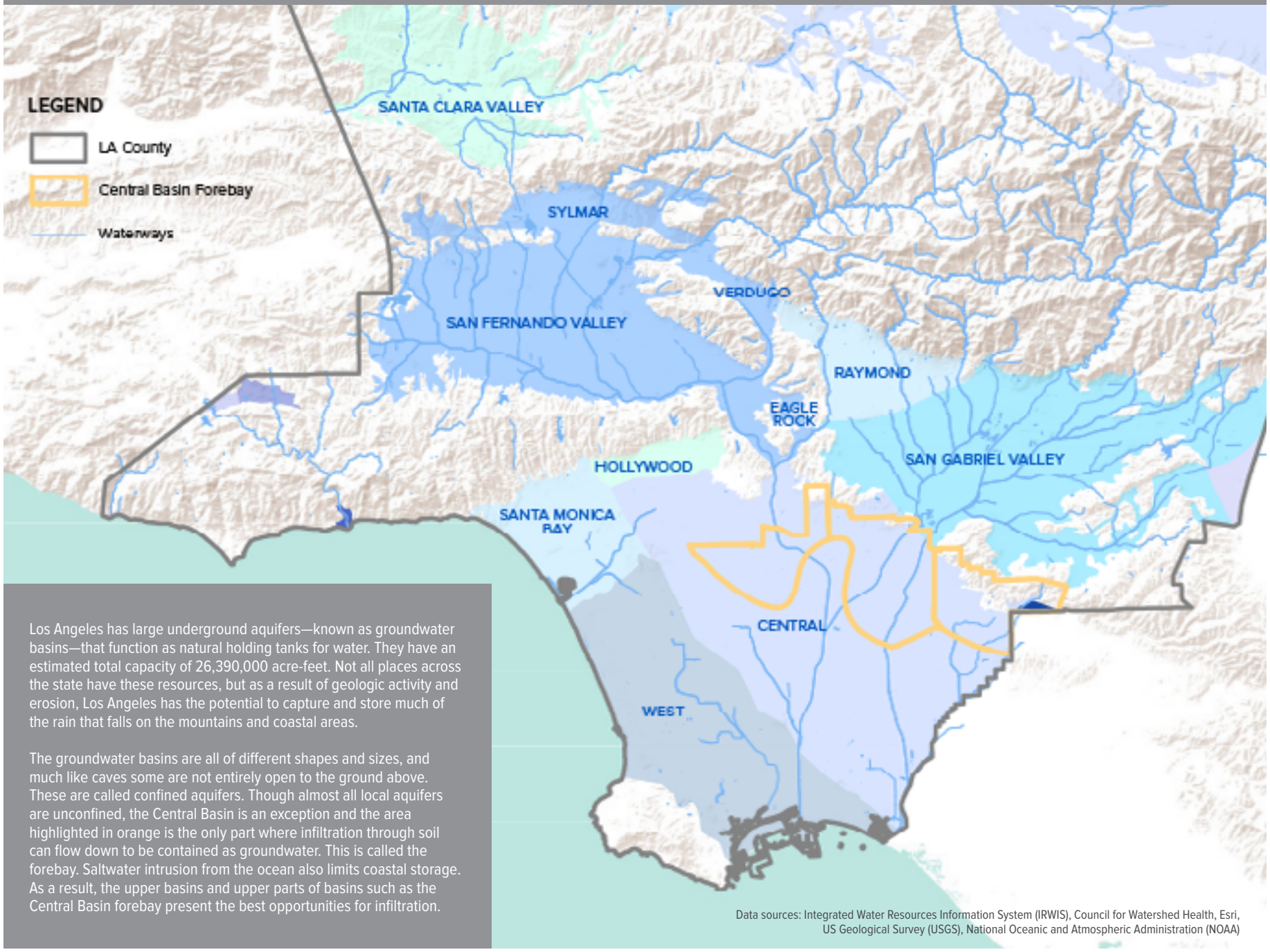
PRECIPITATION



Average rainfall varies significantly across the region, but on the coastal side of the San Gabriel Mountains Los Angeles is not a desert: in simplified terms, areas defined as deserts receive less than 10 inches a year of precipitation. Though storms are concentrated in the cooler months between October and March, and storm frequency is inconsistent year to year, there are significant local water resources. Annual rainfall averages from 12 inches and above supplemented by coastal fog on the ocean, to approximately 15 inches around downtown Los Angeles, up to nearly 30 inches in the foothills, on up to 50 inches and above in parts of the mountains.

Data source: US Natural Resources Conservation Service (NRCS), Esri, US Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA)

GROUNDWATER BASINS

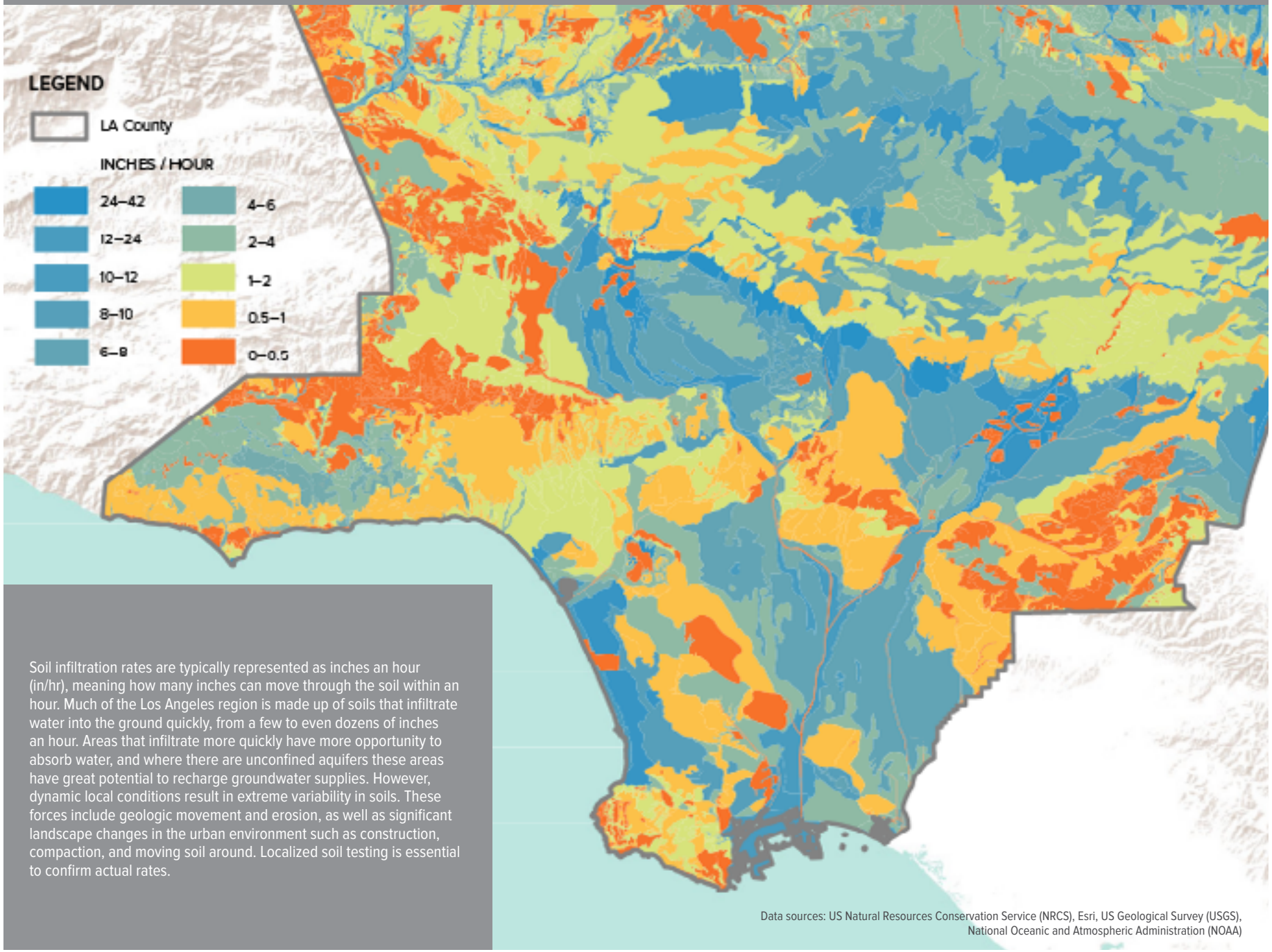


Los Angeles has large underground aquifers—known as groundwater basins—that function as natural holding tanks for water. They have an estimated total capacity of 26,390,000 acre-feet. Not all places across the state have these resources, but as a result of geologic activity and erosion, Los Angeles has the potential to capture and store much of the rain that falls on the mountains and coastal areas.

The groundwater basins are all of different shapes and sizes, and much like caves some are not entirely open to the ground above. These are called confined aquifers. Though almost all local aquifers are unconfined, the Central Basin is an exception and the area highlighted in orange is the only part where infiltration through soil can flow down to be contained as groundwater. This is called the forebay. Saltwater intrusion from the ocean also limits coastal storage. As a result, the upper basins and upper parts of basins such as the Central Basin forebay present the best opportunities for infiltration.

Data sources: Integrated Water Resources Information System (IRWIS), Council for Watershed Health, Esri, US Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA)

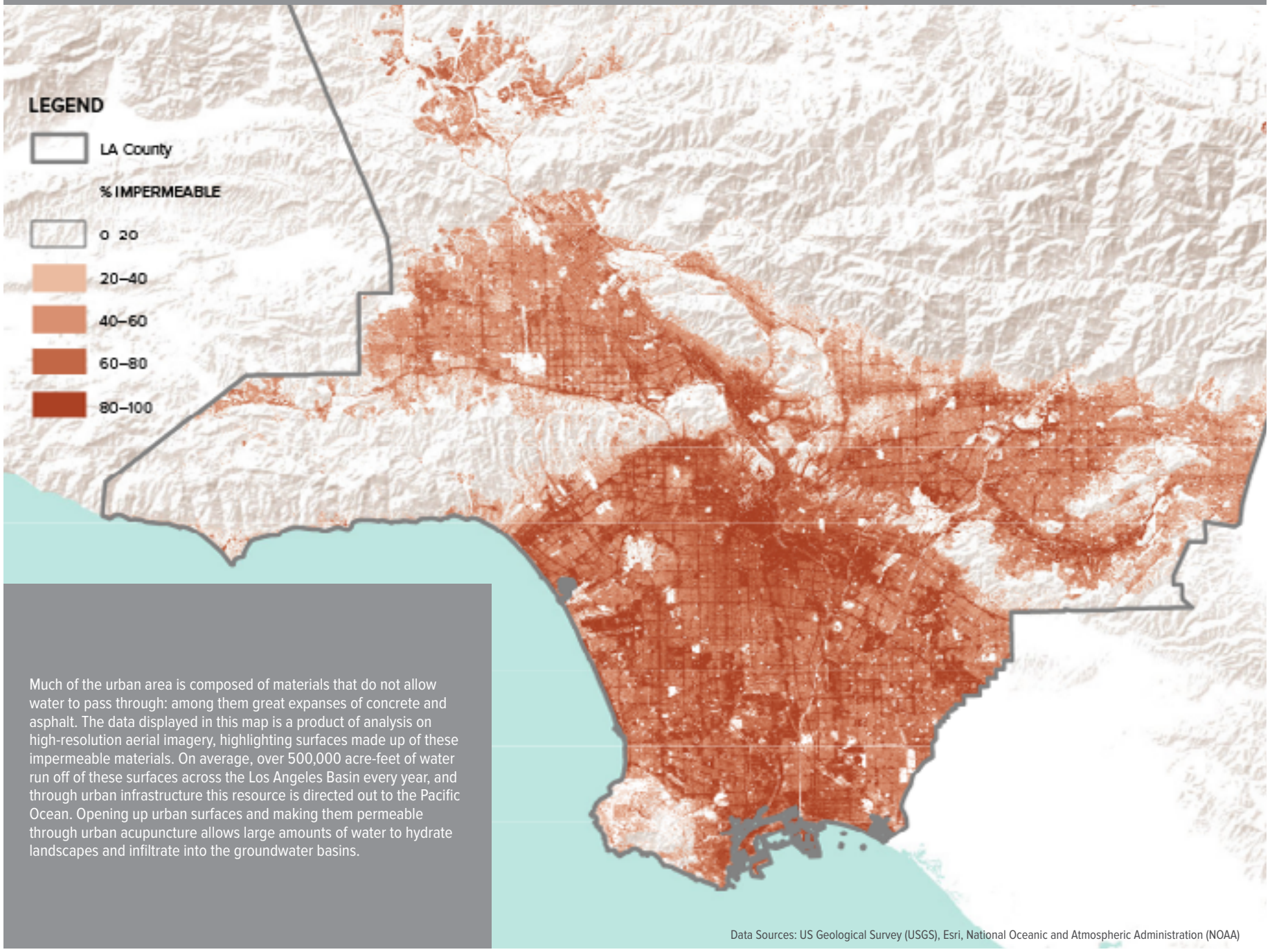
SOIL INFILTRATION



Soil infiltration rates are typically represented as inches an hour (in/hr), meaning how many inches can move through the soil within an hour. Much of the Los Angeles region is made up of soils that infiltrate water into the ground quickly, from a few to even dozens of inches an hour. Areas that infiltrate more quickly have more opportunity to absorb water, and where there are unconfined aquifers these areas have great potential to recharge groundwater supplies. However, dynamic local conditions result in extreme variability in soils. These forces include geologic movement and erosion, as well as significant landscape changes in the urban environment such as construction, compaction, and moving soil around. Localized soil testing is essential to confirm actual rates.

Data sources: US Natural Resources Conservation Service (NRCS), Esri, US Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA)

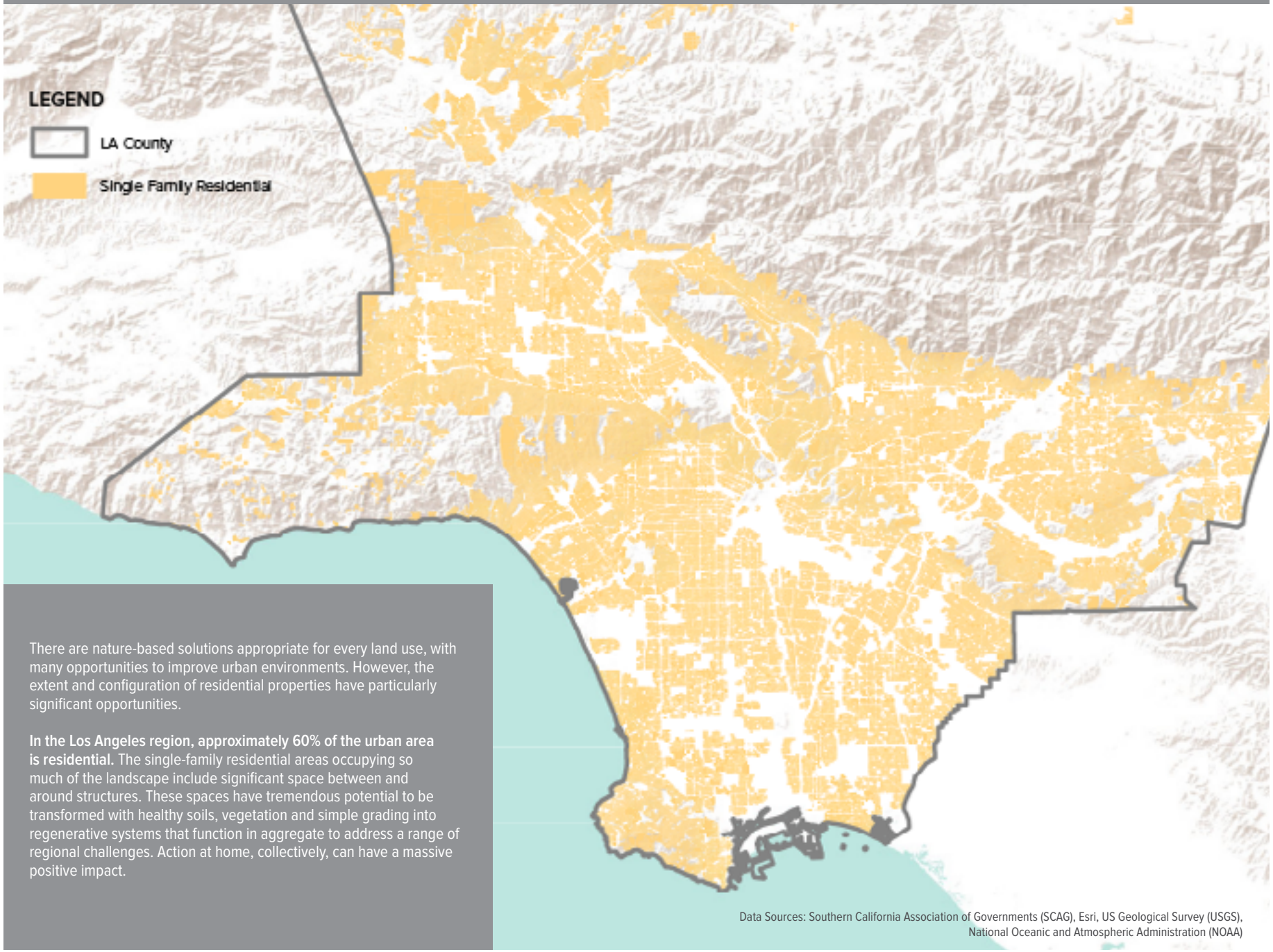
IMPERMEABILITY



Much of the urban area is composed of materials that do not allow water to pass through: among them great expanses of concrete and asphalt. The data displayed in this map is a product of analysis on high-resolution aerial imagery, highlighting surfaces made up of these impermeable materials. On average, over 500,000 acre-feet of water run off of these surfaces across the Los Angeles Basin every year, and through urban infrastructure this resource is directed out to the Pacific Ocean. Opening up urban surfaces and making them permeable through urban acupuncture allows large amounts of water to hydrate landscapes and infiltrate into the groundwater basins.

Data Sources: US Geological Survey (USGS), Esri, National Oceanic and Atmospheric Administration (NOAA)

LAND USE: RESIDENTIAL



There are nature-based solutions appropriate for every land use, with many opportunities to improve urban environments. However, the extent and configuration of residential properties have particularly significant opportunities.

In the Los Angeles region, approximately 60% of the urban area is residential. The single-family residential areas occupying so much of the landscape include significant space between and around structures. These spaces have tremendous potential to be transformed with healthy soils, vegetation and simple grading into regenerative systems that function in aggregate to address a range of regional challenges. Action at home, collectively, can have a massive positive impact.

Data Sources: Southern California Association of Governments (SCAG), Esri, US Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA)

APPENDIX C: TECHNICAL ANALYSIS OF WATER MONITORING/MODELING DATA

Monitoring was planned to utilize pre-project baseline data gathered at the Woodman Avenue Median project. Due to project delays, no baseline data was available, and data gathered at the median was impacted by changes in project configuration. As a result, LADWP offered to model the groundwater recharge, peak flow reduction, and water quality benefits of Water LA projects based on the information provided in each site plan, utilizing the BMP sizing and tributary area to each.

Stormwater capture

To factor the tables included at the end of this section, LADWP used the Los Angeles County Department of Public Works Hydrology Manual and the Modified Rational Method for calculating the peak mitigation for compliance with the Standard Urban Stormwater Mitigation Plan (SUSMP). To estimate the groundwater recharge volume for specific storm events, the project strategy infiltration capacity was measured against the hydrograph for the continued upstream tributary area.

Two storm sizes were modeled using the Los Angeles County's Hydrocalc hydrologic modeling program for the purposes of estimating the amount of groundwater recharged during the specific design storm event. The two design storms used were the 85th percentile storm (1.1" over 24 hours), and the mean storm (0.55'' over 24 hours). These storm sizes were used to determine the percentage of anticipated runoff volume captured by the project strategies relative to the total anticipated runoff for each model storm. The amount of storm water captured was determined by using the combined infiltration rates and storage volumes for each individual project strategy.

The size and volume of each project strategy was listed and applied using the above methods. The total water volume was dictated by property size, and also by upstream tributary areas for project strategies. Of note, the first phase of Water LA was primarily an exploration of strategies, and an initiative to advance best practices.

Not all strategies evaluated have equal impacts for water capture. All properties were designed to capture at minimum a 1" storm event through the suite of strategies available. Some properties were designed to significantly exceed this size, as in one front-yard rain grading project designed to capture at minimum a 10-year storm. A growing emphasis on parkway basins comes largely from results of the first phase, and the significant benefit to municipal objectives.

Additionally, according to the US Natural Resources Conservation Service (NRCS) soil survey released in 2017 the infiltration rates in the study area are generally determined to be approximately 7.3 inches an hour, several times the 1" and 0.5" infiltration rates modeled by LADWP.

Peak flow reduction

Reducing peak flow is a primary objective for comprehensive flood management. Peak flow is the greatest amount of water moving at a moment in time in a given storm event. This is typically when the biggest impacts from flooding occur.

The Water LA BMPs were analyzed for peak flow reduction based on the size of each BMP and the estimated infiltration rates obtained from the 2012 Geosyntec report prepared for this project. The table on the following page shows a breakdown of each BMP incorporated into the Water LA Pilot. Combined, the BMPs implemented by the Water LA Pilot provide a peak flow reduction of 0.065 cubic feet per second (or 29.17 gallons per minute).

Projects in aggregate

The total stormwater capture potential of the Water LA retrofits based on the mean storm as modeled by LADWP is assumed to be 112.97 AF. The average assumed life of these projects is 30 years. Costs of projects are compared against the total impact potential over this period. Dry weather flows may also be substantially greater in given neighborhoods, and are difficult to quantify without field monitoring and evaluations.

Water conservation

Per capita water conservation was also a major objective of Water LA, not only through outdoor water reduction but also indoor practices. To participate in the program homeowners signed agreements to:

- Permit access to their water bills for three years before and after joining the program
- Participate in workshops and dedicate time to help with installations for a collective 60 hours minimum, fostering stewardship, community, and investment in the installations
- Commit to stewardship of the projects

The Water LA team compiled results from participant water bills, observing significant impacts to per capita water use—already below LA averages—over the life of the program. Average per capita water use of participants dropped from 73 gallons per day over the three years prior to participation, to 54.7 gallons per day following the completion of the implementation period. Given that many participants actually increased the number of plants in their landscape, such a drop is notable. This may be attributed to the watershed awareness gained through workshops, the active participation experience of neighbor labor, and the LADWP water conservation tools (shower timers, faucet aerators, written materials, etc.) handed out and discussed through the program.

WATER LA PILOT PROGRAM: 85TH PERCENTILE STORM

		HYDROLOGIC PROPERTIES													LOAD REMOVED BY THE BMPs (85th Percentile Storm)					
Property	Strategy	Tributary Area (Acres)	Runoff Coeff	Avg Annual Precip (ft)	Avg Annual Tributary Runoff (AFY)	Basin Infiltration Bed Size (SF)	Soil Infiltration Rate (in/hr)	Max Basin Infiltration Flow Rate (cf/hr)	Maximum 24 Hour Infiltration (AF)	Maximum Storage (AF)	Total 24 Hour Capture Capacity (AF)	85th Percentile Storm Capture AF (1.1 in/24 hr)	BMP Utilization Rate (85th %ile Storm)	Average Annual Capture Estimate (AFY)	Nitrate (Kg/storm)	Tot Copper (Kg/storm)	Tot Lead (Kg/storm)	Tot Zinc (Kg/storm)	FC (MPN)	TSS (Kg/storm)
1	Rain Garden	0.05	0.91	1.48	0.07	450	1	37.50	0.0207	0.0103	0.0310	0.004	12%	0.060	0.00	0.05	0.03	0.41	1.15E+06	0.08
2	Rain Garden 1	0.02	0.91	1.48	0.03	80	1	6.67	0.0037	0.0018	0.0055	0.002	28%	0.024	0.00	0.03	0.02	0.20	5.74E+05	0.04
2	Rain Garden 2	0.02	0.91	1.48	0.02	32	1	2.67	0.0015	0.0007	0.0022	0.002	69%	0.024	0.00	0.03	0.02	0.20	5.74E+05	0.04
3	Parkway Basin	0.81	0.42	1.48	0.50	100	1	8.33	0.0046	0.0034	0.0080	0.008	100%	0.129	0.01	0.11	0.07	0.81	2.30E+06	0.17
3	Infiltration Trench	0.01	0.91	1.48	0.01	208	1	17.34	0.0096	0.0018	0.0113	0.001	7%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
3	Rain Tanks	0.02	0.91	1.48	0.02	0	1	0.00	0.0000	0.0006	0.0006	0.001	100%	0.010	0.00	0.01	0.01	0.10	2.87E+05	0.02
3	Rain Garden 1	0.02	0.91	1.48	0.02	45	1	3.75	0.0021	0.0005	0.0026	0.002	59%	0.024	0.00	0.03	0.02	0.20	5.74E+05	0.04
3	Rain Garden 2	0.01	0.91	1.48	0.01	26	1	2.13	0.0012	0.0001	0.0013	0.001	58%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
4	Rain Tanks	0.01	0.91	1.48	0.02	0	0.5	0.00	0.0000	0.0020	0.0020	0.001	37%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
4	Parkway Basin	0.42	0.42	1.48	0.26	90	0.5	3.75	0.0021	0.0025	0.0045	0.004	98%	0.072	0.00	0.05	0.03	0.41	1.15E+06	0.08
4	Permeable Paver	0.01	0.91	1.48	0.02	415	0.5	17.29	0.0095	0.0000	0.0095	0.001	8%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
4	Rain Grading	0.04	0.58	1.48	0.03	715	0.5	29.79	0.0164	0.0011	0.0175	0.002	12%	0.033	0.00	0.03	0.02	0.20	5.74E+05	0.04
5	Parkway Basin	0.59	0.42	1.48	0.36	90	1	7.50	0.0041	0.0025	0.0066	0.007	100%	0.107	0.00	0.09	0.06	0.71	2.01E+06	0.15
6	Parkway Basin	0.73	0.42	1.48	0.45	45	0.1	0.38	0.0002	0.0012	0.0014	0.001	100%	0.023	0.00	0.01	0.01	0.10	2.87E+05	0.02
7	Permeable Paver	0.03	0.91	1.48	0.04	710	0.5	29.58	0.0163	0.0000	0.0163	0.002	14%	0.036	0.00	0.03	0.02	0.20	5.74E+05	0.04
8	Parkway Basin	1.43	0.42	1.48	0.89	45	1	3.75	0.0021	0.0012	0.0033	0.003	98%	0.052	0.00	0.04	0.03	0.30	8.61E+05	0.06
9	Parkway Basin	2.80	0.42	1.48	1.74	150	0.1	1.25	0.0007	0.0041	0.0048	0.005	98%	0.076	0.00	0.07	0.04	0.51	1.43E+06	0.10
9	Rain Garden	0.01	0.91	1.48	0.01	45	0.1	0.38	0.0002	0.0008	0.0010	0.001	77%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
9	Infiltration Trench	0.01	0.91	1.48	0.01	18	0.1	0.15	0.0001	0.0002	0.0003	0.000	100%	0.005	0.00	0.00	0.00	0.00	0	0.00
10	Parkway Basin	0.30	0.42	1.48	0.19	75	1	6.25	0.0034	0.0021	0.0055	0.005	99%	0.087	0.00	0.07	0.04	0.51	1.43E+06	0.10
11	Parkway Basin	1.58	0.42	1.48	0.98	80	1	6.67	0.0037	0.0022	0.0059	0.006	100%	0.096	0.00	0.08	0.05	0.61	1.72E+06	0.12
11	Tanks to Trench	0.01	0.91	1.48	0.01	90	1	7.50	0.0041	0.0022	0.0063	0.001	12%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
11	Rain Tanks	0.01	0.91	1.48	0.01	0	1	0.00	0.0000	0.0003	0.0003	0.000	100%	0.005	0.00	0.00	0.00	0.00	0	0.00
12	Parkway Basin	0.71	0.42	1.48	0.44	75	1	6.25	0.0034	0.0021	0.0055	0.005	99%	0.087	0.00	0.07	0.04	0.51	1.43E+06	0.10
12	Rain Garden	0.01	0.91	1.48	0.02	70	1	5.83	0.0032	0.0008	0.0040	0.001	19%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
13	Parkway Basin	0.14	0.42	1.48	0.09	185	1	15.42	0.0085	0.0051	0.0136	0.006	41%	0.089	0.00	0.08	0.05	0.61	1.72E+06	0.12
13	Rain Garden	0.005	0.91	1.48	0.01	18	1	1.50	0.0008	0.0004	0.0012	0.000	31%	0.006	0.00	0.00	0.00	0.00	0	0.00
13	Infiltration Trench	0.004	0.91	1.48	0.00	99	1	8.25	0.0045	0.0005	0.0050	0.000	8%	0.006	0.00	0.00	0.00	0.00	0	0.00
14	Parkway Swale	1.68	0.42	1.48	1.04	60	1	5.00	0.0028	0.0017	0.0044	0.004	100%	0.071	0.00	0.05	0.03	0.41	1.15E+06	0.08
14	Rain Garden 1	0.01	0.91	1.48	0.01	32	1	2.67	0.0015	0.0007	0.0022	0.001	34%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
14	Rain Garden 2	0.01	0.91	1.48	0.01	32	1	2.67	0.0015	0.0007	0.0022	0.001	34%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
14	Infiltration Trenches	0.01	0.91	1.48	0.01	128	1	10.67	0.0059	0.0005	0.0064	0.001	12%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
14	Infiltration Trench	0.01	0.91	1.48	0.01	64	1	5.34	0.0029	0.0006	0.0036	0.001	21%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
14	Rain Barrels	0.01	0.91	1.48	0.01	0	1	0.00	0.0000	0.0013	0.0013	0.001	60%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
15	Parkway Basin	3.70	0.42	1.48	2.30	75	1	6.25	0.0034	0.0021	0.0055	0.006	100%	0.088	0.00	0.08	0.05	0.61	1.72E+06	0.12
15	Rain Grading	0.04	0.6	1.48	0.04	462	1	38.50	0.0212	0.0007	0.0219	0.002	10%	0.034	0.00	0.03	0.02	0.20	5.74E+05	0.04
16	Rain Grading	0.02	0.91	1.48	0.02	60	1	5.00	0.0028	0.0007	0.0034	0.002	44%	0.024	0.00	0.03	0.02	0.20	5.74E+05	0.04
16	Hardscape	0.03	0.91	1.48	0.04	580	1	48.33	0.0266	0.0000	0.0266	0.002	8%	0.036	0.00	0.03	0.02	0.20	5.74E+05	0.04
16	Infiltration Trench	0.00	0.91	1.48	0.01	6	1	0.46	0.0003	0.0001	0.0003	0.000	100%	0.006	0.00	0.00	0.00	0.00	0	0.00
17	Rain Garden	0.02	0.91	1.48	0.02	40	1	3.33	0.0018	0.0009	0.0028	0.002	55%	0.024	0.00	0.03	0.02	0.20	5.74E+05	0.04
17	Rain Tank	0.02	0.91	1.48	0.02	0	1	0.00	0.0000	0.0006	0.0006	0.001	100%	0.010	0.00	0.01	0.01	0.10	2.87E+05	0.02
17	Rain Barrel	0.01	0.91	1.48	0.01	0	1	0.00	0.0000	0.0002	0.0002	0.000	100%	0.003	0.00	0.00	0.00	0.00	0	0.00
17	Infiltration Trenches	0.01	0.91	1.48	0.01	38	1	3.17	0.0017	0.0005	0.0023	0.001	33%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
17	Infiltration Trench	0.01	0.91	1.48	0.01	30	1	2.50	0.0014	0.0016	0.0030	0.001	25%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
18	Parkway Basin	0.13	0.42	1.48	0.08	75	1	6.25	0.0034	0.0021	0.0055	0.005	93%	0.082	0.00	0.07	0.04	0.51	1.43E+06	0.10
18	Rain Garden 1	0.01	0.91	1.48	0.01	40	1	3.33	0.0018	0.0005	0.0023	0.001	33%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
18	Rain Garden 2	0.02	0.91	1.48	0.03	72	1	6.00	0.0033	0.0008	0.0041	0.002	37%	0.024	0.00	0.03	0.02	0.20	5.74E+05	0.04
18	Rain Barrels	0.02	0.91	1.48	0.02	0	1	0.00	0.0000	0.0014	0.0014	0.001	100%	0.023	0.00	0.01	0.01	0.10	2.87E+05	0.02
18	Infiltration Trench	0.03	0.91	1.48	0.04	14.75	1	1.23	0.0007	0.0002	0.0009	0.001	91%	0.013	0.00	0.01	0.01	0.10	2.87E+05	0.02
19	Parkway Swale	0.26	0.42	1.48	0.16	90	1	7.50	0.0041	0.0025	0.0066	0.007	100%	0.107	0.00	0.09	0.06	0.71	2.01E+06	0.15
19	Rain Garden	0.01	0.91	1.48	0.02	190	1	15.83	0.0087	0.0033	0.0120	0.001	6%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
19	Parkway Basin	0.66	0.42	1.48	0.41	45	1	3.75	0.0021	0.0012	0.0033	0.003	98%	0.052	0.00	0.04	0.03	0.30	8.61E+05	0.06
19	Rain Tank	0.01	0.91	1.48	0.01	0	1	0.00	0.0000	0.0016	0.0016	0.001	47%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
19	Hardscape	0.01	0.91	1.48	0.01	320	1	26.67	0.0147	0.0000	0.0147	0.001	5%	0.012	0.00	0.01	0.01	0.10	2.87E+05	0.02
19	Rain Grading	0.05	0.68	1.48	0.05	671	1	55.92	0.0308	0.0010	0.0318	0.003	9%	0.047	0.00	0.04	0.03	0.30	8.61E+05	0.06
20	Parkway Basin	6.61	0.42	1.48	4.10	60	1	5.00	0.0028	0.0017	0.0044	0.005	100%	0.072	0.00	0.07	0.04	0.51	1.43E+06	0.10
21	Parkway Basin	0.19	0.42	1.48	0.12	45	1	3.75	0.0021	0.0012	0.0033	0.003	98%	0.052	0.00	0.04	0.03	0.30	8.61E+05	0.06
22	Parkway Basin	12.58	0.42	1.48	7.81	150	1	12.50	0.0069	0.0041	0.0110	0.011	100%	0.182	0.01	0.15	0.09	1.12	3.16E+06	0.23
22	Infiltration Trench	0.04	0.91	1.48	0.05	58.5	1	4.88	0.0027	0.0003	0.0030	0.001	30%	0.014	0.00	0.01	0.01	0.10	2.87E+05	0.02
22	Rain Barrels	0.01	0.91	1.48	0.02	0	1	0.00	0.0000	0.0003	0.0003	0.000	100%	0.005	0.00	0.00	0.00	0.00	0.00	0.00
	Water LA PC Totals	**36.0029**	**44.9100**	**88.6500**	**22.7870**	**7393.5000**			**0.2845**	**0.0858**	**0.3703**	**0.14**		**2.24**	**0.02**	**1.88**	**1.28**	**14.56**	**41,312,000.00**	**2.92**

WATER LA PILOT PROGRAM: MEAN STORM

Property	Strategy	Tributary Area (Acres)	Runoff Coeff	Avg Annual Precip (ft)	Avg Annual Tributary Runoff (AFY)	Basin Infiltration Bed Size (SF)	Soil Infiltration Rate (in/hr)	Max Basin Infiltration Flow Rate (cf/hr)	Maximum 24 Hour Infiltration (AF)	Maximum Storage (AF)	Total 24 Hour Capture Capacity (AF)	Mean Storm Capture AF (.55 in/24 hr)	% of Capacity (Mean Storm)	Average Annual Capture Estimate (AFY)
1	Rain Garden	0.05	0.91	1.48	0.07	450	1	37.50	0.0207	0.0103	0.0310	0.001	2%	0.024
2	Rain Garden 1	0.02	0.91	1.48	0.03	80	1	6.67	0.0037	0.0018	0.0055	0.001	14%	0.024
2	Rain Garden 2	0.02	0.91	1.48	0.02	32	1	2.67	0.0015	0.0007	0.0022	0.001	34%	0.024
3	Parkway Basin	0.81	0.42	1.48	0.50	100	1	8.33	0.0046	0.0034	0.0080	0.008	100%	0.257
3	Infiltration Trench	0.01	0.91	1.48	0.01	208	1	17.34	0.0096	0.0018	0.0113	0.000	3%	0.012
3	Rain Tanks	0.02	0.91	1.48	0.02	0	1	0.00	0.0000	0.0006	0.0006	0.001	99%	0.020
3	Rain Garden 1	0.02	0.91	1.48	0.02	45	1	3.75	0.0021	0.0005	0.0026	0.001	29%	0.024
3	Rain Garden 2	0.01	0.91	1.48	0.01	26	1	2.13	0.0012	0.0001	0.0013	0.000	28%	0.012
4	Rain Tanks	0.01	0.91	1.48	0.02	0	0.5	0.00	0.0000	0.0020	0.0020	0.000	18%	0.012
4	Parkway Basin	0.42	0.42	1.48	0.26	90	0.5	3.75	0.0021	0.0025	0.0045	0.004	98%	0.143
4	Permeable Paver	0.01	0.91	1.48	0.02	415	0.5	17.29	0.0095	0.0000	0.0095	0.000	4%	0.012
4	Rain Grading	0.04	0.58	1.48	0.03	715	0.5	29.79	0.0164	0.0011	0.0175	0.001	6%	0.033
5	Parkway Basin	0.59	0.42	1.48	0.36	90	1	7.50	0.0041	0.0025	0.0066	0.007	100%	0.213
6	Parkway Basin	0.73	0.42	1.48	0.45	45	0.1	0.38	0.0002	0.0012	0.0014	0.001	100%	0.046
7	Permeable Paver	0.03	0.91	1.48	0.04	710	0.5	29.58	0.0163	0.0000	0.0163	0.001	7%	0.036
8	Parkway Basin	1.43	0.42	1.48	0.89	45	1	3.75	0.0021	0.0012	0.0033	0.003	98%	0.104
9	Parkway Basin	2.80	0.42	1.48	1.74	150	0.1	1.25	0.0007	0.0041	0.0048	0.010	100%	0.325
9	Rain Garden	0.01	0.91	1.48	0.01	45	0.1	0.38	0.0002	0.0008	0.0010	0.000	37%	0.012
9	Infiltration Trench	0.01	0.91	1.48	0.01	18	0.1	0.15	0.0001	0.0002	0.0003	0.000	100%	0.012
10	Parkway Basin	0.30	0.42	1.48	0.19	75	1	6.25	0.0034	0.0021	0.0055	0.005	98%	0.173
11	Parkway Basin	1.58	0.42	1.48	0.98	80	1	6.67	0.0037	0.0022	0.0059	0.006	100%	0.192
11	Tanks to Trench	0.01	0.91	1.48	0.01	90	1	7.50	0.0041	0.0022	0.0063	0.000	6%	0.012
11	Rain Tanks	0.01	0.91	1.48	0.01	0	1	0.00	0.0000	0.0003	0.0003	0.000	97%	0.010
12	Parkway Basin	0.71	0.42	1.48	0.44	75	1	6.25	0.0034	0.0021	0.0055	0.005	99%	0.175
12	Rain Garden	0.01	0.91	1.48	0.02	70	1	5.83	0.0032	0.0008	0.0040	0.000	9%	0.012
13	Parkway Basin	0.14	0.42	1.48	0.09	185	1	15.42	0.0085	0.0051	0.0136	0.003	20%	0.089
13	Rain Garden	0.005	0.91	1.48	0.01	18	1	1.50	0.0008	0.0004	0.0012	0.000	15%	0.006
13	Infiltration Trench	0.004	0.91	1.48	0.00	99	1	8.25	0.0045	0.0005	0.0050	0.000	3%	0.005
14	Parkway Swale	1.68	0.42	1.48	1.04	60	1	5.00	0.0028	0.0017	0.0044	0.004	100%	0.143
14	Rain Garden 1	0.01	0.91	1.48	0.01	32	1	2.67	0.0015	0.0007	0.0022	0.000	17%	0.012
14	Rain Garden 2	0.01	0.91	1.48	0.01	32	1	2.67	0.0015	0.0007	0.0022	0.000	17%	0.012
14	Infiltration Trenches	0.01	0.91	1.48	0.01	128	1	10.67	0.0059	0.0005	0.0064	0.000	6%	0.012
14	Infiltration Trench	0.01	0.91	1.48	0.01	64	1	5.34	0.0029	0.0006	0.0036	0.000	10%	0.012
14	Rain Barrels	0.01	0.91	1.48	0.01	0	1	0.00	0.0000	0.0013	0.0013	0.000	29%	0.012
15	Parkway Basin	3.70	0.42	1.48	2.30	75	1	6.25	0.0034	0.0021	0.0055	0.006	100%	0.177
15	Rain Grading	0.04	0.6	1.48	0.04	462	1	38.50	0.0212	0.0007	0.0219	0.001	5%	0.034
16	Rain Grading	0.02	0.91	1.48	0.02	60	1	5.00	0.0028	0.0007	0.0034	0.001	22%	0.024
16	Hardscape	0.03	0.91	1.48	0.04	580	1	48.33	0.0266	0.0000	0.0266	0.001	4%	0.036
16	Infiltration Trench	0.00	0.91	1.48	0.01	6	1	0.46	0.0003	0.0001	0.0003	0.000	56%	0.006
17	Rain Garden	0.02	0.91	1.48	0.02	40	1	3.33	0.0018	0.0009	0.0028	0.001	28%	0.024
17	Rain Tank	0.02	0.91	1.48	0.02	0	1	0.00	0.0000	0.0006	0.0006	0.001	99%	0.020
17	Rain Barrel	0.01	0.91	1.48	0.02	0	1	0.00	0.0000	0.0002	0.0002	0.000	100%	0.006
17	Infiltration Trenches	0.01	0.91	1.48	0.01	38	1	3.17	0.0017	0.0005	0.0023	0.000	16%	0.012
17	Infiltration Trench	0.01	0.91	1.48	0.01	30	1	2.50	0.0014	0.0016	0.0030	0.000	12%	0.012
18	Parkway Basin	0.13	0.42	1.48	0.08	75	1	6.25	0.0034	0.0021	0.0055	0.003	47%	0.082
18	Rain Garden 1	0.01	0.91	1.48	0.01	40	1	3.33	0.0018	0.0005	0.0023	0.000	16%	0.012
18	Rain Garden 2	0.02	0.91	1.48	0.03	72	1	6.00	0.0033	0.0008	0.0041	0.001	18%	0.024
18	Rain Barrels	0.02	0.91	1.48	0.02	0	1	0.00	0.0000	0.0014	0.0014	0.001	54%	0.024
18	Infiltration Trench	0.03	0.91	1.48	0.04	14.75	1	1.23	0.0007	0.0002	0.0009	0.001	91%	0.026
19	Parkway Swale	0.26	0.42	1.48	0.16	90	1	7.50	0.0041	0.0025	0.0066	0.005	78%	0.165
19	Rain Garden	0.01	0.91	1.48	0.02	190	1	15.83	0.0087	0.0033	0.0120	0.000	3%	0.012
19	Parkway Basin	0.66	0.42	1.48	0.41	45	1	3.75	0.0021	0.0012	0.0033	0.003	98%	0.104
19	Rain Tank	0.01	0.91	1.48	0.01	0	1	0.00	0.0000	0.0016	0.0016	0.000	23%	0.012
19	Hardscape	0.01	0.91	1.48	0.01	320	1	26.67	0.0147	0.0000	0.0147	0.000	3%	0.012
19	Rain Grading	0.05	0.68	1.48	0.05	671	1	55.92	0.0308	0.0010	0.0318	0.001	5%	0.047
20	Parkway Basin	6.61	0.42	1.48	4.10	60	1	5.00	0.0028	0.0017	0.0044	0.005	100%	0.146
21	Parkway Basin	0.19	0.42	1.48	0.12	45	1	3.75	0.0021	0.0012	0.0033	0.003	97%	0.103
22	Parkway Basin	12.58	0.42	1.48	7.81	150	1	12.50	0.0069	0.0041	0.0110	0.012	100%	0.370
22	Infiltration Trench	0.04	0.91	1.48	0.05	58.5	1	4.88	0.0027	0.0003	0.0030	0.002	51%	0.048
22	Rain Barrels	0.01	0.91	1.48	0.02	0	1	0.00	0.0000	0.0003	0.0003	0.000	97%	0.010

APPENDIX D: ASSESSMENT OF REGIONAL WATER PLANS, CODE BARRIERS, AND PROGRESS

While few people are familiar with the complex set of policies, codes, and standards that shape the built environment of all cities, these rules are central in determining the form of urban space. Water planning documents encourage (and in some cases mandate) the widespread adoption of distributed green infrastructure strategies. However, over the course of the Water LA pilot, the team discovered a range of city codes and policies that disincentivize and even prohibit residents from adopting these retrofits.

This appendix reviews the role of distributed solutions in major LA-area water planning documents; the elements of local building codes that hinder the adoption of these strategies; the information gaps that undermine efforts to implement them widely; and examples of successful efforts by Water LA team members to ameliorate such mismatches.

DISTRIBUTED SOLUTIONS IN LA'S WATER PLANS

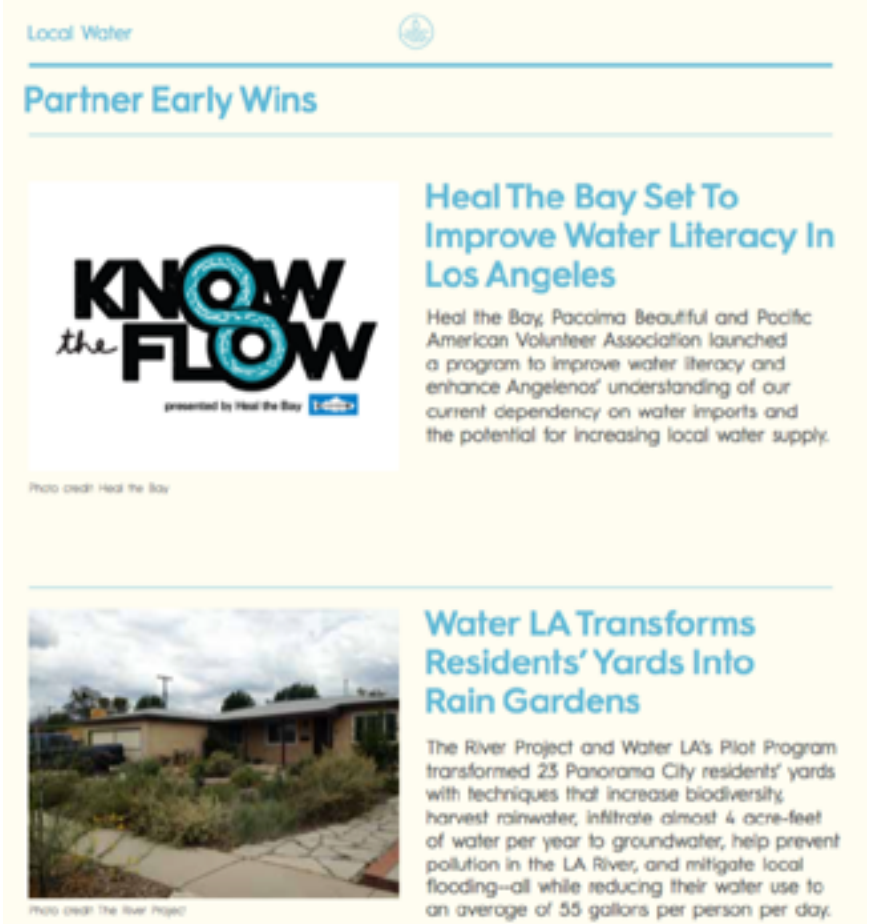
Four major plans developed by local agencies during the 2012-2016 drought outline targets for the adoption of distributed stormwater solutions at the parcel and the streetscape scale. All call for relatively aggressive rates of adoption to meet their water management targets, and reference the Water LA Program as a vehicle to meet their goals.

City of LA Sustainable City pLAn (2015)

This document sets overarching city targets for local water provision and stormwater capture, and indicates that distributed green infrastructure should be among the priority strategies for attaining these goals. The targets relevant to Water LA include:

- Cut the city's percentage of imported water by 50% by 2025.
- Source 50% of water supply locally by 2035, including 150,000 acre-feet per year through stormwater capture.
- Improve beach water quality GPA to 3.9/3.2 by 2025 and 4.0/3.5 by 2035.
- Develop integrated, stakeholder-driven "One Water." comprehensive water strategy.
- Expand the number of green infrastructure sites (bioswales, infiltration cut outs, street trees).
- Add street trees, prioritizing neighborhoods with most severe heat island effect.
- Prioritize water system funding for local water supply development.
- Expand scope and financing of DWP's turf replacement incentive program.
- Implement and expand other DWP conservation incentives.
- Expand rain tank program.
- Encourage residential water storage (rain tanks).
- Develop soil health and "no net loss" biodiversity strategy for the city.
- Lead regional cities to make GHG reduction commitments.
- Educate and engage residents in ongoing awareness & action campaigns.
- Reduce the number of census tracts in the top 10% of CalEnviroScreen 25% by 2025.
- Target highest-scoring CalEnviroScreen census tracts for investments of cap and trade revenue.
- Green jobs: 72.5k by 2025, 150k by 2035
- Expand and improve access to financing (PACE, green bank, etc.).

Water LA was showcased in the first annual Sustainable City pLAn Report as a "Partner Early Win."



Local Water

Partner Early Wins

Heal The Bay Set To Improve Water Literacy In Los Angeles

Heal the Bay, Pacoima Beautiful and Pacific American Volunteer Association launched a program to improve water literacy and enhance Angelenos' understanding of our current dependency on water imports and the potential for increasing local water supply.

Photo credit: Heal the Bay

Water LA Transforms Residents' Yards Into Rain Gardens

The River Project and Water LA's Pilot Program transformed 23 Panorama City residents' yards with techniques that increase biodiversity, harvest rainwater, infiltrate almost 4 acre-feet of water per year to groundwater, help prevent pollution in the LA River, and mitigate local flooding—all while reducing their water use to an average of 55 gallons per person per day.

Photo credit: The River Project

LADWP Stormwater Capture Master Plan (2015)
This plan provides a more detailed analysis of the opportunities for distributed infiltration, direct-use, and green streets stormwater infrastructure within the City of L.A:

Opportunity: the report estimates an opportunity area of 11,425 acres of single-family residential landscapes for on-site infiltration; 12,236 acres of single-family residential landscape for on-site direct use; and 34,174 acres of residential streets for green streets retrofits.

The SCMP also estimates the necessary parcel-based implementation rates for meeting its targets for citywide stormwater capture.

Implementation: For the opportunity spaces identified above, the report posits two scenarios for rate of implementation: "conservative" and "aggressive." Under its "conservative" scenario, the report estimates an annual implementation rate of 1.4% of residential parcels adopting infiltration retrofits and .4% of residential parcels adopting direct use interventions. Under their "aggressive" scenario, the report estimates 4.4% of residential parcels adopting infiltration retrofits and 1.2% of residential parcels adopting direct use interventions.

All told, the SCMP estimates that between 8,200 and 25,750 residential parcels in the City of Los Angeles must adopt distributed stormwater solutions each year in the coming decades to meet its local water supply goals. The plan acknowledges that swift and sustained action on the part of LADWP and its partners is critical, and identifies collaboration as a fundamental element of all work associated with implementation of the SCMP. It recommends joint development of standard MOUs with common partners to streamline continued participation in projects that provide multiple benefits in communities while optimizing local government funding efficiency, and anticipates that the neighborhood-wide on-site implementation program Water LA could be implemented in this way.

The plan recognizes that while projects located on private property are not suited to be implemented by LADWP directly, willingness to implement projects can be greatly influenced by a number of factors including education programs, rebates and incentives, financing opportunities, design assistance, and ease of permitting. It recommends the development of standard terms for maintenance

and monitoring of infiltration projects that would be required in order to be eligible for credits and grants.

Further, it notes that Water LA's Homeowner's "How-To" Guides are becoming available to help individuals design, implement, and steward small-scale stormwater capture and use systems, and suggests strengthening the existing LID Ordinance to require stormwater capture projects be installed upon sale.

Upper LA River Enhanced Watershed Management Program (2016)
The region's Enhanced Watershed Management Programs (EWMPs), developed in compliance with the federal Clean Water Act, outline methodologies for meeting local water quality standards. Many of these rely heavily on distributed solutions (parcel-based and green streets), particularly in the Santa Monica Bay, Compton Creek, Rio Hondo, San Jose Creek and Upper Los Angeles River watersheds.

The Upper LA River EWMP notes that 70% of the runoff from the developed portion of the watershed is generated from impervious areas on individual parcels, and considers parcel-scale interventions to be the critical first line of defense for water quality improvements. The Program recommends treating runoff through a voluntary program at the residential parcel scale to significantly offset the need for regional or neighborhood-scale green infrastructure BMPs and reduce the overall operations and maintenance burden on EWMP Group members.

The Program's Reasonable Assurance Analysis (RAA) assumes that a robust and extensive residential LID program will be initiated within the watershed to encourage and incentivize residential homeowners to retrofit their properties with LID features such as rain tanks and infiltration basins. The goal is to annually enroll 1% of residential parcels in the residential LID program starting in 2017.

Given the large number of discrete projects required and the heavy reliance on these small-scale strategies, the Program recommends systematizing implementation to establish streamlined project planning processes, and to cleanly integrate with capital improvement programs. Partnering with key NGOs is recommended as an effective strategy to rapidly develop an effective program that includes community engagement and the development of standard plans and procedures to ensure that pollutant reduction goals are achieved and multiple benefits accrue to local communities.

Notably, the EWMP directly cites the success of the Water LA pilot in advancing a comprehensive and well-designed program to engage individual homeowners in implementing and stewarding urban acupuncture projects at home.

Los Angeles Basin Stormwater Conservation Study (2016)
The LA County Flood Control District/Bureau of Reclamation's Basin study assesses a range of local water stormwater conservation interventions, including distributed infiltration. The report estimates the parcel-scale interventions will capture between 76,000 and 111,000 acre-feet of stormwater each year. Local stormwater capture and regional programs to implement it rank highest under the report's trade-off analysis, which considered the additional benefits of flood mitigation, water quality improvement, habitat, heat island mitigation, recreation, and climate resilience.

The report recognizes the need for collaboration and coordination through partnerships to share in the development of these projects, and identifies the Water LA Program Collaborative as a program where these partnerships could be further developed to facilitate regional uptake and stewardship of these climate adaptive strategies.

The activities undertaken by the Water LA Program were captured in the LA Basin Study analysis. Its modeling approach assumes that LID implementation would be implemented basin-wide. The stormwater policies and green infrastructure management solutions assume a

significant increase in residential implementation rates, as programs such as Water LA encourage homeowners to willingly implement LID on their properties.

Two other, more recent agency documents further reinforce the value of a distributed approach to stormwater capture. The state's IRWM program requires each region to develop a Stormwater Resources Plan. The Greater Los Angeles IRWM Group recently combined components of the above studies into a compliant version of what the state requires. This may serve as the basis for the forthcoming Stormwater Plan that will guide the upcoming County Funding Measure.

It is anticipated that the forthcoming LA City Sanitation/LADWP One Water LA Plan (2018), will call for stormwater capture targets and distributed capture adoption rates comparable to those outlined in the pLAn, SCMP, and EWMP.

Taken together, these documents suggest that a wide range of agencies in Southern California recognize the value of the urban acupuncture approach to stormwater – a promising signal to those seeking to spread distributed, nature-based solutions to the region's water challenges.

CODE AND DATA BARRIERS TO SCALING UP DISTRIBUTED SOLUTIONS

Unfortunately, many elements of the City of LA's residential water policies and building codes stand to stymie the spread of these strategies. Further, certain forms of critical data related to the urban landscape remain unavailable or outdated, complicating efforts to carry out these retrofits in a science-driven manner.

CODES

City of LA Residential Parkway Landscaping Guidelines

Updated in 2015, these guidelines limit sustainable options and directly encourage the use of high-water-use and high-maintenance materials including five varieties of Bermuda grass, which is recognized by the California Invasive Plant Council (CAL-IPC) as invasive, and which is also notoriously difficult to remove. Further, it requires residents pay a minimum $400 charge for an A-permit to remove thirsty turf and sprinklers, and its plant list conflicts with those required for the LADWP turf removal rebate. Parkways longer than 25 feet require a 48" wide lateral walkway of impermeable material every 25 feet, the installation of which requires an A or B-permit (the language triggering a B-permit is vague and its cost, while substantially larger than that of an A-permit, is unspecified). Mulched convenience strips, permeable or decorative paving material, and all stormwater capture techniques require R-permits, costing a minimum $540. Many effective parkway basin configurations are severely constrained by these rules, a serious hindrance for a strategy that addresses water quality, water supply, flooding, tree canopy, and sidewalk upheaval issues within the city. Effective parkway guidelines would support Sustainable City pLAn goals by focusing on reduced potable water use, reduced hardscapes, reduced chemical inputs to landscapes, increased biodiversity, standards that support the development of healthy tree root systems (to avoid damage to sidewalks), and facilitation of stormwater infiltration. Moreover, an appropriate permit fee structure should incentivize rather than hinder progress towards these goals.

City of LA Department of Building and Safety's "approved drainage facilities" definitions

While these were amended in 2014 with input from the Water LA team, resulting in reduced setback requirements from structures and property lines, these should be further adjusted to allow un-mortared stone to be considered a 'non-erosive device' for conveying stormwater away from building foundations, remove the existing requirement for burying downspouts, and eliminate the restriction that prohibits overflow from rain gardens and tanks to flow across the sidewalk area. These needs can be addressed with a simple 'Information Bulletin' defining the standardized Water LA strategies as "approved drainage facilities."

City and County of LA Low Impact Development (LID) ordinance

The BMPs included in existing LID ordinances are somewhat limited, generally grey-green, and beyond the reach of most residents. As an amendment to LA's LID ordinances, Water LA's Guidebook on urban acupuncture strategies would provide clear, accessible, and consistent guidance to property owners not subject to ordinance requirements who wish to voluntarily implement these beneficial strategies. Such action is underway with the city and county, and should be considered by other incorporated cities within the county as well.

DATA

State Liquefaction Zone Classificatory Map

Research suggests that this map inaccurately classifies many key areas in the region as unsafe for infiltration. This limits effective LID implementation, and may prove counterproductive to the goals for which the original liquefaction zone classifications were established. Depleted groundwater may result in subduction, sinkholes, and increased volatility in the events of seismic activity. Additionally, subduction and compression of depleted aquifers will result in irreversible reduction of storage capacity. A reassessment of the methodology and data is necessary.

National Resource Conservation Service (NRCS) soils data

Data on LA's soils, based on comprehensive soil tests and representative of actual conditions, has recently been released by the NRCS. This data should be incorporated in the datasets that underlay the Stormwater Capture Master Plan and the Enhanced Watershed Management Plans, as well as the LA County Hydrology Manual.

Soil infiltration rates

Standard models applied to calculate the rate of water absorption by vegetated soils do not account for many complex factors, including soil structure, sorptivity, and changes to the infiltration capacity over time associated with plants, microorganisms, macroinvertebrates, and associated cover such as mulch. Observation suggests that these processes increase absorptive capacities far beyond those modeled, indicating the need for development of a standardized and generally accepted method of calculations that can account for these factors and accurately represent field conditions.

PROGRESS: CODE AND POLICY BARRIERS OVERCOME THROUGH THE WATER LA PROCESS

The list above may seem daunting. However, the Water LA process suggests that—with sustained study and dialog—many policy roadblocks are surmountable. A key piece of Water LA's mission was to identify and troubleshoot existing code barriers to widespread adoption of parcel-scale stormwater retrofits. Below is an account of the prohibitive codes and policies that were successfully modified through collaboration with agencies during the Water LA process.

Setbacks

DBS's Stormwater Infiltration Guidelines Informational Bulletin—developed to guide adoption of LID techniques—previously dictated that stormwater infiltration facilities must be sited at least ten feet away from building foundations and adjacent property lines, a requirement that severely limited the available area for these

facilities. Under advisement from Water LA team members, in 2014 the city's Bureau of Sanitation (BoS) successfully petitioned the DBS to reduce the setback requirement from adjacent property lines from ten feet to five feet.

Permeable pavement

Previously, the LA City Municipal Code mandated the use of "hard, durable asphaltic paving or Portland cement" for parking lots, driveways, and car storage areas. Permeable paving materials could be used in some cases, but required an individual assessment and approval by the city's Department of Building and Safety (DBS). Water LA team members worked with staff at the Planning Department to pass an ordinance allowing such water absorbent materials as permeable concrete, interlocking pavers, decomposed granite, and gravel to be used without a permit. The ordinance was adopted in 2012.

Greywater

Before the Water LA process, city building codes required that all home greywater system other than laundry-to-landscape setups (which require no permit) receive an individual permit, and have their plans approved by both DBS and LA County's Department of Public Health (DPH). This multi-agency process was prohibitively expensive (permits could cost well over $1200) and time consuming, often taking up to nine months. Members of the Water LA team worked directly with representatives from the DBS and DPH to streamline the permitting process for branched drain greywater system, developing a $105, over-the-counter permit. Building code-compliant greywater recycling systems can now be permitted in as few as two weeks at a significant savings for homeowners and contractors.

STORMS Program and new MS4 permit

Water LA has served as an example for the development of the California Strategy to Optimize Resource Management of Storm Water (Storm Water Strategy or STORMS) program, and the new municipal Separate Storm Sewer Systems (MS4) Permit. Recognizing the significant potential of these distributed strategies to address Los Angeles' Clean Water Act goals, Water LA was studied by State Water Board staff as they developed a new framework for water quality compliance in California. The new STORMS program and MS4 permit embrace distributed nature-based strategies such as Water LA's berms, swales, healthy soils, and curb cuts.

Standardized plans

To facilitate easy approval of Water LA strategies, the Water LA team developed standardized plans to guide their design, construction, and stewardship. The city and county are currently in the process of assessing and adopting these standards.

Standard plans

The Water LA Team presented the Parkway Basin strategy plans developed through the program (below) to the City and County of Los Angeles for consideration. After a process of collaboration, the City Bureau of Engineering (BOE) added these strategies to their Green Streets Standard Plans in 2017 as S-487-0 Residential Parkway Basin (Without Curb Inlet) and S-488-0 Residential Parkway Basin (With Curb Inlet). The River Project is now working in partnership with the City and County to implement 50 parkway basins with curb cuts in County unincorporated areas, and 100 in the City of Los Angeles.

Sidewalk settlement

Many sidewalks in the City of LA have been damaged by parkway tree roots growing upwards. This is a result of various factors including the tree species chosen, planting practices, and parkway guidelines that limit nature-based solutions. A successful lawsuit from the disability community that requires the city to develop a sidewalk repair program providing safe access for all will likely result in the loss of thousands of mature trees. At the same time, the city

must increase tree canopy to mitigate heat island impacts–and the need to identify non-potable water sources to support street trees in dry years was highlighted during the drought. Water LA Team members and allies worked to show city staff that implementing Parkway Basins in tandem with sidewalk repair and parkway tree plantings could address multiple imperatives the city must balance: healthy soils encourage downward growth of tree roots–avoiding future sidewalk impacts while bolstering new trees' odds of reaching maturity; parkway basins with curb cuts place trees at a level below sidewalks, providing a means for stormwater to support trees without potable supplies while also addressing TMDL requirements, recharging groundwater supplies, and mitigating flood risk. As a result, the City accelerated completion and adoption of the new S-487/488 standard plans.

LADWP turf rebate

During the recent drought, the Metropolitan Water District increased its contribution to member agencies' turf rebate programs, resulting in a significant spike in overall program participation. However, investment in removing lawn is also a critical opportunity to promote best practices to incentivize water capture and other associated benefits. The Water LA Team and allies worked with LA City Councilmember Koretz and the Mayor's Office to explore revisions to rebate terms and conditions through a collaborative process with LADWP staff. As a result, the new turf rebate requires a rain capturing feature–such as a rain garden, swale, infiltration trench, or rain tank–a minimum 3" cover of natural mulch on all exposed soil, at least 50% coverage of native or climate appropriate plants at maturity, and no more than 25% coverage with pavers, gravel, or decomposed granite. It also eliminates invasive plants, synthetic weed barriers, and artificial turf from eligibility.

Quantifying value

Another element is the quantification of performance value. Prior to the Water LA pilot, rain gardens were considered educational tools at best. The SCMP recommended that LADWP develop procedures to measure, model, or estimate distributed infiltration projects' contribution to local groundwater, and the pilot provided staff an opportunity to work collaboratively with the Water LA team, using the detailed designs and "as-built" documents for each intervention to develop such procedures. The recent UC Davis findings on GHG reductions associated with conservation programs adds another dimension to consider. Being able to quantify these projects' value helps agencies establish meaningful incentives and helps inform decisions over how to prioritize their capital and program investments.

This progress in modifying the codes and policies that quietly shape LA's urban landscape is among the most promising elements of the Water LA pilot. It is also suggestive of the long-term, often obscure work necessary to facilitate the spread of on-site water management strategies.

PB 1 OF 4

PARKWAY BASINS

DEFINITIONS

1. Parkway basins are depressions in the area between the street and sidewalk designed to capture stormwater from adjacent areas as sources of on-site irrigation, and allow for groundwater recharge.
2. **Parkway basins with curb cuts** capture runoff by creating openings in the curb that allow flow from the street and adjacent areas into basins. When a basin is full, runoff will not be able to enter the basin and will continue to travel in the gutter to the storm drain. See sheets PB1-4 and 3-4 for plans and sections.
3. **Simple parkway basins without curb cuts** are shallow depressions in the parkway that can catch runoff from sidewalks and adjacent landscape areas. They do not receive street runoff. See sheet PB 4-4 for plan and sections.

SELECTION CRITERIA

1. For parkway basins with curb cuts, parkway width must be at least 5' wide to accommodate all necessary specifications. In a parkway basin this narrow, vegetation may not fit in the bottom of the basin. For simple parkway basins with no curb cuts, parkway must be at least 3' wide to accommodate a shallow basin.
2. Soils must be sufficiently porous so that they drain completely within 48 hours of a rainstorm.
3. Locate utilities and tree roots prior to project layout. Do not disturb, break, cut or attempt to move utilities. Cutting into or otherwise damaging roots can result in a tree's death over a period of years (not necessarily immediate). Do not situate basin under an existing tree's canopy without the assistance of a certified arborist.
4. Locate parkway basins where prevailing slopes are less than 6%. Low gradient slopes are recommended. Finished bottom of basin slope must be less than 3%.
5. Prior to commencing work, gently excavate with hand-held shovel to full depth at curb cut location from curb to sidewalk. In the event there are unmarked utilities, do not disturb, cut, or move conduit. For conduit that is more shallow than 6" below street level, select the simple parkway retrofit.

PERMITTING GUIDELINES

1. A no-fee permit will be required provided the guidelines are followed for site selection and design, appropriate city-approved plants are used, and excavation does not exceed 2 feet below the existing grade, 1' above the existing grade, or total more than 50 cubic yards of excavated material.
2. Street tree permits are required by City of Los Angeles for all trees planted within the public right-of-way. See x.
3. Permits are not required for approved plants other than street trees. See Section 6.4 for recommended trees and shrubs. Never use plants identified as invasive by the California invasive plants council (CAL-IPC).
4. Projects that go beyond the outlined plan guidelines may result in the requirement of an A-, B-, or R- Permit from the City of Los Angeles.

MAINTENANCE REQUIREMENTS

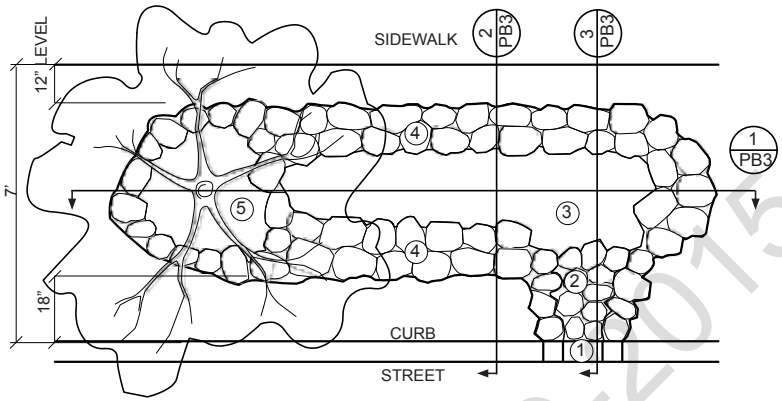
1. Provide establishment irrigation as needed.
2. Maintain walkways free of vegetation and overgrowth.
3. While plants may be left to go to seed for wildlife and landscape benefits, prune and mulch dead branches and leaves as needed or desired.
2. Replenish mulch periodically, maintaining min. 2" layer.
4. Remove invasive weeds before they can establish and proliferate.
5. Maintain parkway retrofit free of debris and trash, periodically clear the erosion control at curb cut, and prevent leaf litter from accumulating on sidewalk.

Water LA
capture • conserve • reuse

NOTES

PB 2 OF 4

PARKWAY BASINS



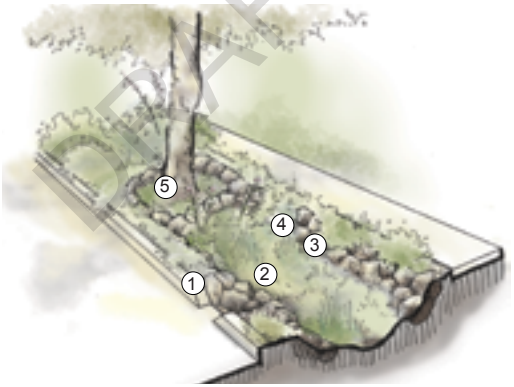
PLAN VIEW

KEY

1. Curb cut. See section 3, page PR3.
2. Erosion control to slow inflowing water and capture fine sediment. See section 3, page PR3
3. Basin for stormwater capture. Depth of basin shall be no greater than 2', and slope no more than 3%.
4. Side slopes. See section 2 page PR3 for details.
5. Optional basin shelf for tree or other planting.

NOTES

1. Call DigAlert at 811 at least 72 hours prior to work to locate utilities.
2. Side slopes shall be dry set (unmortared) with min. 9" stone.
3. Maintain all appropriate slopes, setbacks and clearance distances.



PARKWAY BASIN WITH CURB CUT PLAN AND DIAGRAM

CITY APPROVED DETAIL NO. XXXXX

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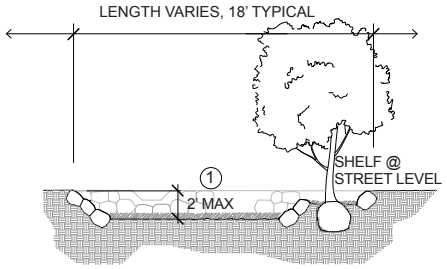
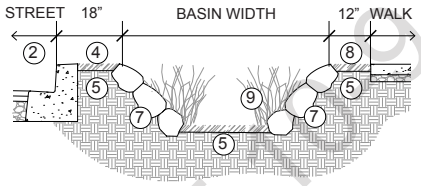
PB 3 OF 4

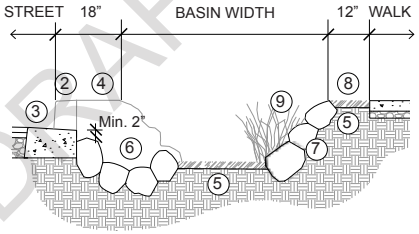
PARKWAY BASIN



0 1 2 3 4 5 FT — 1 PB3 **LENGTHWISE SECTION**



0 1 2 3 FT — 2 PB3 **TYPICAL CROSS-SECTION**

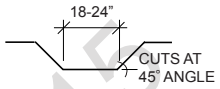


0 1 2 3 FT — 3 PB3 **EROSION CONTROL CROSS-SECTION**

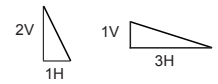
KEY

1. Basin for stormwater capture and street runoff. Depth of basin shall be no more than 2', and slope less than 3%.
2. 6" Concrete curb, typical

   Stormwater basin inlet cut into curb. Elevation view:



4. 18" flat step-out area including curb. Located along basin except at curb cut inlet.
5. Min. 2" thick mulch layer over soil.
6. Erosion control at curb cut. Stones should be securely embedded min. 2" below street level and on slope. A bowl shape will slow flow and catch fine sediment.
7. Side slopes. Maximum side slope shall be 1' horizontal: 2' vertical drop. Reinforce with dry set (unmortared) min. 9" stone. Slopes that are 3' horizontal: 1' vertical drop or less do not require stone reinforcement.



8. Provide 12" flat convenience strip adjacent to sidewalk. Maintain the top of mulch layer even with the sidewalk.
9. Vegetation. Select from approved lists and keep clear from curb cut inlet and walkways.

NOTES

1. Tree crowns are not to be lower than street level.

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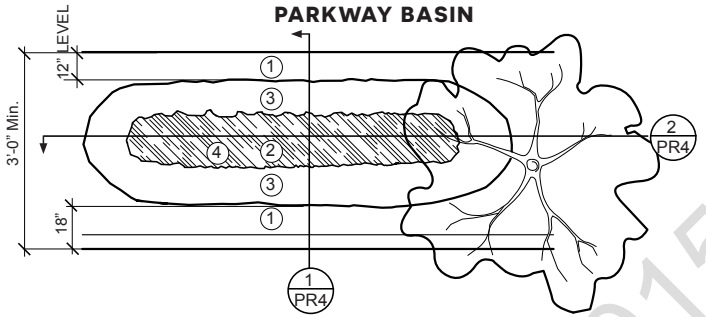
PARKWAY BASIN WITH CURB CUT SECTIONS

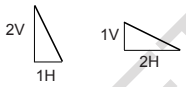
PB 4 OF 4

PARKWAY BASIN



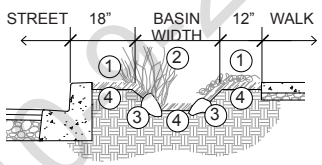
KEY

1. Level around basin. Min. 18" step-out from the front of curb to basin along the street, and 12" convenience strip along sidewalk. Maintain mulch flush with the curb and sidewalk.
2. Basin for stormwater capture. Depth of basin shall be no more than 2', and slope less than 3%.
3. Side slopes. Maximum side slope shall be no more than 1' horizontal: 2' vertical drop with dry set (unmortared) stone. Slopes of 2' horizontal: 1' vertical or less do not require stone reinforcement.



4. Min 2" mulch layer over soil.
5. Vegetation throughout. Select from approved lists and keep clear from walkways.

0 1 2 3 4 5 FT — **PLAN VIEW**



0 1 2 FT — 1 PR4 **CROSS-SECTION**

0 1 2 3 4 5 FT — 2 PR4 **LONG SECTION**

SIMPLE PARKWAY BASIN WITHOUT CURB CUT PLAN & SECTIONS

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CITY APPROVED DETAIL NO. XXXXX

APPENDIX E: WATER LA COLLABORATIVE OVERVIEW

Background and rationale

Environmental advocates have long recognized the need to retrofit the region to capture, infiltrate, and reuse the water that falls on urban landscapes. Through the Water LA Pilot, The River Project team identified the major barriers to scaling up the implementation of simple residential landscape transformations. The project team worked directly with agencies to cut through red tape, streamlined permitting processes for a number of retrofit strategies, developed a set of design templates for six key retrofit techniques, and are now working with city and county staff to incorporate these as an appendix to their respective Low Impact Development ordinances. These efforts have also produced tangible policy achievements, including revised incentives for lawn replacements and rain tanks and the ability to utilize a range of permeable materials in driveways—accomplishments worth celebrating. These successes will facilitate a smoother process for residential retrofits in the future—but will not be sufficient to support rapid, large-scale uptake of nature-based urban acupuncture solutions.

Meeting the goals established in the region's water conservation, water quality, and groundwater recharge plans would require retrofitting between 16,850 and 23,600 single-family properties each year. A quick glance at any LA neighborhood reveals the scale of work that remains if the region is to maximize its use of local water resources and reduce reliance on imported supplies—particularly in residential landscapes.

The need for sustained collaboration among the region's environmental groups to foster this scale of residential water capture, conservation, and reuse was foremost among the Water LA team's takeaways from their pilot project. If LA is to achieve a materially significant scale of residential urban acupuncture retrofits in a timely manner, residents will need different options and forms of assistance. No single entity has all of the skills or the necessary capacity to provide all of the support that Angelenos need to transform their properties.

Sharing strengths and resources, the Water LA Collaborative will include at its core the non-profits that Angelenos trust to inform them about the region's watersheds as well as those with a long history of practical expertise in nature-based interventions (Heal the Bay, LA Waterkeeper, The River Project, North East Trees, Greywater Action, Theodore Payne Foundation). These groups will mobilize their widespread name recognition, social media presences, and educators to spread the word about urban acupuncture and resilience retrofits, linking residents to the technical information, expertise, and tools which will allow the ability to actualize the region's water conservation, quality and recharge at a substantial scale. Close coordination across the groups will allow the collaborative to maintain educational message integrity across all mediums. It will serve as the mechanism to receive and direct funding to where science and demographics tell us the highest needs are, assure quality control of installations, and organize and facilitate a much broader network of participants.

The collaborative will also include community groups—some neighborhood-based, some faith-based, some culture-based, some interest-based—who will engage to connect consistent programming with members, friends, and families. These connections will allow the collaborative to reach diverse communities and neighborhoods. Many of these groups—such as the Koreatown Youth and Community Center and Pacoima Beautiful—serve as stewards for their neighborhood environments, helping maintain street trees and advocate for green infrastructure solutions. These organizations' familiarity with their local environments will help the collaborative effectively tailor outreach

and education strategies in these areas, to emphasize the most locally appropriate and desired urban acupuncture solutions for a given neighborhood or community.

The collaborative will also include small businesses with expertise in the design, installation, or maintenance of one or more urban acupuncture strategies, as well as workforce development groups. Increased demand for urban acupuncture retrofits will create tremendous opportunities to expand the region's green economy, and these groups can play a critical role in providing connections to recruitment pipelines that support the development and expansion of careers in green infrastructure, nature-based solutions, and climate resilience.

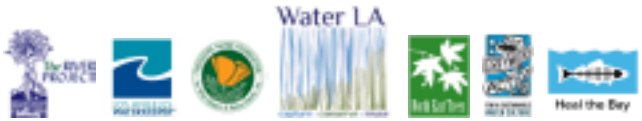
The overlap in all these groups' missions and skillsets offer the potential for powerful synergy. Partnering to achieve a shared goal and speaking from a common playbook would allow each individual group to maximize their own mission-driven impact and to amplify the power of the collaborative's overarching message and vision for a climate-resilient LA.

Process and progress

Since 2015, Water LA team members have been drawing a blueprint for structuring and implementing such a collaborative, based on the Water LA pilot project experience. With support from the Rose Foundation for Communities and the Environment, the six core organizations have convened a series of meetings to develop documents outlining a shared vision and process for moving forward.

To date, the groups have signed off on an official vision statement, included below, and developed a draft MOU, and a set of communication protocols. The group also identified existing relationships and mapped potential collaborative partners (community-based, environmental and environmental justice, faith-based, workforce development, academic, and green jobs) throughout the county. At the time of this writing, the work of establishing a formalized structure and developing a financing plan is in process.

Water LA Collaborative Mission Statement



VISION: A region that has a climate-appropriate relationship to local resources

MISSION: The Water LA Collaborative leverages the collective expertise and energy of our local communities to raise awareness and empower residents and landscape professionals to implement urban acupuncture strategies.

URBAN ACUPUNCTURE: Urban acupuncture relieves stress in the environment. It creates small-scale but catalytic changes in the urban fabric using strategies including lawn to natives conversion, Rain Grading, Rain Tanks, Parkway Basins, Breaking up hardscapes, Greywater Systems, and Infiltration Trenches.

HOW DO WE ACHIEVE THIS MISSION?

By channeling the expertise and energy of non-profits, community groups and business…

- Educate neighborhoods through community specific workshops on regenerative nature based solutions
- Change the Los Angeles landscape through the installation of urban acupuncture projects and education that instills a culture of stewardship
- Build an urban acupuncture green workforce through the creation of a community college certificate program

STRATEGIC GOALS: 5-7 YEAR TIME HORIZON

1. Facilitate the adoption of urban acupuncture strategies on 1% of residential parcels each year across Los Angeles County.
2. Create and implement a nature-based solutions certificate pathway through Community Colleges that includes in-field experience.
3. Support adoption of standardized plans for voluntary implementation
4. Establish community resource centers or Resilience Hubs throughout the region

CORE VALUES

Water LA Collaborative fundamental beliefs are the foundation from which we perform our work and conduct our business. We are:

- **PASSIONATE:** *We are fearless advocates for local water, local landscapes, and local jobs*
- **CREDIBLE:** ***Together we represent over 150 years of expertise in our respective fields***
- **RELEVANT***: We are catalyzing a new normal. The impacts of climate change are all around us*
- **HOLISTIC***: A regenerative approach addresses inter-related challenges simultaneously*
- **EQUITABLE:** *Everyone has a right to clean water, healthy watersheds and a sustainable future*
- **INCLUSIVE:** *Our success depends on the active involvement of diverse community partners*

APPENDIX F: WATER LA WEB TOOL OVERVIEW

Project summary

The Water LA Site Assessment Web Tool is designed to serve as an engaging, personalized, bi-lingual, data-driven tool to support homeowners in implementing effective water capture, conservation, and reuse solutions on residential properties. The tool will allow Angelenos to create a property-specific graphic assessment of the rainfall available to them, and support them in selecting, sizing, and implementing a suite of simple strategies to take advantage of rainwater as a resource. In addition, the tool will help participants identify how and where they use water at home, and guide them towards personalized water conservation actions.

Each user will be tasked with accomplishing the goals of using no more than 55 gallons per capita per day, and managing a 2" rainstorm on site.

The tool's design and user experience provide the added benefit of raising Angeleno awareness of the role they can play at home in helping LA become more climate resilient by recharging local groundwater supplies, improving water quality, reducing flood risk, conserving potable water supplies, sequestering carbon, mitigating heat impacts, and expanding habitat.

Context

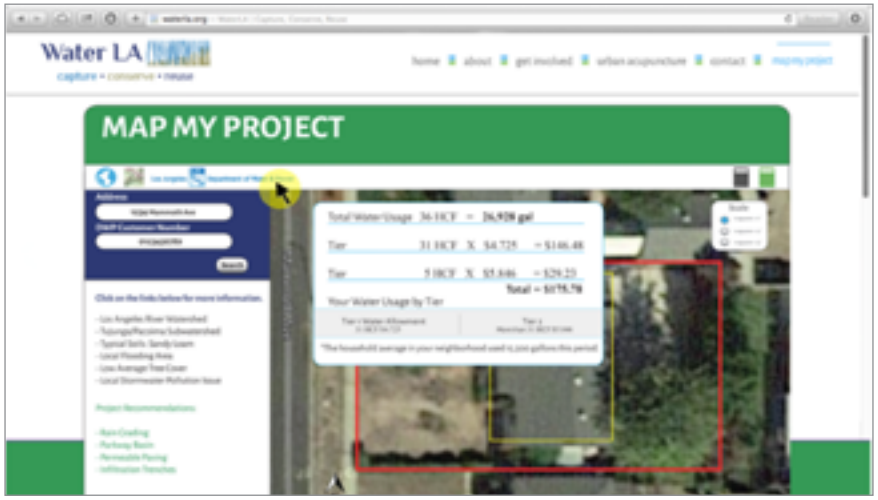
A personalized site assessment is the first step in helping Angelenos to design their property-specific stormwater management and water conservation strategies. The Water LA project team received a grant from the LADWP to initiate creation of the tool, which is currently in development.

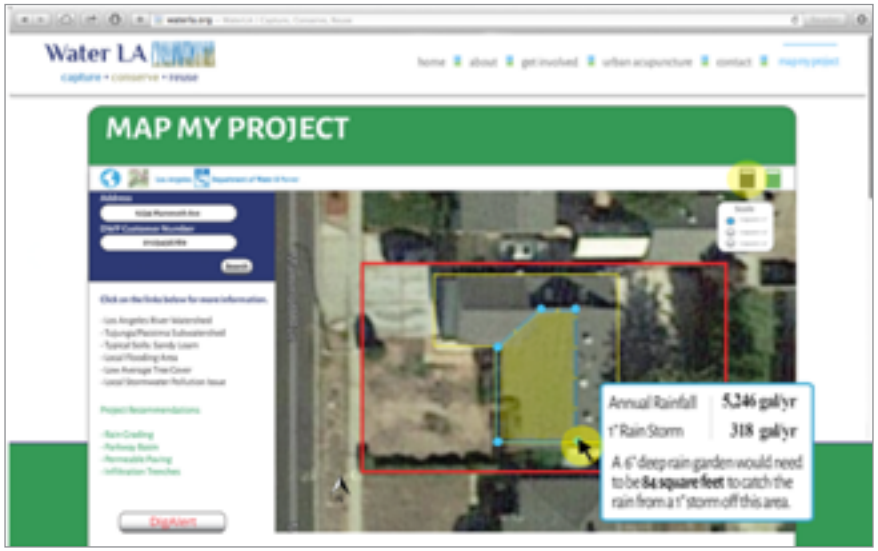
In the Water LA pilot, the project team observed that some participants struggled with the process of assessing the urban acupuncture potential of their properties. Measuring the footprint of structures and other impermeable surfaces could be taxing for single householders or differently-abled populations, and quantifying the runoff coefficient of different surfaces involves various mathematical calculations, which some people find challenging and few people enjoy.

While participants succeeded completing in this analysis with guidance and support, the challenges associated with the process alerted the team to a need to devise an accessible tool to support these efforts. Creation of such a tool has particular relevance if the goal is to implement these strategies widely across the region in a timely fashion. Guiding the analysis of the web tool are questions such as:

- Are residents taking full advantage of rainfall when available/ in the event of a major rain storm?
- Is there groundwater recharge potential on the property?
- What is the infiltration rate of the property's soils?
- Does the neighborhood lack adequate tree canopy?
- What is the community's flood risk?
- How much of the household's water is used outdoors?
- How many gallons does each person in the household use in an average day?
- Is the neighborhood a water quality hot spot?

Not only are these questions novel to most Angelenos, but the data or tools needed to answer such questions are not typically easily or immediately available.





Working with the tool

Residents will begin by registering with their address, their water agency customer number, and a password. They will create a basic profile including a simple self-assessment and the total number of people in the home. Ultimately, integration with their water agency database will display actual water usage over the last year and current billing tier level. The tool will translate their overall water usage into a “gallons per capita per day” (gpcd) number.

User-provided information will be combined with data from other systems to encourage the most location-appropriate strategies. Utilizing robust geospatial data, the tool will allow users to create an accurate and reliable site assessment that reflects climatic, geologic, hydrologic, anthropogenic and socio-demographic factors. The tool will help users measure the permeable and impermeable surfaces on their properties including roofs, driveways, walkways, sidewalks, lawns, and landscaped areas. It will calculate and display their potential turf rebate amount. It will show users the volume of rainwater available for beneficial use in an average year, and calculate the appropriate size rain tank, rain garden or infiltration trench needed for any given impermeable surface area runoff.

The application will automatically suggest Water LA strategies based on GIS-informed site-specific opportunities and constraints, pointing residents to a suite of retrofits that could be combined to hit the two key targets: 55 gpcd water use and 100% of 2” storms managed/ infiltrated on site. Links will be provided to the relevant incentives, video tutorials, and the Water LA How-To Handbook.

The application will also assist homeowners in creating an inventory of their water appliances and fixtures (Do their faucets have aerators? Are their shower heads low-flow? Are their appliances water smart and energy star rated? Is their irrigation timer set for efficiency?), and an estimated use analysis of each (How many showers/baths/loads of dishes/laundry per week?). Based on this information, the application will suggest the most effective water-saving devices for a given property and link to the relevant water agency rebates and incentives.

Other outputs

Ultimately, the web tool would include the ability for registered users to submit their retrofit plan directly to the agencies providing rebates and incentives who record and verify implemented projects. Users would be able to add project descriptions and photos to a public map that would be a resource to other Angelenos who are interested in making similar changes to their property.

The resulting database would include total water conserved, total stormwater infiltrated/managed and remediated, and total financial savings across projects, etc. These factors could also be used by partner stormwater agencies to track progress towards EWMPs through integration with the county's WRAMP tool, and by water agencies to track conservation goals, calibrate incentives, and identify the best areas to focus efforts, funding, outreach, and monitoring.

APPENDIX G: TRAINING AND CERTIFICATION PROGRAM

Overview and rationale

The successful spread of urban acupuncture as a beneficial water management technique across the region will depend on a workforce trained and certified in the installation and maintenance of these nature-based, parcel-scale strategies.

During the last drought, more resources were needed as demand surged for retrofits to capture, conserve, and reuse water, and many eager homeowners needing guidance failed to make their intended transformations. Homeowner capacities for installing retrofits and managing long-term maintenance vary widely, and many will need assistance to implement and sustain them. Additionally, agencies incentivizing these retrofits will want to know that they will meet expected safety standards and performance benchmarks. Recognizing these needs, the Water LA team has developed a proposal to establish a widely accessible training and certification program for workers interested in developing these skills.

Investments in distributed green infrastructure will provide local water security and urban environmental resilience. Recent studies by the Los Angeles Economic Roundtable (2011) and the Pacific Institute (2013) suggest that they can also spur substantial economic development and lead to new, green jobs—a key target in LA's Sustainable City pLAn (2015). Developing a workforce with expertise in these areas will directly support the local market for such labor.

Like existing solar PVC training certification courses, this program will enable the spread of small businesses staffed by trained professionals with specialized expertise. In doing so, it will benefit both workers—giving them entry to a rapidly expanding new market—and consumers—by increasing options and access to these essential services. In addition, it can help establish this labor as a respected trade with a viable career path, and serve as a solid training ground for a municipal green infrastructure workforce. Jobs for the *Future's Exploring Green Infrastructure Workforce* (2017) identifies the field as an important target for workforce development, especially to increase opportunities for low-income, low-skilled workers currently underrepresented in the workforce. Workers with such a certification may have an advantage seeking employment with niche contractors that specialize in green infrastructure projects

The Water LA Certification program proposed below is designed to maximize these local environmental and economic benefits through a targeted investment in technical training in on-site water management and nature-based green infrastructure techniques. It will foster sustainable green jobs and expand the region's pool of workers capable of retrofitting and maintaining LA homes and yards to capture, conserve, and reuse water.

Courses will combine desk-based learning with applied training. They will incorporate a traineeship component, ensuring that all workers are vetted by expert peers before receiving the certification. Participants will also be required to display mastery of relevant codes and technical principles by passing a 50-question exam upon completion of the course. Appropriate rubrics detailing the core competencies of each course will be designed to guide students' learning.

Members of the Water LA Collaborative will oversee bilingual curriculum design, teacher training, and traineeship oversight in subfields of their expertise.

BACKGROUND RESEARCH AND NEEDS ASSESSMENT

The Water LA Certification program is designed based on research on successful green industry certification programs offered by other jurisdictions, non-profit organizations, and professional associations. The team reviewed a 2014 report prepared by Harvard University's Environmental Law Clinic, titled *Certifications for Green Infrastructure Professionals: The Current State, Recommended Best Practices, and What Government Can Do*. This document surveys 18 programs that confer certifications for stormwater management infrastructure, including a number that entail collaboration between colleges and municipalities.

Review also included the National Green Infrastructure Certification Program (NGICP), which offers municipal water utility workers targeted training in on-site water management techniques appropriate for grey-green infrastructures in public spaces. Non-profit organizations have worked with municipalities to offer river and bay-friendly landscape trainings. While these programs are important, few take a comprehensive or integrated approach to nature-based water management. The program proposed below both fills these gaps and offers a unique training opportunity for people entering the workforce, and workers not employed by public agencies, such as small business owners and independent contractors.

The aim is to replicate the best practices of programs with similar scope while tailoring the content and structure to serve the LA context and realize urban acupuncture goals.

Programs surveyed include:

- **Watershed Management Group Water Harvesting Design Certification** (Tucson): This intensive, week-long course trains enrollees in a suite of on-site water management techniques, including cisterns, greywater systems, and earthworks. The course combines classroom learning and supervised system installations. The program's integrative approach also builds site assessment skills (water budgeting, soil percolation tests, etc.). Applicants who have successfully completed the course and passed the final exam are listed on WMG's website as certified professionals.

- **Green Gardener Certification Program** (Santa Barbara): Developed by the City and County of Santa Barbara in partnership with Ecology Action with funding from a Proposition 13 grant in 2005. Gardeners attend 15 weekly 2.5-hour training courses on resource-efficient and waste-minimizing gardening techniques. The classes are conducted in partnership with local community colleges, and a Spanish-language track is offered. After passing an exam, they receive a Green Gardener Certification card and are placed on Santa Barbara's official list of certified gardeners.

- **River-Friendly Landscaping Green Gardener Training Program** (Sacramento): EcoLandscape California, a Sacramento-area non-profit, serve as the program managers for the River-Friendly Landscaping Green Gardener Training Program. The curriculum is adapted from the Santa Barbara Green Gardener Program, tailored to the environmental conditions and challenges of the Sacramento River watershed. The course is taught over ten sessions (including field components), and gardeners who pass the exam are listed on EcoLandscape's website as certified Green Gardeners.

- **Bay-Friendly Professional Training & Certification Program** (San Francisco Bay Area): The non-profit Bay-Friendly Landscaping & Gardening Coalition offers two professional training courses: one for landscape design and one for landscape maintenance. Both are oriented towards maximizing on-site rainwater retention and native landscaping. Each requires workers to complete 24 hours of training and pass an exam. Certified gardeners are listed on the Coalition's website.

- **Qualified Water Efficient Landscaper Certification Program** (Sonoma County, other locations): The QWEL worker certification program was developed by the Sonoma County Water Agency Water Conservation Program. Other jurisdictions, community colleges, and job training may offer the QWEL curriculum, if they commit to teaching it with no modifications. Recognized as an EPA WaterSense certification program for irrigation system audits, QWEL's 20-hour curriculum teaches water-efficient irrigation system design and maintenance.

- **Native California Landscape Professionals Certification Program** (statewide): Currently in development by the California Native Plant Society. The program covers soils, site prep, installation, watering, maintenance and troubleshooting. The course consists of 20 hours of instruction over three consecutive Saturdays, followed by a 1-year mentoring period, a test readiness class, and final exam. Certification is valid for two years with re-certification upon completion of qualifying CECs.

- **American Rainwater Catchment Systems Association Certification Program** (national): ARCSA, a national professional organization, certifies workers in the design of rainwater catchment systems. For their Accredited Professional and more advanced Rainwater Harvester Master programs, they offer a standard curriculum through a 2-day intensive, desk-based workshop, or a web-based training platform. To receive the certifications, workers must complete the workshop, pass an exam, and provide documentation of participation in the design and installation of at least five rainwater harvesting systems. Certifications must be renewed annually through membership fees and qualifying CECs.

Best management practices

Following a careful analysis of these programs, the team identified the following best practices that will be incorporated into the Water LA program:

- Designing a curriculum that reflects the local climate, soil, and other environmental factors and challenges
- Employing a combination of desk-based and hands-on learning
- Supplementing written evaluation with apprenticeship periods on projects with experienced professionals
- Providing 'stackable' credentials that present a low barrier to entry, while providing a transparent track for career advancement
- Prominently displaying searchable lists of certified workers online to maximize their visibility to clients
- Partnering with local community colleges, trade schools, job training organizations, and non-profits in conducting the programs

Integration enhances the impact of all programs, which would be supported by a policy of mutually recognized certification with all relevant programs conducted outside of LA. For instance, recognize ARCSA's "Accredited Professional" as an equivalent qualification to the "basic" level rain tanks certification, and vice versa. Another mutual recognition to pursue may be designation from the EPA's WaterSense program for irrigation training, which has been designed in accordance with the same water-efficient goals.

Proposed program

The Water LA Certification program will foster sustainable green jobs and expand the region's pool of workers capable of retrofitting and maintaining LA homes and yards to capture, conserve, and reuse water. Participants will receive training in the site assessment, and the design, construction, and maintenance of all six Water LA urban acupuncture strategies, as well as training in landscape management with a focus on native plants and healthy soils:

- Rain tanks
- Rain grading and gardens
- Parkway retrofits
- Greywater systems
- Infiltration trenches
- Permeable paving
- Native landscape management

Community college platform

As noted above, successful worker certification programs frequently partner with local organizations and institutions to maximize visibility and streamline service delivery. Further, embedding the training within a higher education institution helps establish these skillsets as a legitimate trade. To support workforce equity and diversity, programs must be accessible and affordable to the widest possible audience. This in mind, the state Community College System provides a unique platform for program delivery. The intent is to pilot the program with one to three Community Colleges, working towards a statewide program over time.

For example, LA Trade Tech already partners with the Building Performance Institute and the North American Board of Energy Practitioners to offer official certifications in weatherization and solar PV. The collaborative is prepared to develop materials—including relevant rubrics—to be made available on the Canvas platform adopted by the State CC system. This will enable Water LA to take advantage of synergies in mission and utilize classrooms, teaching space, as well as easy connections to interested students and workers in allied fields. The partnership will offer opportunities for CC faculty to develop new skills and take on new teaching roles, through a "train the trainers" component (discussed in more detail below).

CA Community Colleges' basic course fee is $46 per unit for a California resident. These fees have been waived for low-income residents since 1986, and Governor Brown recently signed a bill waiving course fees for a year for all new students so long as they are enrolled full-time. The class structure has been designed to enable the college to charge similar fees to enrollees. Professional training courses—many of which include lab components comparable to the proposed hands-on training sessions—run between three and nine units, for a cost-to-student range of $138-$414. These courses frequently meet once per week, often on Saturdays, scheduling classroom time in the morning and lab time in the afternoon. A similar schedule would maximize the accessibility of proposed courses to working professionals.

Water LA Certification Program—details and structure

All participants in the Water LA certification program will be required to complete the Water LA site assessment certification. This course serves as the foundation for all of the other, more specific skills-training modules. Workers will learn the basics of all six strategies, and how to holistically design a landscape to maximize their benefits. They will be trained to analyze the water flows within individual parcels, and how to place and combine different strategies. In addition, workers will develop an understanding of the region's watersheds, water supplies, and climate challenges.

Upon completion of this course, workers will be able to pursue specialized certifications in six areas: rain tanks, rain grading and native landscaping, parkway retrofits, greywater systems, infiltration trenches, and permeable paving. Some of these areas have multiple

levels of certification (basic, intermediate, and advanced), aligned with the complexity of systems the workers have been trained to install. Others have specialization areas—for instance, upon completing the "basic" rain grading and native landscaping course, workers can complete certifications in water-efficient irrigation and drought-tolerant landscape management. In addition, the program will offer two designations—"Landscape Specialist" and "Hardscape Specialist"—for students who have completed the full cluster of either landscape or hardscape-related certifications. Workers certified in all of the techniques will receive a "Watershed Steward" designation, denoting this wide-ranging skill set.

- Course structure: 24 hours instruction (8-12 classroom/ 12-16 hands-on field-based, depending on course level)
- Student assessment: 50-question exam; successful completion of course-specific practicum, demonstrating expertise
- Apprenticeship requirement: complete 20 hours of work under the supervision of a Water LA Collaborative-approved company or participating non-profit organization

Water LA aims to make these courses as widely inclusive and accessible as possible. Like all of the other certification courses, workers will be charged a fee to participate in these trainings. However, all participants will have the option to pay their fees in the form of geographically convenient work-trade with affiliated green businesses, non-profit, and community groups. In addition, courses will be offered in both English and Spanish to maximize the program's reach.

Curriculum development, instructors, and instructor training
Water LA Collaborative members and partner organizations have drafted a framework for the curricula, and will produce appropriate content for coursework. Materials will be tailored to the region's climatic and hydrological conditions, in order to ensure that solutions are deployed in a locally appropriate manner. Where feasible, mutual recognition will be pursued with statewide and national certification programs to minimize duplicative training. Materials will be made available through the Canvas platform, as appropriate.

Local instructors with professional expertise in the field will be selected to teach these courses. For desk-based teaching, the program will maintain a ratio of 30 students per instructor, the typical target at Community Colleges. To ensure adequate oversight during hands-on teaching, the program will maintain a ratio of 8 students per instructor for these portions. Assistants will be hired to provide this oversight.

To ensure that all instructors are operating based on the same integrative water management framework, the Water LA Collaborative will partner with Tucson's Watershed Management Group (WMG) to offer a "train the trainers" course. WMG has offered similar trainings in Santa Barbara and Tucson, geared towards professionals with adequate technical skills at a particular water management strategy with an interest in teaching others in the field. This 1.5-week process walks teams through conducting an assessment, then designing, preparing, and co-leading a water-harvesting workshop. The process builds individuals' pedagogical capacities, ensuring that they understand integration, assessment, and design concepts, as well as effective teaching tactics for this skill sets. Completion of this course will be compulsory for all instructors within the program.

Teaching space

The certification will require two different types of venues for instruction:

- Standard classrooms at community colleges for desk-based training components, which will include use of the web tool.
- Private homes affiliated with the Water LA Collaborative program for hands-on installation training components. Homeowners will be advised of the training courses, and Water LA staff will coordinate between instructors and homeowners to ensure availability.

Project management and coordination

The River Project continues to advance the realization of the training and certification program, and is actively seeking funding partners. Further development and deployment of the certification program will be a complex operation, requiring substantial collaboration, oversight, management, and coordination to ensure its success. With key action, experts and professionals from the Water LA Collaborative network will mobilize program development.

APPENDIX H:
RESILIENCE HUBS OVERVIEW

Destinations to support stewardship

The Water LA Collaborative will serve to not only raise Angelenos' awareness of urban acupuncture solutions, but also to facilitate widespread adoption of these strategies. We're enlisting residents as partners in creating a new normal, and need to make both the physical components and the social support as accessible as possible in this critical early phase. Paired with a consistent and robust program of relevant educational resources, this will give us the necessary fuel to reach the tipping point that creates the ultimate paradigm shift.

One of the Collaborative's strategic goals is the establishment of "Resilience Hubs," sites stocked with necessary materials and resources to support community efforts. The idea for establishing these hubs arose during the Water LA pilot project phase. Collaborators installing the retrofits often struggled to source all of the necessary project parts, as some are highly specialized or simply hard-to-find. For instance, there are no local manufacturers or wholesale suppliers of rain tanks. Acquiring necessary parts for a simple greywater system can mean purchases from four different suppliers. Native plant nurseries are distant from many target population areas in the region. Accessing quality mulch can present challenges to participants as well. Further, interactions with homeowners revealed that even the most enthusiastic participants will need access to continued support and resources to either install systems on their own, or develop confidence in maintaining them properly once installed. Resilience Hubs can help serve these needs.

The concept of establishing localized hubs to support urban resilience has recently been taken up by the City of LA's Chief Resilience Officer as an avenue to provide residents with shelter and resources in the event of a calamity, such as an earthquake. We support such aspirations for emergency preparedness, but propose that the role of these hubs should be expanded to offering ongoing, non-emergency support for proactive sustainability-related projects. A recent collaborative scoping process between the Los Angeles chapter of the US Green Building Council and the community-based non-profit Strategic Concepts in Organizing and Policy Education (SCOPE) opened up an exploration of a more systemic approach to what a resilience hub might look like. In addition, the non-profit LA Compost has recently begun an effort to establish compost hubs where communities can transform local food waste into an accessible resource. They aim to create shared spaces "where individuals can be part of something bigger than themselves." Moving forward with a plan that brings these related initiatives together through a more comprehensive notion of resilience makes good sense.

A proposed program summary

Activated spaces at key locations are ideal for hubs. They could be established at existing community centers, or municipalities could partner with local NGOs and CBOs to develop hubs on surplus properties. Ideally, hubs would be sited throughout each subwatershed such that no resident will have to travel far to access a center, and issues common to each subwatershed would be locally highlighted.

Through partnerships with local businesses, materials companies, and distributors, each site would be stocked with the materials necessary to complete the full suite of Water LA strategies, e.g. a wide variety of different sized rain tanks, a selection of 36 native plant species suited to the local microclimate, a pre-packaged kit of greywater parts, mulch, and compost. The hubs could also serve

as a tool library, where community members could borrow shovels, a roto-tiller for sod cutting, etc. They would also be stocked with a library of relevant educational materials, books and manuals, and a public computer where residents can access the Site Assessment Web Tool and other digital resources. Specialized courses could also be offered at these sites. Some municipalities require residents to complete classes in order to qualify for incentives and rebates, and hubs would be ideal spaces to host such educational events. Partnering with the Water LA Collaborative would provide access to a network of experts, apprentices and volunteers who could advise residents on the technical aspects of projects, and assist in planning and troubleshooting. Hubs could also host ongoing watershed education and engagement activities such as workshops, trainings, and project planning meetings.

In addition to supporting the successful installation and maintenance of urban acupuncture retrofits, the hubs will raise the visibility of nature-based strategies and the region's resilience goals. Further, the sites will foster a collaborative community of stewardship, helping increase expertise on watershed issues and resilience techniques across neighborhoods and social groups.

APPENDIX I: RESIDENTIAL EXCERPT FROM FINANCIAL INCENTIVES WHITEPAPER

Coalition for Our Water Future

Whitepaper on the Use of Financial Incentives for Stormwater Fees in Los Angeles County

Prepared by Coalition for Our Water Future Subcommittee
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Photograph of Los Angeles River

** The Whitepaper was prepared and accomplished by the authors in their personal capacity. The opinions expressed in the document do not necessarily reflect the view of the organizations they belong to.

Coalition for Our Water Future (COWF)
coalitionforourwaterfuture.tumblr.com

Introduction

The Los Angeles County Flood Control District (LACFD) led a multi-year effort to develop a sustainable funding source for municipalities to manage stormwater programs and implement water quality improvement projects. In 2013, the effort led to a proposed parcel fee, the "Clean Water/Clean Beaches Measure." Members of the greater Los Angeles community provided numerous comments and suggestions on the measure, including asking whether this fee or tax could be reduced or eliminated if they were to manage stormwater on their private properties.

The Coalition for our Water Future (COWF) acknowledges the significant progress made by the LACFD to initiate and advance the complex discussion of a dedicated funding source for stormwater on a countywide basis. By producing this whitepaper, it is our hope that it will continue to advance the discussion and improve the likelihood of success of some future effort.

While new property development and the re-development of properties are already required to manage stormwater by State regulations that require them to capture, infiltrate, use, evapo-transpirate, or treat the 85th percentile rain storm (the standard used in the regulations), the question has been raised: "How can incentives be created for the implementation of comprehensive Stormwater Management Practices (SMPs) on private properties that are not undergoing new development or re-development?"

This whitepaper outlines concepts for motivating private property owners to implement SMPs outside of development cycles, or to implement SMPs that manage offsite water, either during or outside a development cycle.

As agencies and municipalities have developed Integrated Regional Water Management Plans to identify strategies that go beyond the regulatory requirements of the Clean Water Act and also augment local water supplies, mitigate flood flows, and adapt to a changing climate, they are concluding it will be necessary to capture, infiltrate, treat and/or use stormwater from existing properties that are not undergoing development or re-development. These types

of stormwater management strategies can be termed "retrofits," in that an existing property is modified to implement an SMP outside of a new property development or redevelopment scenario (what we call the development cycle).

This whitepaper outlines concepts for motivating private property owners to implement SMPs outside of development cycles, or to implement SMPs that manage offsite water, either during or outside a development cycle. The members of the COWF believe that those property owners, whose actions contribute to the regional goals of water quality, enhanced local water resources, demand reduction, climate resiliency and public safety, could be rewarded for their efforts. By practicing comprehensive stormwater management, these property owners provide a true "triple bottom line" benefit for people, the environment and our economy. Likewise, those property owners who haven't done so, could be motivated by financial incentives to join others in doing what they can and be similarly rewarded.

There are many ways that private property owners can beneficially manage stormwater. Opportunities for improvement depend on location, soil type, slope, size and current use of the property, among other factors. Each property has unique characteristics that can yield one or many opportunities that the owner could choose to enact. The resulting improvements should create a commensurate stormwater fee credit.

The remainder of this whitepaper provides:

1. An overview of what other cities and counties across the country are doing to support and reward property owners for improvements that manage stormwater beneficially.
2. Various incentive options for stormwater improvements that could be considered for residential, commercial, and industrial properties in Los Angeles County.
3. Lessons Learned from the Los Angeles County Clean Water/Clean Beaches Initiative in 2013.
4. Draft recommendations for those incentive options that best fit the opportunities for property owners in the county.

Definition of terms:
Incentive - Stormwater management program incentives are one time disbursements that compensate a property owner for "partnering" with the city to achieve a stormwater management objective, such as the installation of a rain garden, rain tank, infiltration trench or parkway basin.

Credit - A conditional, recurring reduction in the amount of a stormwater user fee to an individual property based on approved Stormwater Management Practice (SMP), a National Pollutant Discharge Elimination System NPDES industrial stormwater discharge permit, or proof of direct discharge outside of the service area.

Overview of Stormwater Credit Programs

A stormwater credit program is a mechanism provided to property owners to reduce their stormwater charges in recognition of on-site stormwater management. Stormwater credits can be earned as a result of the implementation, operation, and maintenance of Stormwater Management Practices (SMP) that reduce a parcel's contribution of stormwater to a city's collection and conveyance systems. There are a variety of credit programs in use by stormwater utilities across the United States.

When developed properly, credit programs can help a utility** meet a number of objectives, such as:

- Increase acceptance of proposed stormwater fee programs;
- Provide incentives for on-site stormwater management;
- Allow customers increased ability to control their stormwater charge and enhance the validity of a user fee;
- Encourage practices and behaviors that support the utility's stormwater management policies and objectives.

Credit programs, by allowing a reduction to a customer's bill, provide an economic incentive to promote stormwater management activities that serve to reduce the burden a property imposes on the stormwater system.

Credit programs vary significantly in the types of the credits offered, including:

- **Quantity credits** – This type of credit is offered to properties that through SMPs reduce the peak rate and/or volume of stormwater runoff discharged from the property. Examples include cisterns, and detention/retention ponds that hold the stormwater runoff and provide for a gradual infiltration, release or reuse.
- **Quality credits** – This type of credit is offered to properties that reduce pollutants in stormwater runoff through SMPs. Examples include infiltration basins, constructed wetlands, vegetative swales, and pervious pavements.
- **Education credits** – This type of credit is offered to schools/school districts for developing and adopting curriculum specific to stormwater management education to students.
- **NPDES credits** – This type of credit is offered to properties that have been issued an industrial NPDES permit for their business operations and are in full compliance with the permit requirements and/or exceed the permit requirements.
- **Green credits** – This type of credit is offered for SMPs that manage stormwater and/or reduce potable supply demand. Examples include rain grading, greywater systems, trees, green roofs, and infiltration planters.

Considerations when Developing a Credit Program

Credit programs in use by stormwater utilities vary significantly in both the scope and nature of the program. Several factors need to be considered in any analysis of a potential program.

For instance:

- What are the goals of the credit program?
- What property types will the program cover (e.g. residential, commercial, industrial, open space, etc.)?
- Will the program recognize both "quantity" and "quality" related stormwater management?

- Will credits be provided for facilities/activities that meet the City's existing stormwater management requirements for property development or only for those management practices that "go above and beyond" the minimum requirements?

Determination of the Goals of the Credit Program

An effective stormwater credit program needs to be fully aligned with the overall stormwater management mission and goals of the utility. For instance, does the utility strive to pursue a regional approach to stormwater management, developing regional detention/retention facilities? If so, the utility may not want to implement a credit program that includes incentives for individual or site specific facilities. Conversely, a utility that wishes to encourage distributed stormwater management may wish to include a credit program that provides economic incentive for implementation of such facilities. Similarly, if the utility intends to promote and integrate green solutions, then the stormwater credit program can be aligned to include credits for such green solutions. It is likely that an effective stormwater management program will include a portfolio of SMPs that range from small, onsite SMPs to mid-sized 'green streets' to larger regional facilities.

Program Reach

In many municipalities, stormwater credit programs are offered primarily to non-residential customers only. Typically, residential properties have relatively less property area when compared with non-residential properties and consequently, while much of the total land area is residential, the level of stormwater fees for each individual single-family residential property is fairly low. Administration of a credit program requires periodic inspections and audits to ensure that the stormwater management systems for which credits are provided are fully functional. Conducting such audits and inspections has been viewed as challenging due to the large number of such properties. Development of mechanisms that facilitate residential audits is an important factor in developing a broadly applied program. Non-residential property owners with large properties and high levels of impervious surface cover will have higher stormwater fees, and thus may have a higher economic incentive to undertake required activities. For the utility, auditing and inspecting the number of such properties is considered manageable from an administrative standpoint.

Evaluation of Eligible Activities

The utility needs to determine whether credits will be provided for facilities or activities that address quantity-related concerns (total flow) and peak rates of flow only, or also address the quality-related issues that are required to be met by federal legislation, and other stormwater associated climate impacts. Most commonly, credits have been given for volume of retention/detention basins and peak flow reduction of stormwater. A few utilities provide credits based on quality-related concerns. It is expected that as utilities continue to implement programs to meet federal water quality requirements and adapt to climate change, the use of credits to encourage activities related to these improvements will become more prevalent.

Impact of a Credit Program

When a stormwater utility implements a credit program, a primary goal is to induce customers to install SMPs or otherwise manage their property in a manner that help manage costs to the utility as a whole. The increased use of on-site detention, for instance, could reduce the need for a utility to design and construct costly regional detention facilities. Oftentimes, the benefits are not immediate, but rather result in a system-wide, long-term reduction in costs. It is therefore extremely important to anticipate the level of participation in the credit program over time and calibrate the size of the stormwater fee against likely credit program participation levels in order to maintain a balance in the overall impact on the utility's operational costs.

** For purposes of this section, "utility" serves as a catch-all for the entity imposing and managing the fee.

Potential Incentive Options for Stormwater Improvement

The following section includes suggestions or options to be considered for residential, commercial and industrial properties in Los Angeles County, followed by some general recommendations.

Residential Land Uses

Residential property owners can be motivated by various factors. Single-family homeowners and owners of multi-family residential properties are all motivated by lower water bills and enhanced property values. However, stormwater management measures that are appropriate for high-density residential properties have more in common with those for commercial properties. High-density multi-family residential properties should be characterized as commercial under any fee program. Single-family and low-density residential homeowners are also typically motivated by a variety of more localized, personal drivers such as the potential to have a vibrant, low-water dependent landscape, reduce local flooding, increase tree canopy and local habitat, or the knowledge that their actions help create a healthier, more climate resilient community*.

Accomplishing a paradigm shift in residential land use practices has significant value. Individual residential properties may seem small in relation to individual commercial or industrial sites, but in aggregate they comprise nearly 60% of the developed land in the County. If residential properties can effectively manage stormwater on-site, the need for expensive regional facilities will decrease. With stormwater management distributed more evenly across the region, municipal retrofits of streets and waterways will become more the feasible and cost effective as their management burden decreases.

Engaging residential property owners in becoming partners in local water resource management is critical to accomplishing our regional goals.

Engaging residential property owners in becoming partners in local water resource management is critical to accomplishing our regional goals. Building trust, eliminating barriers to participation, and making investments in education

are key components to success. Increasingly over the last century, residents were encouraged and conditioned *not* to think about where their water comes from or where it goes. Investing in education that reconnects them to the fundamentals of their relationship to water and land use in the region is an important first step that should precede any fee proposal. Existing barriers to participation must be recognized and sufficiently addressed in advance of any fee adoption.

Residential properties are well suited to retrofits that can accomplish multiple benefits. A program that encompasses all aspects of residential water management will be more meaningful to residents, and ultimately be more effective and efficient to manage. Goals could include: Clean Water Act compliance to the regulatory storm event; on-site management of a minimum two-year storm; groundwater recharge; potable supply demand reduction to 55 gpp/pd.

If retrofits are to be designed and implemented according to a site's characteristics and to accomplish program goals, property owners will require comprehensible tools, tailored for the general population: clear guidance; consistent metrics; accessible resources; affordable solutions; simplified permitting; and credit for compliance. Various avenues of participation and types of support should be made available to accommodate the diverse abilities of the population.

*A 2013 poll by the Public Policy Institute of California found that a record-high majority (75%) of voters support immediate action by state and federal governments to prepare for climate impacts. A 2014 USC Dornsife/LA Times poll found that 89% of Californians surveyed characterized the drought as a major problem or crisis, and 45% supported raising water rates to promote conservation.

The following options could motivate residential property owners to retrofit their own parcels for resilience, help manage local street runoff, and reduce demand for imported water supplies.

Raise Requirements for New Development

- In recent years, Cities and Counties have adopted LID ordinances requiring new & re-developing properties to modify traditional building practices and implement on-site measures to help meet Clean Water Act requirements. These ordinances could be amended to address the imperatives of today's

more comprehensive challenges, such as requiring new developments to manage specific volumes of runoff, limit impervious surface cover, include greywater stubouts, implement rain grading or parkway basins and use climate appropriate landscaping. Properties developed under the original ordinance could receive credit for going beyond those bottom line requirements. Continuous compliance would be required and periodically reviewed as part of the permit. Properties that fall out of compliance would be penalized and proceeds would be utilized to offset the costs of verifying compliance and administering the program.

Credits for Retrofitting Residential Property

- Residential property owners who implement and maintain stormwater management measures would receive a credit, or fee reduction, up to a set cap. Metrics would be employed to establish the maximum possible credits earned for each category: Quality (regulatory event), Quantity (runoff managed for two-year storm, groundwater recharge), Climate (potable reduction, impervious surface/heat island reduction, native plants). Additional credits could be earned for managing stormwater in the Public ROW (parkway basins), and for Education (time bank, public tours, signage, etc.). Compliance would be reviewed and credits renewed annually. Properties that fall out of compliance would be penalized at twice the value of the credit received.

Incentives to Residential Property Owners to Fund Retrofits

- Provide cash rebates to cover some percent, or all of residential retrofits. This is being done currently through incentive programs provided by MWD and LADWP for water and energy efficient appliance upgrades, rain tanks, and lawn removals. This scenario would be in line with those existing mechanisms. Incentive programs could be expanded to cover parkway basins, rain grading, infiltration trenches, impervious surface reduction, and greywater systems. Through a combination of incentives, the owner can fully retrofit for resilience. Projects would have to meet specified criteria for stormwater management and potable demand reduction. Funds can be allocated based on a variety of benefits realized so that projects with greater co-benefits can receive higher priority for funding. This can be part of the funding package.

Educate, Inform, and Ease Voluntary Retrofits

- Provide services to educate, inform, and assist private property owners with retrofits. This provides the context for voluntary retrofitting by persuading property owners of the value to themselves and the community. A portion of the fee would support an ongoing education and assistance program that helps residential property owners to select, design, install and maintain any combination of strategies that accomplish the goal of on-site water capture, conservation and reuse. Engaging non-profit partners to take the lead in this area will establish a higher level of trust amongst residential property owners.

- A range of services would be made available, starting with the development of a new chapter in the existing LID Guidebook for voluntary residential retrofits, geared towards the general population. Standardized plans and guidance that provide sufficient parameters for quality assurance will be included in the document, along with information on site-specific constraints like slope and other criteria. Simple instructions will be provided on how to calculate the property's runoff value, select and size the appropriate retrofits, and on how to either accomplish the retrofit, access assistance, or hire someone to do it. Maintenance requirements will be outlined as well.

- These same guidelines would be made more accessible through an online portal available in both English as well as Spanish. Online tools, including a GIS-based property map interface and calculators, would make the process exponentially more accessible. Step by step instructions, how-to videos, schedules of workshops, access to incentives, examples of successful projects, streamlined permitting, and the ability to securely register projects with the program and apply for credits are all technologies that can be deployed.

- Ongoing hands-on workshops can be provided through a collaborative partnership with several non-profits. Neighborhoods in high priority areas (based on infiltrative soils, TMDL issues, local flooding, DAC communities) could be eligible for higher levels of support. Households that may still require additional support could earn incentive credits through time banking.

- Resource centers could be established in each major subwatershed where materials for retrofits could be purchased, educational events could be held,

experts could be on hand to answer questions, time bank or education credits could be earned, and green job training could be co-located.

- This is Water LA's "urban acupuncture" approach. The educational aspect of this can improve the implementation of non-structural best management practices as well as achieve widespread voluntary installation of parcel scale retrofits. Somewhat analogous programs are Watershed Management Group in Tuscon, AZ and Daily Acts in Petaluma, CA.

Inspect for Residential Compliance

Inspecting large numbers of residential properties may appear challenging. However, various mechanisms for accomplishing periodic inspections to verify the performance of residential SMPs might be developed as part of the funding package program and maintained with a portion of proceeds from the penalty:

- Train and utilize staff already deployed to read water meters to do a visual inspection of SMPs when they read meters and provide warnings/citations for SMPS observed to be in decline.
- Provide a training and certification program for SMP and landscape maintenance service providers to design, install, maintain and certify SMP performance. This would provide a relative seamlessness of practice for property owners that already utilize such a service. Any certified maintenance provider that failed to properly maintain a SMP would share the penalty with the property owner and lose certification.
- Storm drain meters could provide both volumetric and pollutant load data at a subcatchment level. Areas where flow volumes or pollutant loads exceed expectations (based on registered SMPS in the subcatchment) could receive additional scrutiny.

Ordinance Driven Retrofits

- Pass an ordinance requiring all private properties to be retrofit for resilience by 2025. This would provide a 10-year runway for property owners to comply before the ordinance took effect. In the interim, all property owners would be subject to the stormwater fee and hence be eligible to take advantage of incentive programs offered. Early compliance would result in commensurate fee credit. The ordinance would establish a penalty mechanism for non-

compliance to offset some of the costs of verifying compliance and administering the program. The remainder could be funded from the general fund, much as most stormwater programs are currently funded. An analogous ordinance is the City and County of San Francisco's Soft Story Retrofit Ordinance, passed on the basis of promoting the health and well being of the citizens. This ordinance requires all buildings that meet specific criteria to install seismic retrofits within a specified timeframe.

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WATER LA | 2018 REPORT

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ADDITIONAL THANKS TO

Water LA Program Participants, Staff at the City and County of Los Angeles, Geosyntec, Green Gardens Group, Pave Drain, Rose Foundation for Communities, Vulcan Materials, Waste Management, Shawn Scudder, Jessica Hall, Paul Herzog and finally, Dorthy Green for inspiring a generation of watershed stewards

"The Water LA program not only tackles a key challenge in meeting stormwater management needs, but by enlisting residents as partners, presents a model for the type of large-scale and long-term engagement necessary to achieve broader sustainability goals."

GARY GERO, CHIEF SUSTAINABILITY OFFICER, COUNTY OF LOS ANGELES

"Stormwater, grey water, and water conservation are key tools for people in the LA Basin to use as they deal with variable weather exacerbated by climate change. Many are using these tools and teaching others through the Water LA program, and the lessons learned will inspire the state."

FRANCES SPIVY-WEBER, RETIRED VICE CHAIR, STATE WATER RESOURCES CONTROL BOARD

"Private properties have always been the third rail in Los Angeles stormwater work. Through working with residents directly, providing green stormwater solutions, and training residents to maintain these solutions, The River Project has cracked it with this Water LA program."

MARK GOLD, ASSOCIATE VICE CHANCELLOR FOR ENVIRONMENT AND SUSTAINABILITY, UCLA

"Water LA enables everyday citizens to be highly effective stewards of their neighborhoods, watersheds, and city. As people transform their yards into beautifully thriving, drought-mitigating, flood-controlling, water-conserving gardens harvesting rain and greywater, they also transform the community for the benefit of all."

BRAD LANCASTER, AUTHOR, *RAINWATER HARVESTING FOR DRYLANDS AND BEYOND*

"For the last century, we've provided water to Angelenos with large-scale reservoirs and pipelines. With our changing climate and more people moving in every day, our pipes may soon run dry. But by managing our water use on small scales, in every household, in every yard, and on every street, we can provide a great deal more water for everyone. It's in the details, and the details are in this book."

BILL NYE, SCIENCE EDUCATOR, PROFESSIONAL ENGINEER