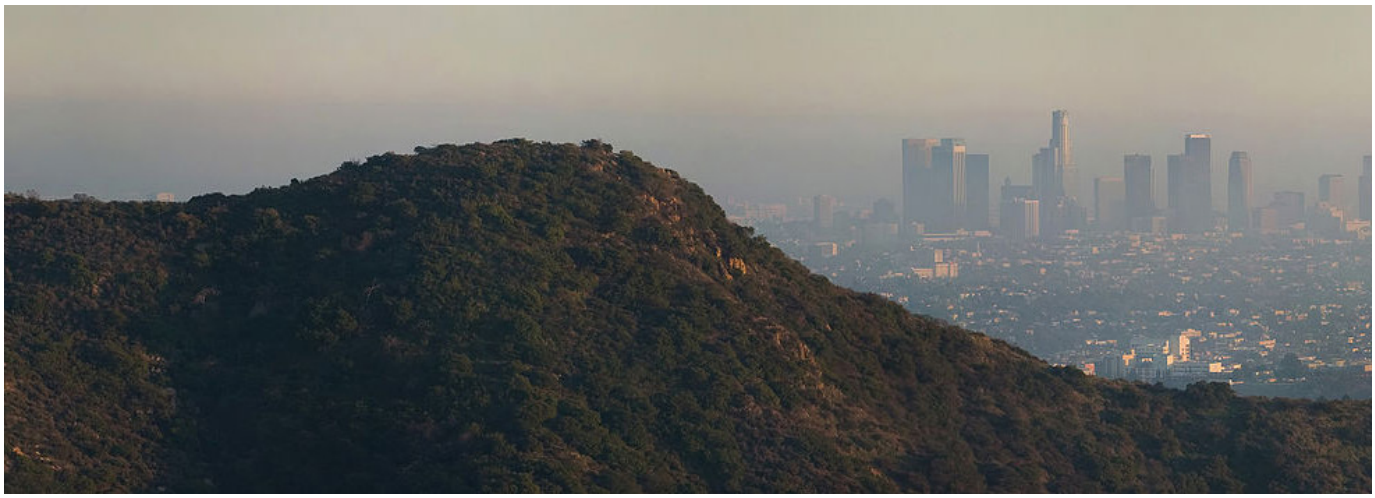
AGU THRIVING EARTH EXCHANGE



Air pollution in Los Angeles (pictured) has reached new heights in recent years in connection to climate change. To connect air quality issues with water management during droughts, community leader Joseph Gallegos approached AGU's Thriving Earth Exchange to find ways to reduce particulate matter with what he calls "continuous regenerative plant foliage," such as shade trees and fruit trees, grown with graywater discharge. Photo by DAVID ILIFF (CC BY-SA 3.0).

Creating clean air using passionfruit vines

AGU's Thriving Earth Exchange helps the Watts neighborhood of Los Angeles understand the link between air quality and water management

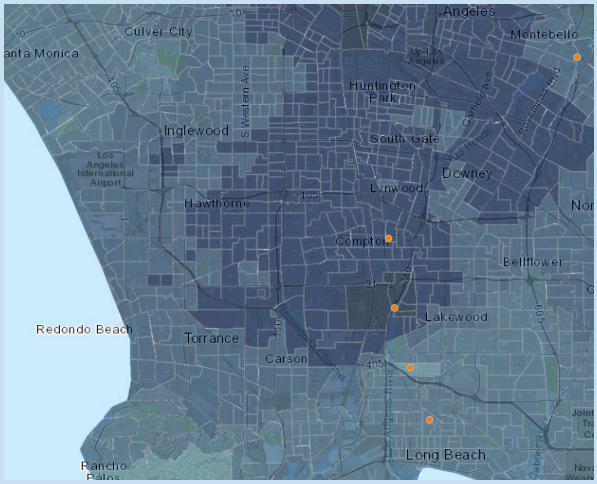
One weekend a long time ago, Joseph Gallegos dug up his Los Angeles yard to try and put wastewater to work. At the time, the city was experiencing a severe drought and water restrictions ensured that whatever had been green before was now brown, and whatever was brown would kick up as dust and debris with the slightest breeze in the air or shuffle of the feet.

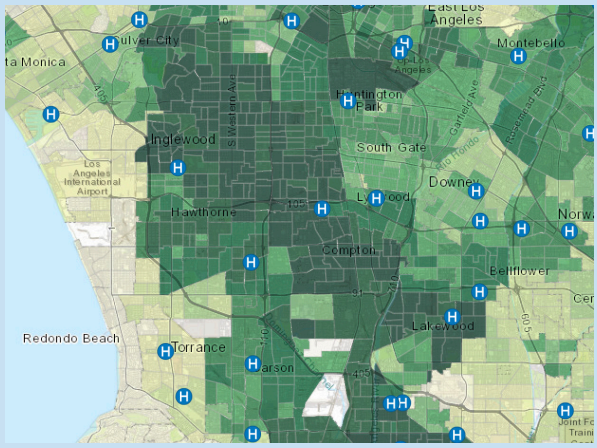
"It started because I was tired of my lawn looking brown," said Gallegos, "so I asked the question, 'How do I get my laundry water to my lawn?' There wasn't anything on the market and yet all the literature said you can do it."

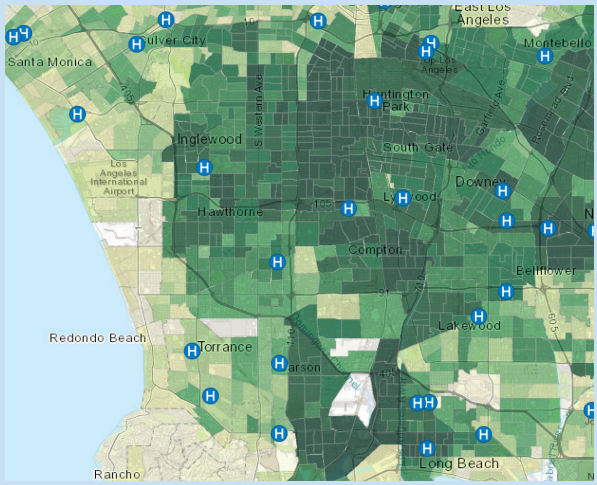
To pursue his interest in water, Gallegos founded Grey4Green.com, a company that provides free Do It Yourself (DIY) videos and self help guilds for residents on installing graywater systems that can turn laundry waste into irrigation, rather than relying on city water that's subject to restrictions. Yet, brown yards are argu-ably the least of the challenges caused by area drought, taking a back seat to the far more pernicious and damag-ing effects of declining air quality in Los Angeles County, which has long been linked to heart disease, heat stroke, and airborne illnesses including asthma and bronchitis, as well as more recently, susceptibility to COVID-19.

To connect water management to air quality issues, Gallegos approached AGU's Thriving Earth Exchange to find ways to reduce particulate matter with what he calls "continuous regenerative plant foliage" such as shade trees and fruit trees. If they can use recycled water on say, tree canopies and vines that ultimately provide shade and cooler ground temperatures, then a greener landscape can also help reduce the amount of particulate matter in the area. In turn, this alleviates additional strain on municipal, domestic, and even agricultural resources. Through the Thriving Earth Exchange, Gallegos formed a team that included Dylan Mendoza, a community out-reach director at Grey4Green.com; Sehdia Mansaray, a University of Arizona graduate student and the project's Community Science Fellow; and Samira Muhammad, who received her PhD from University of Antwerp and serves as the project's community scientist.

In Los Angeles, and in dozens of communities around the country, AGU's Thriving Earth Exchange serves as a connector and facilitator to bring together communities who have self-identified concerns, fellows who organize and administer community-based projects that address those concerns, and experts who can address the spe-cific scientific issues that come to bear on the projects. The Thriving Earth Exchange trains and convenes fellows during the course of their projects, offers limited mone-tary support, and provides opportunities for community members to create awareness of the scientific chal-lenges that projects raise and, ideally, help solve, as well as opportunities for fellows to share their work.







Looking at the Watts neighborhood situated just north of Compton, particulate matter (PM) monitors around the (as represented by orange dots in the top map) help health authorities measure the differences between neighborhoods. Darker shades indicate greater intensities of PM, while lighter shades indicate cleaner air. The number asthma cases in the region (middle map) are greater in the same regions where PM monitors show greater intensity of airborne particles, as are the instances of cardiovascular disease (bottom map). Courtesy California Office of Environmental Health Hazard Assessment.

Putting water to work

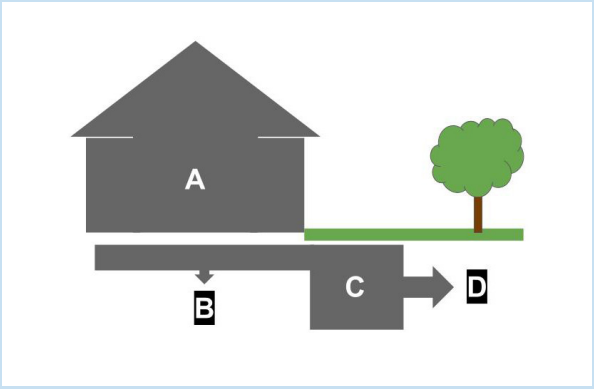
To Gallegos and his Thriving Earth Exchange team, the larger project of improving air quality must begin with individual properties, which must manage water better to facilitate green landscapes that sequester carbon from the air, filter other impurities, and help transform urban heat islands into much cooler zones that can generally improve health.

Graywater—leftover, untreated water that has already been used for domestic purposes like, bathtubs, sinks, or washing machines—is a unique approach to extend the use of urban water resources, and it is especially useful during droughts when outdoor water use is restricted. By substituting part of the water that would have otherwise been used for outdoor irrigation, graywater reuse sys-tems can reduce the strain on municipal water supplies. To make graywater safe and convenient for homeown-ers to use in their yards, California established standards for plumbing design and equipment in 1992 and has leg-islated residential use of graywater for irrigation. Cities like Los Angeles are attempting to simplify the instal-lation and maintenance of graywater systems on the average home by mandating all new homes come equip with graywater diversion. For existing homes, the basic system attached to washing machines with daily discharge capacities of 250 gallons or less are exempt from the need for a permit in Los Angeles. The city also provides online calculators for homes to estimate how much graywater they can gener-ate as well as possible cost savings. A rudimentary laun-dry-to-landscape system, according to the city, may help homeowners save more than $220 annually.

According to the Water Education Foundation, several San Francisco Bay Area counties have implemented graywater rebate programs, including Santa Clara County, which offers residents up to $400 to install a graywater system. Overall, 20 states have adopted codes allow-ing some level of graywater reuse. With the increase of adoption of graywater use in homes, the greener the landscapes. The more greenery that thrives, the cooler the temperatures and the cleaner the air.

Los Angeles' geography and climate are as key to man-aging drought as its water supply and infrastructure. The city's microclimates—localized set of atmospheric con-ditions that are different from those in the surrounding areas—sometimes dramatically diverge, as temperatures within a 24-hour cycle can vary as much as 36 degrees in some places. Yet, on par, the area is classified as a mostly Mediterranean, but dry subtropical climate. The warm and dry conditions that persist year-round lend themselves to severe drought, which affects more than 9.8 million people in the Los Angeles area, according to the National Oceanic and Atmospheric Administration's National Integrated Drought Information System pro-gram. During long droughts, crops dry up and, as soil moisture levels drop, become more sensitive to pests.

In the 19th century, Watts was a vital ranging community and railroad hub for southern California that was ultimately coopted by Los Angeles in 1926. Today, it is one of the densest residential communities in California with nearly 40,000 residents within just over two square miles. Residents who are 18 or younger comprise 39% of the population, 70% identify as Latinx or Hispanic, and 28% as Black or African-American. According to Watts Community Studio, Spanish is spoken at over two-thirds of homes there.



To Gallegos and his Thriving Earth Exchange team, the larger project of improving air quality must begin with individual properties, which must manage water better to facilitate green landscapes that sequester carbon from the air, filter other impurities, and help transform urban heat islands into much cooler zones that can generally improve health. Water used shower water and laundry water are two common types of graywater (A) that commonly drain into city sewer systems or septic tanks (B), but may also be routed to surge tanks (C) that, when used with a pump, can push the discharge into yards fed by subsurface emitters (D). Graphic created by Team Three

During brief ones, they can suffer considerable damage during crucial times in their cycles, such as right after planting or during flowering. As farmers deal with decreased crop hauls, consumers can often expect to pay more for local food. Another condition of drought is the lack of available water to wash produce, which can affect consumer health and sanitation.

The mixture of very small solid particles suspended in air is referred to as particulate matter (PM), commonly call air pollution, which is used to measure air quality. The makeup of particulates varies greatly, as does their respective sizes. Some, like dust, dirt, or smoke, are large enough to be seen, but others are so tiny they can only be seen under a microscope. Smaller particles are more dangerous to your health than larger ones since they can enter your lungs deeply through the mouth and nose.

According to the Environmental Protection Agency, pollutant air that is emitted into the atmosphere has the potential to alter the climate. The term "climate forcers" is frequently used to describe pollutants, which include greenhouse gases. The climate is warmed by ozone in the atmosphere, and it can be warmed or cooled by various PM constituents. Particulate pollution exposure has an impact on the heart and lungs. It has been connected to chronic bronchitis as well as respiratory symptoms like coughing and breathing problems. Particulate exposure worsens asthmatic patients' symptoms, and increases the chance of a heart attack in adults with heart disease. Long-term exposure to high levels of particle pollution really raises the danger of dying from heart and lung conditions. According to a recent study by the California Air Resources Board, particle pollution kills more than 9,000 people in California each year.

Climate change can impact air quality and, conversely, air quality can impact climate change. Ozone helps provide a shield against the sun's harmful rays in the stratosphere, located far above the surface of the earth. Ozone, however, is a dangerous contaminant at ground level. When sunlight interacts with airborne nitrogen oxide emissions, ground-level ozone is produced. It becomes a significant issue, reaching hazardous levels due to the summer's strongest sunshine.

To narrow the project's focus, the team needed a starting point. They settled on a low-income neighborhood in Los Angeles called Watts, which is a densely-populated area with nearly 40,000 residents. Residents who are 18 or younger comprise 39% of the population, 70% identify as Latinx or Hispanic, and 28% as Black or African-American. According to Watts Community Studio, Spanish is spoken at over two-thirds of homes there.

"What we discovered was that most of the homes [in this area] had multiple generations and extended families living in one house," said Gallegos. "Instead of four people, you had more like 12 people living in a house, so the water used for laundry was dramatic."

In response, Gallegos and the Thriving Earth Exchange team designed the graywater system to supply not just

one or two trees on one property, but five to seven trees. Additionally, the team needed to figure out which plants work best, and settled on passionfruit, a vines species that's native to South America and thrives in subtropical climates.

"We're using passionfruit as a baseline because provides shade, produces food, and as we start to add additional plants, which we haven't done yet, we can use passion-fruit to figure out if the next vine species is positive or negative by comparison," says Gallegos.

"At the end of the day, we hope a homeowner will have a plant palette to pick from," said Gallegos. "We want them to think, 'If I plant these species around my house, this is how much my air quality will be improved.'"

Gallegos and the Thriving Earth Exchange team believes that by quantifying the amount of greenery or vines in a particular area can change the way a homeowner views their yard landscape, or a developer creates a strip mall or a mixed-use project.

"We want people to take our calculations to figure out how many vines within or around that development to sequester the particulate matter," said Gallegos. "I call it my 'retirement career,' to try and help people" he says, "and my emphasis is on the environmental aspects of our community."

"Quantifying the environmental benefits of using urban greenery to remove particulate matter (PM 2.5 and PM10)" is a project of AGU's Thriving Earth Exchange, which advances community solutions to some of the most vexing environmental challenges. Thriving Earth Exchange helps scientists, community leads and spon-sors work together to conserve natural resources, mit-igate climate change and create awareness of natural hazards and their impacts on communities.

Learn more at thrivingearthexchange.org.