

Creating a Climate Resilient California using Nature-based Solutions

by **Jennifer A. Lentz, Ph.D.**

LEED Green Associate, EcoDistricts AP

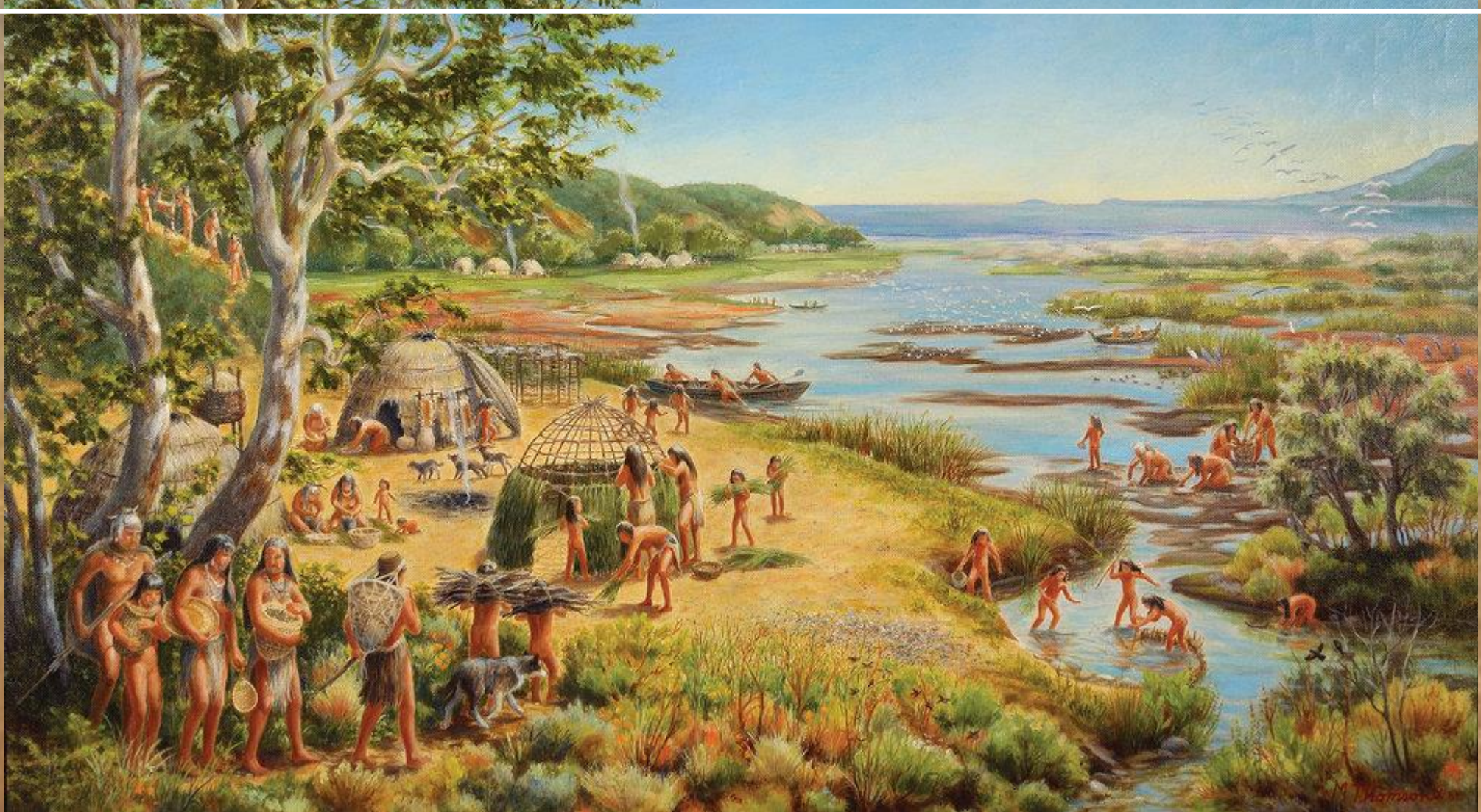
*Education Coordinator for Climate Resilient & Community Science Programs
Aquarium of the Pacific, Long Beach, CA*

California Garden Club, Inc. (CGCI) 2020 Winter Board Meeting
& National Garden Clubs (NGC) Tri-Refresher, at Queen Mary Hotel, Long Beach, CA

02/04/2020



Living in Harmony **with** Nature



“Wiyot’s Children” by Mary Leighton Thomson, depicting life of the Tongva people before the Spanish arrived in the 1800s.

Photo courtesy of the Friends of Ballona Wetlands

[illegible][illegible][illegible]

A detailed historical map of Southern California, centered on Los Angeles. The map shows the city of Los Angeles in the center, with surrounding areas like Pasadena, Glendale, and Burbank to the north. To the south, Long Beach and Signal Hill are visible. The coastline includes San Pedro, Los Angeles Harbor, and various beaches like Huntington Beach and Newport Beach. The map is color-coded with greens for land and blues for water. Numerous city names are labeled throughout the region, including San Francisco, San Diego, and San Jose in the distance. The map is titled 'Orange County Archives' in the top left corner.

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This is a historical map of Southern California, focusing on the Los Angeles metropolitan area and surrounding regions. The map is color-coded, with green representing land, blue for water, and brown for mountains. Major cities and towns are labeled in bold, black capital letters. The map shows the coastline of California, with the Pacific Ocean to the west and the Gulf of California to the south. Key locations labeled include Los Angeles, Long Beach, Anaheim, Huntington Beach, and Newport. The map also shows the surrounding mountains, including the Sierra Madre and the San Gabriel Mountains. The map is a detailed representation of the region's geography and urban development at the time.

[illegible][illegible]

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[illegible][illegible][illegible]

Orange County Archives

1920s

1920s

Signal Hill

Courtesy of Los Angeles Public Library Photo Collection

1920s

Orange County Archives

1920s

Signal Hill

Courtesy of Los Angeles Public Library Photo Collection

1920s

Orange County Archives

1920s

Signal Hill

Courtesy of Los Angeles Public Library Photo Collection

1920s

Orange County Archives

Pasadena

Los Angeles

Compton

Signal Hill

Long Beach

San Pedro

Huntington Beach

Newport

1920s

1920s

Signal Hill

Courtesy of Los Angeles Public Library Photo Collection

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Courtesy of Los Angeles Public Library Photo Collection

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Signal Hill

Courtesy of Los Angeles Public Library Photo Collection

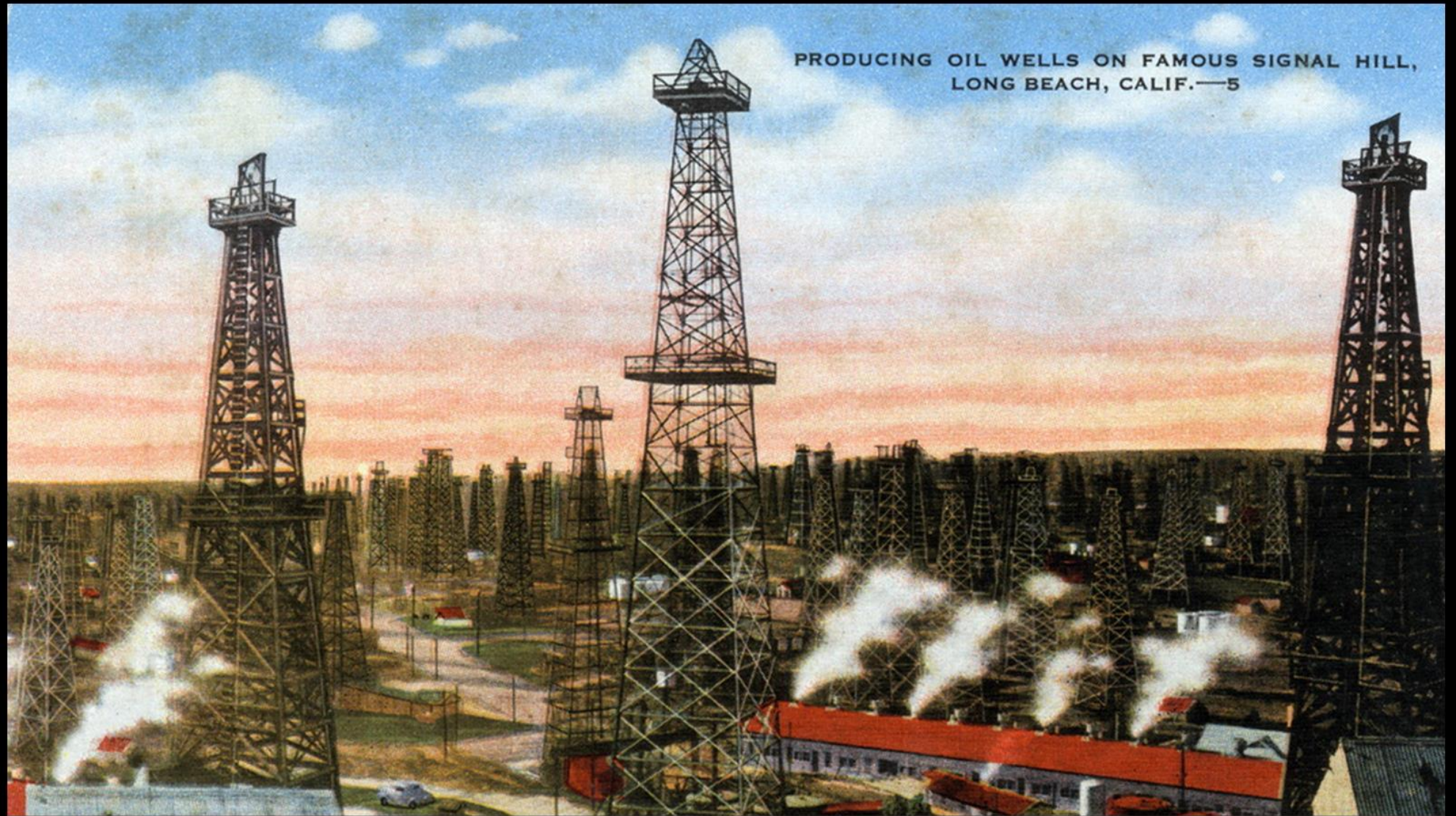
Santa
Monica

El Segundo

Torrance

San
Pedro

1920s



Circa 1926 postcard of Signal Hill. Courtesy of the Werner Von Boltensstern Postcard Collection, Department of Archives and Special Collections, Loyola Marymount University Library.

Santa
Monica

Los Angeles

El Segundo

Torrance

San
Pedro

Compton

Signal
Long

Pasadena



Courtesy of Los Angeles Public Library Photo Collection

Orange County Archives

Santa
Monica

Los Angeles

El Segundo

Torrance

San
Pedro

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Signal

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Pasadena



Google Earth 3D Rendering of Present Day.

Santa
Monica

Los Angeles

Pasadena

Riverside

El Segundo

Torrance

San
Pedro

Laguna
Beach

March 2, 1938

Flooding at West 43rd Place & 11th Avenue

Photo Courtesy of the Los Angeles Times



Santa
Monica

El Segundo

Torrance

San
Pedro

1948



**Edward Koehn, Chief of flood control design for the LA district,
explains the model to colleagues**

Photo Courtesy of the Los Angeles Public Library

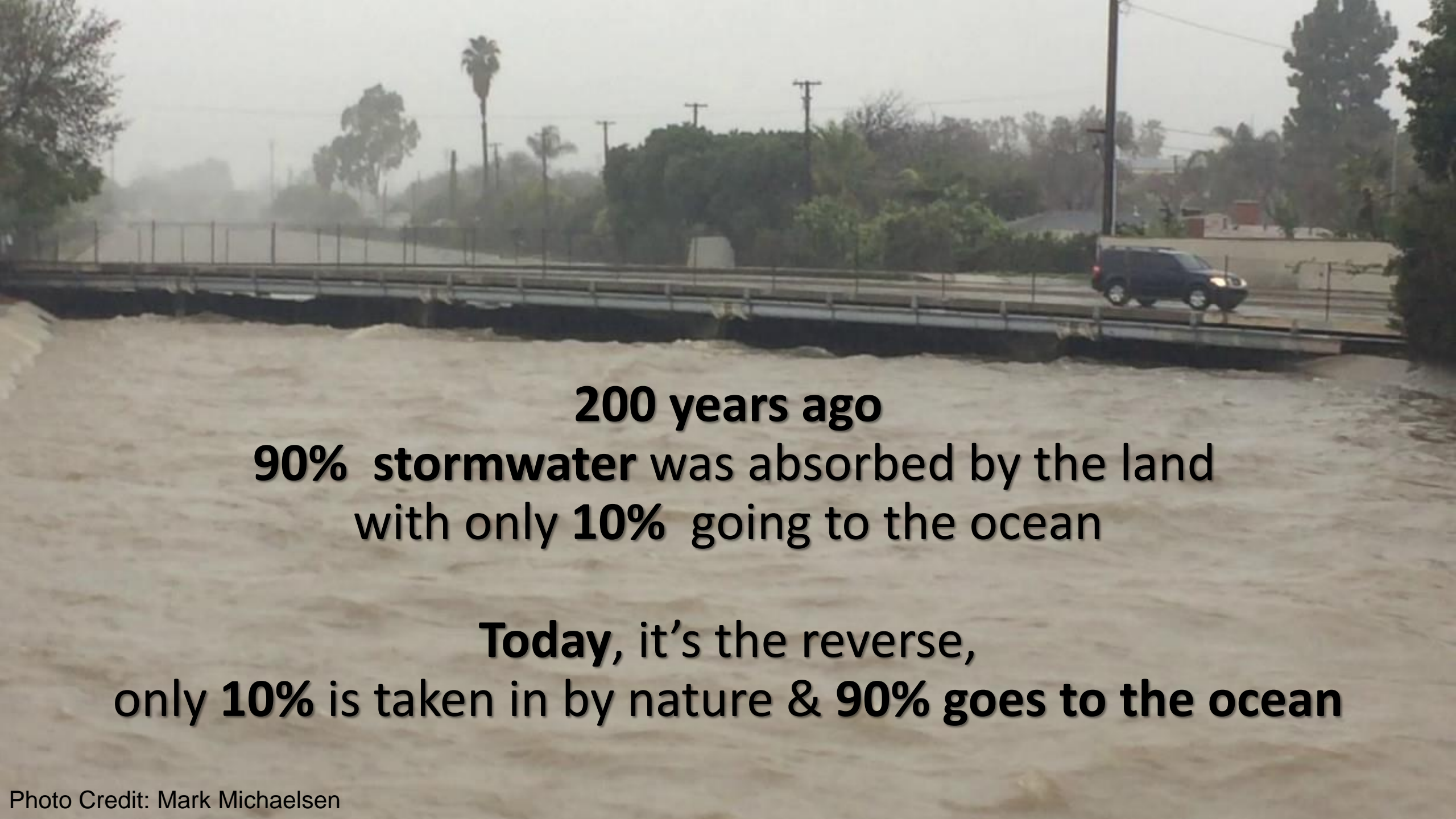
Riverside

Laguna
Beach

Los Cerritos Channel in Long Beach, CA



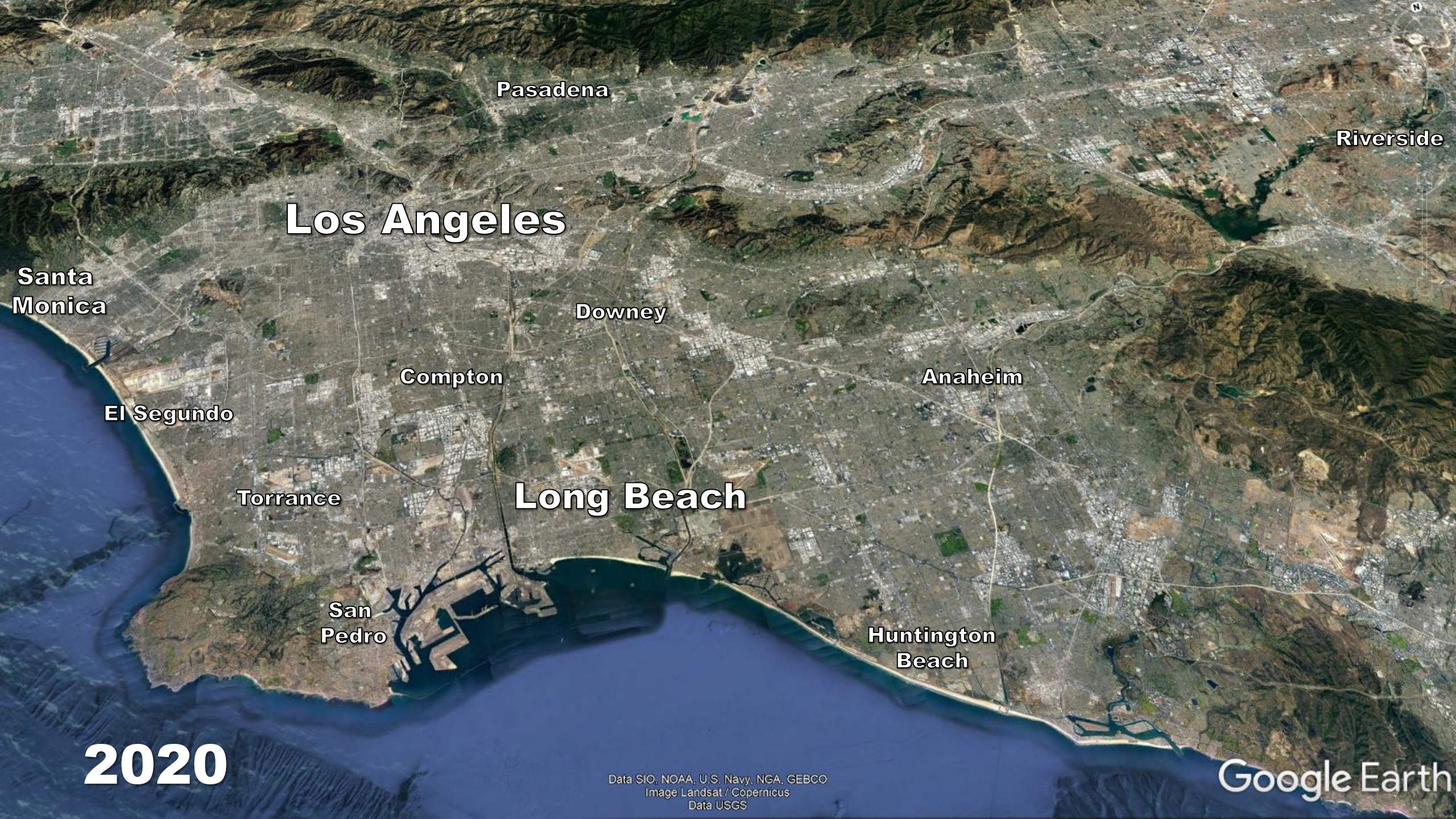
>2 million cubic yards of concrete later,
almost all Greater LA area waterways have been channelized



200 years ago

90% stormwater was absorbed by the land
with only **10%** going to the ocean

Today, it's the reverse,
only **10%** is taken in by nature & **90%** goes to the ocean



Pasadena

Riverside

Los Angeles

Santa
Monica

Downey

Compton

Anaheim

El Segundo

Torrance

Long Beach

San
Pedro

Huntington
Beach

2020

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
Data USGS

Google Earth



CALIFORNIA

is already experiencing
the impacts of
CLIMATE CHANGE

California's 2017 Climate Change Scoping Plan –
Executive Summary (CARB 2017), page ES2



Extreme Heat



**Deteriorating
Air Quality**



**Diseased & Dying
Vegetation**



Wildfires



Extreme Weather



Drought



Toxic Oceans



Sea Level Rise



Natural Climate Solutions (NCS)

cost-effective solutions to keep warming $< 2^{\circ}\text{C}$ while \uparrow **Climate Resilience**

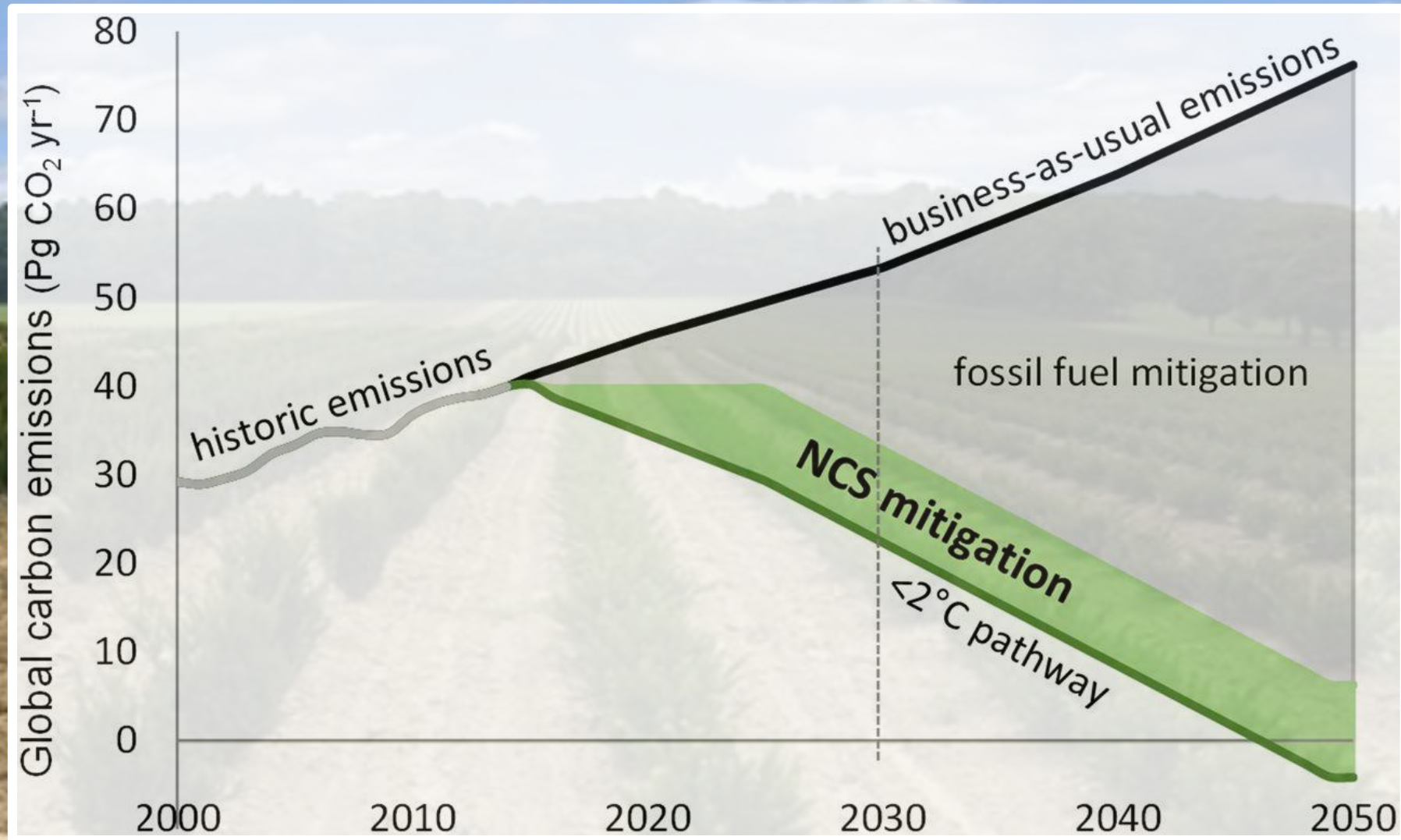
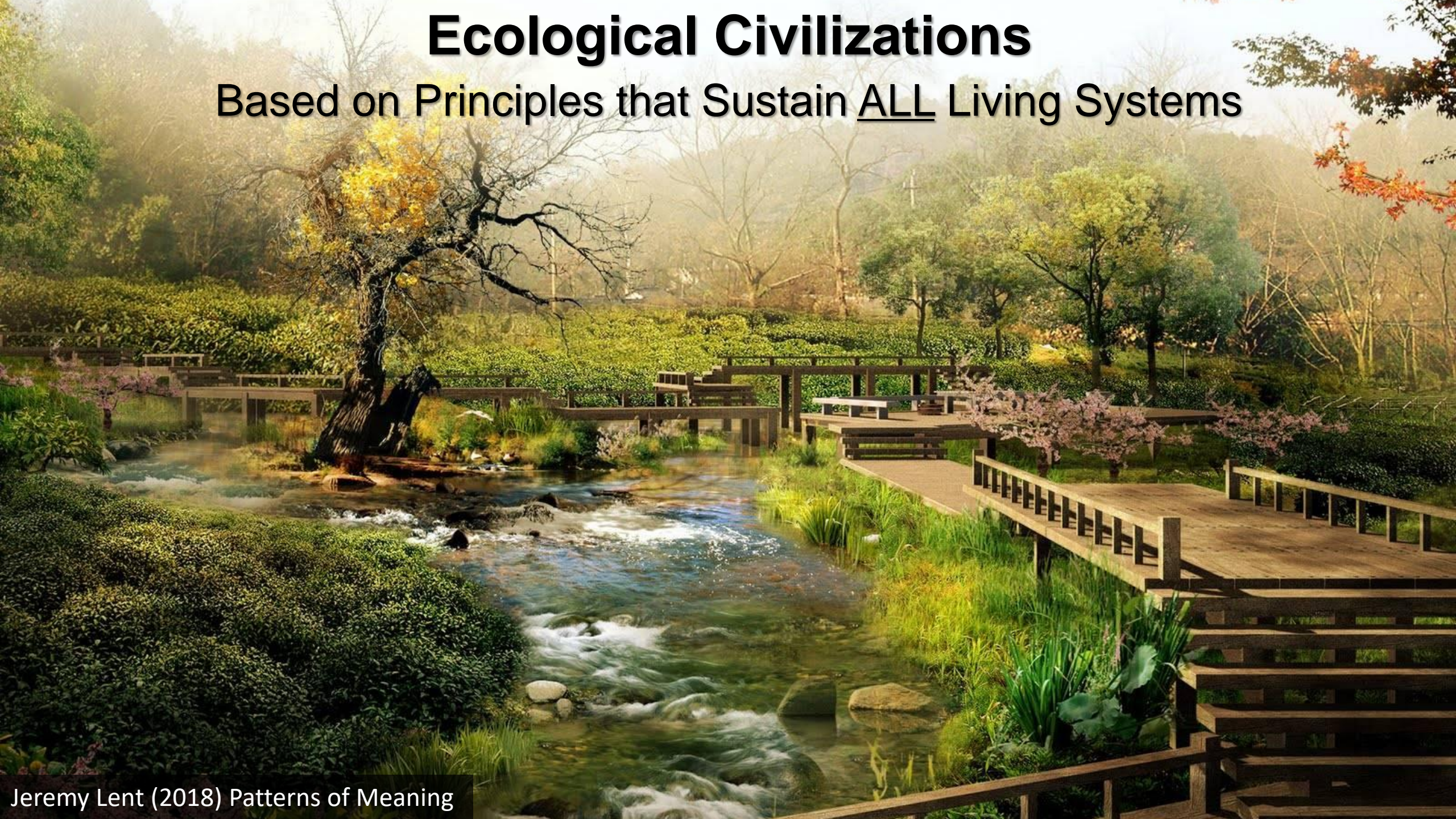


Fig 2.
Griscom et al.
(2017) PNAS

Ecological Civilizations

Based on Principles that Sustain ALL Living Systems



Vegetation Cools the Air

A multi-story modern building with extensive green roofs and balconies covered in lush vegetation. The building features large glass windows and balconies with metal railings. The vegetation includes various green plants, vines, and small trees. In the background, there are mountains and a clear sky.

Camelview Village, Scottsdale, Arizona, by David Hovey

Credit: Bill Timmerman, Timmerman Photography, Inc.

Source: <http://www.2030palette.org/green-roof/>

Shaded areas under **tree canopies** are **2-9°F cooler** than open terrains & **20-30°F cooler** than parking lots



Image: <https://waterbucket.ca>

Data from: <http://www.2030palette.org/vegetative-cooling/>



Shaded Walls & Surfaces can be **20 - 45°F cooler** than **unshaded surfaces**

Data from: <http://www.2030palette.org/vegetative-cooling/>

Vegetation Improves Air Quality



Consorcio Building - Santiago
Enrique Browne & Borja Huidobro
Providencia, Santiago, Chile
Credit: Enrique Bowne

Data from: <http://www.2030palette.org/vegetative-cooling/>

“Studies have shown that **green infrastructure** such as **trees** & other **vegetation** can reduce **volatile fine & ultra-fine particles** by up to **60%**” (Pugh et al. 2012)



Images from: www.arup.com/cities_alive

© Arup 2016



Images of ParkRoyal on Pickering, WOHA, Singapore
Credit: WOHA / Patrick Bingham-Hall



Source: <http://www.2030palette.org/green-roof/>

Vegetation & Green Infrastructure help to restore ecosystem services by taking in & utilizing stormwater which ↓ nuisance flooding, polluted runoff, & potable water use on vegetation



Large-Scale Revitalization of the LA River, by AECOM

Restoring Wetlands ↓ Climate Impacts & ↑ Resilience

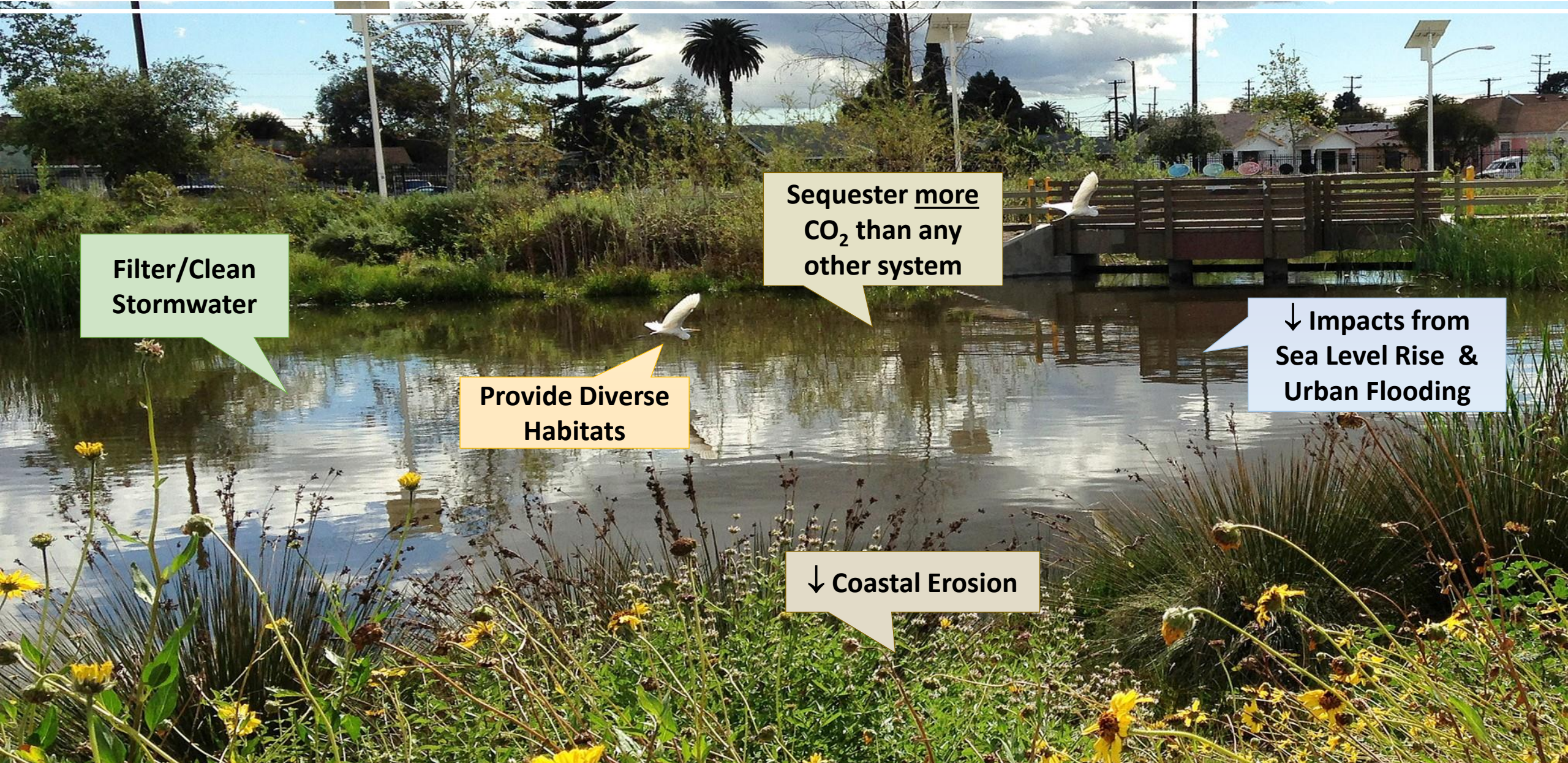
Filter/Clean
Stormwater

Sequester more
CO₂ than any
other system

Provide Diverse
Habitats

↓ Impacts from
Sea Level Rise &
Urban Flooding

↓ Coastal Erosion



LA River Revitalization Master Plan

Arroyo Seco



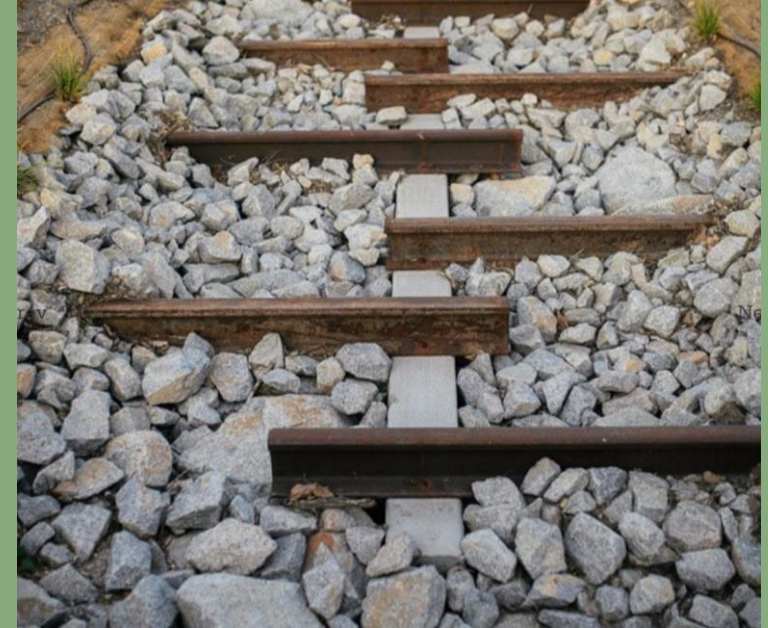
LATC



Current Conditions

After Planned Revitalization

Source:
Los Angeles River Ecosystem Restoration Project – Reader's Guide
(pages 30 - 31)



Green Infrastructure provides Stormwater & Complete Street Solutions

21st St. Improvements in Paso Robles, CA

By CannonCorp Engineering Consultants

Green Infrastructure

Stormwater Planters & Permeable Pavements



Fig. 2.1 3D View of Stormwater Planter
Philadelphia Green Streets Design Manual



Image: EPA
(water.epa.gov)



Watershed Approach **Landscapes**

Source: **California Watershed Approach to Landscape Design**
Image Credit: **Marilee Kuhlmann, Los Angeles © 2018**

detain the rain



© Paul Herzog, 2018

Contours for Rain Capture

Every garden can become a **Sponge.**

Homeowner John Huber, Ventura
Source: **California Watershed Approach to Landscape Design**

detain the rain

Slow, Spread, Sink and Store

© Tom Rau, 2018

Tom Rau, Los Angeles

Great Permeable Hardscapes



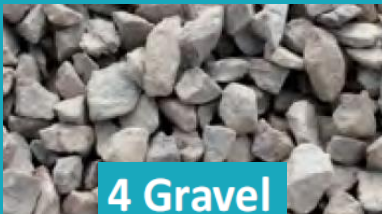
1 Sand set pavers



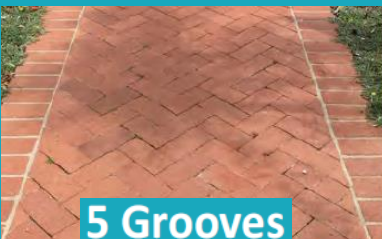
2 Porous concrete



3 Interlocking pavers



4 Gravel

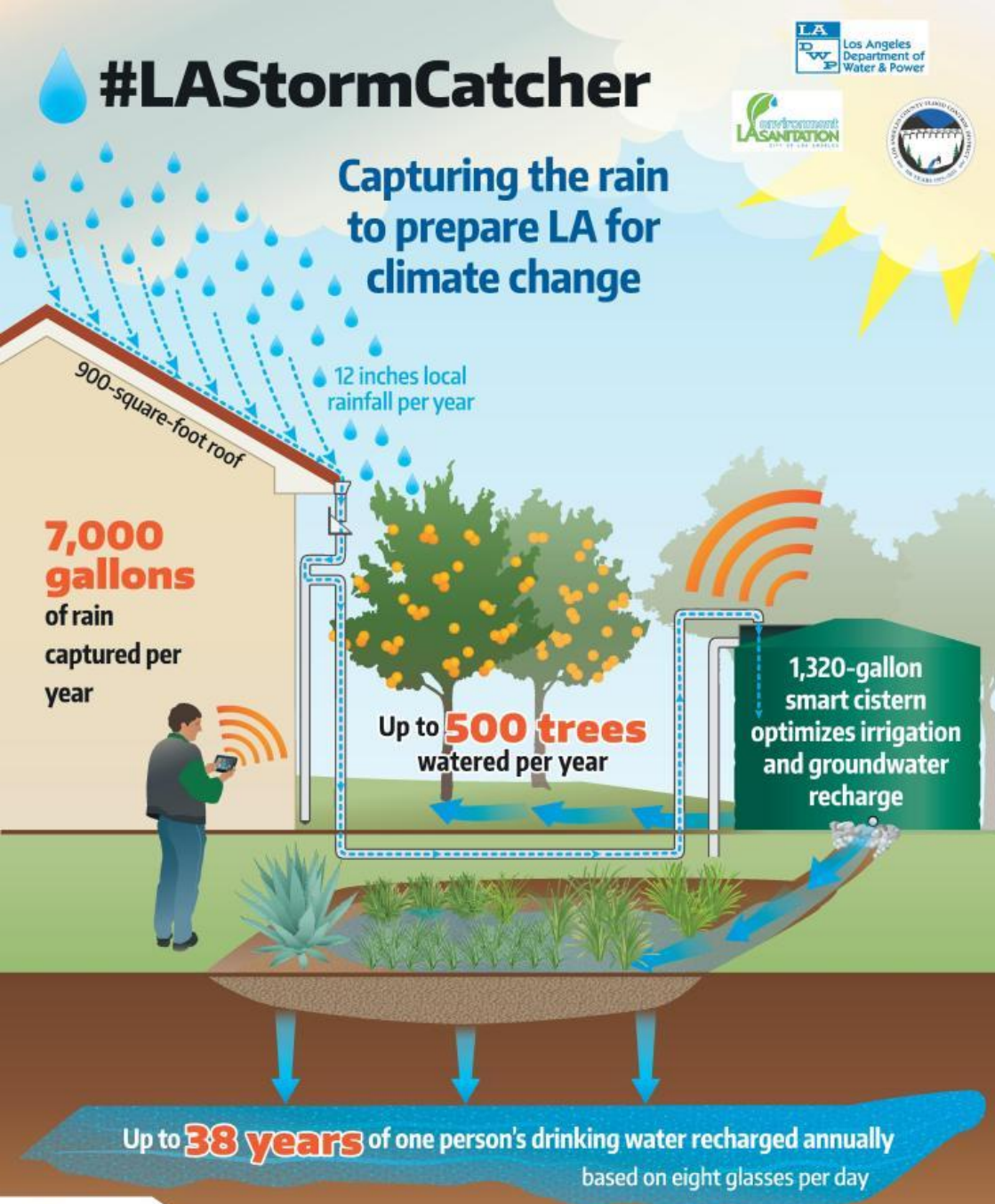


5 Grooves

cut into brick path

Replaced Lawn with Native Plants & Rain Garden

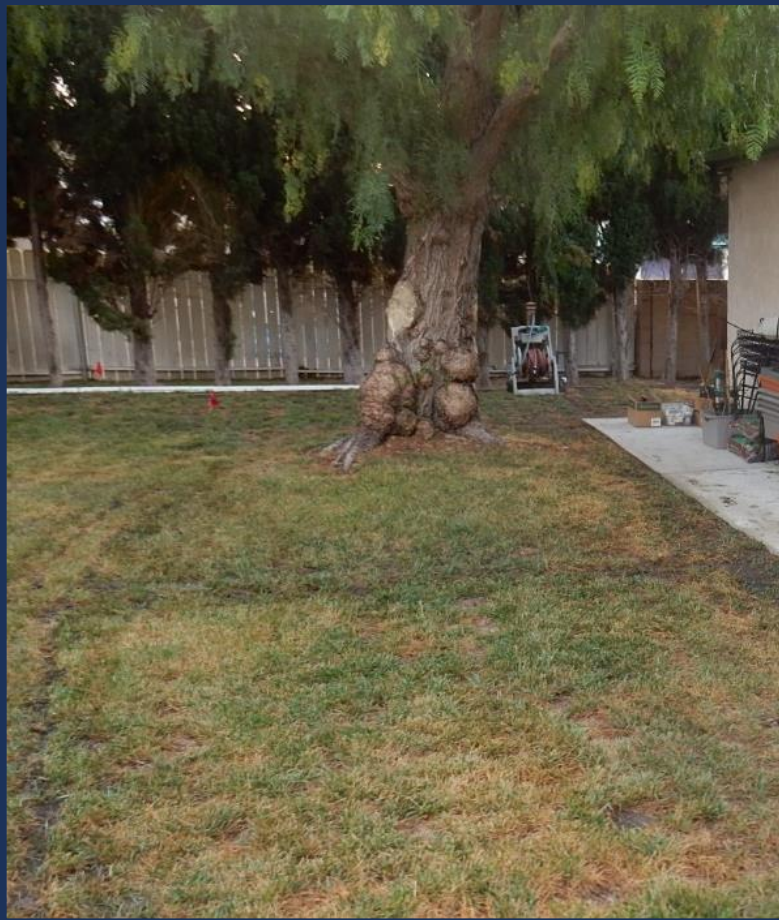




Source: <https://stormwater.wef.org>

Image Credit: James Kellogg, TreePeople

Healthier, more Resilient Grass



Aeration



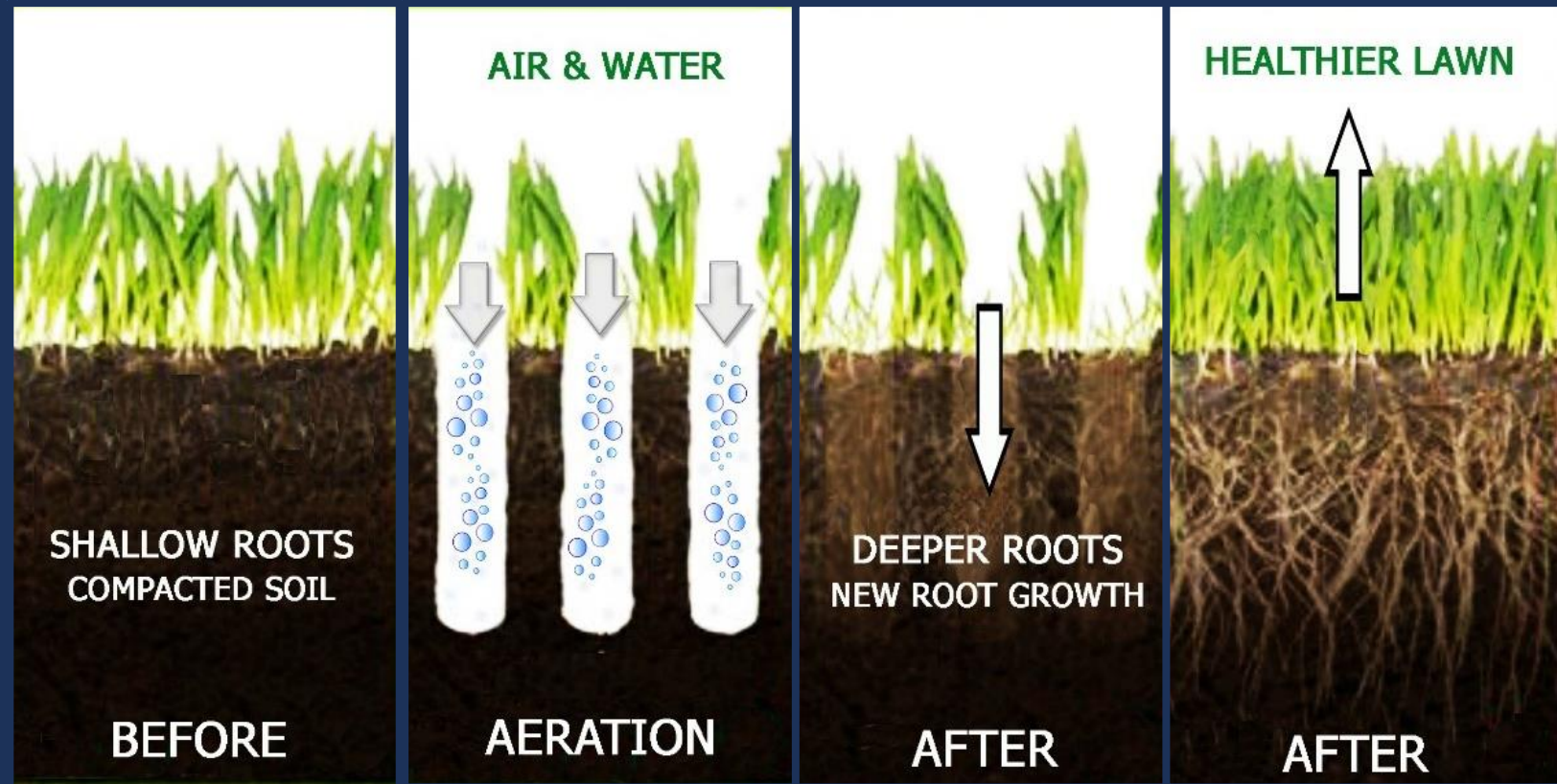
Grasscycling



Aeration



Credit: Gardzen Hand Hollow Tine Lawn Aerator



Credit: The Lawn Institute

creates **holes** in the lawn to help **air, water & nutrients** penetrate deeper
↓ **soil compaction**, ↓ **thatch**, & ↑ **root depth**

Grasscycling



↓ **Evaporation of Water**
(clippings contain 80-85% water)

↓ **Fertilizer Use by 50%**
(Nutrients retained onsite)

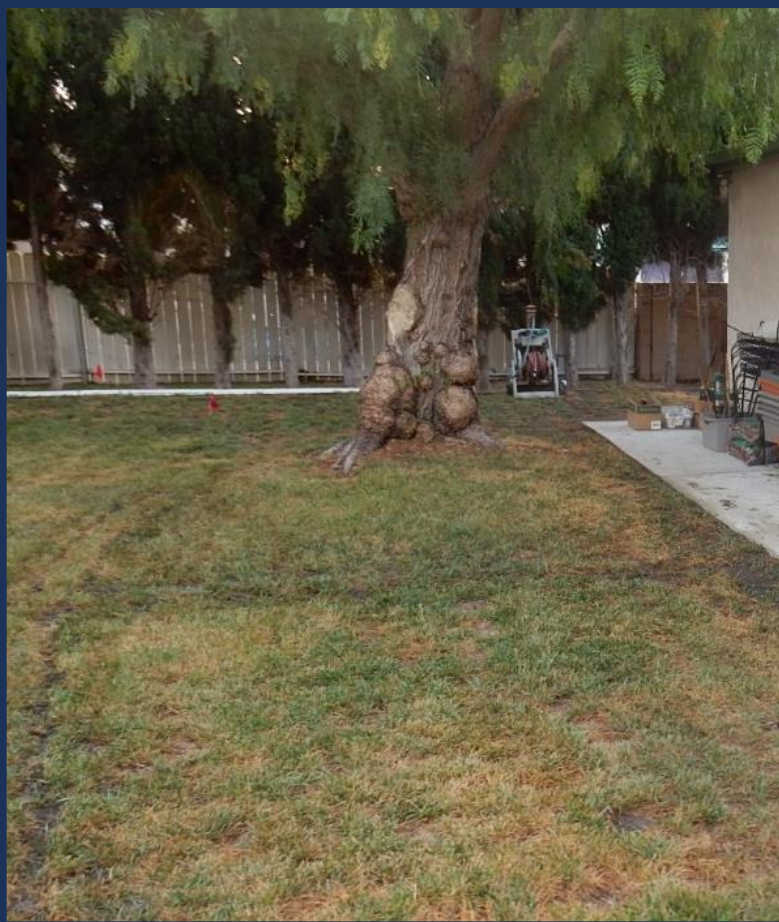
↓ **Yard Waste by 75%**

Credit: Apple Valley Eco Landscapes

Clippings left on lawn after mowing,
mow every 10-14 days (or less) & only when grass is dry



Healthier, more Resilient Grass



Save Time (mow less often, 10-14 days)

Save Water (50-80% ↓)

Save the Planet (↓ Fossil Fuel Use & ↑ Air Quality)

Save \$\$\$ (Fertilizer ↓ 50%) & **Get \$\$\$**

(Rebates for electric mowers, weather sensors & efficient sprinkler heads)



Water Use

The average
Californian uses
196 gallons per day

of which
~70% (130+ gallons)
is used outdoors
to water plants or
fill swimming pools



LACWaterworks.org

Follow us on Twitter [@LACoWaterworks](#)

Los Angeles County Waterworks Districts



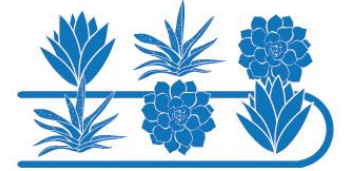
**Look for leaky or broken
sprinkler heads**

Saves 20+ gallons per
head every 10 minutes



**Plant drought resistant
trees and plants**

Saves 30-60 gallons per
1,000 square feet each time



Install drip-irrigation

Saves 15 gallons each
time you water



**Use a broom to clean
outdoor areas**

Saves 8-18 gallons
per minute



**Water plants early in the
AM or at night**

Saves 25 gallons each
time you water



Use mulch on soil surface

Saves 20-30 gallons per
1,000 square feet each time



**Adjust sprinkler to water
plants, not your driveway**

Saves 12-15 gallons each
time you water



**Cover the swimming pool
when not in use**

Reduce the amount of
make-up water needed
by 30-50%



**Set mower blade to 3" to
encourage deeper roots**

Saves 16-50 gallons
per day



Guide for Establishing Drought Tolerant Trees

Guía para Establecer Árboles Tolerante de Sequía

Months 1-6
1-6 Meses

**Water inside
basin**
*Dentro de la
cuenca de riego*



Months 6-12+
6-12+ Meses



Water outside basin
Regar fuera de la cuenca



5 gallons per watering
5 galóns cada riego

Month 1
1 Mes

Water twice a week
Regar dos veces a la semana

Months 2-3
2-3 Meses

Water every week
Regar cada semana

Months 4-8
4-8 Meses

Water every two weeks
Regar cada dos semanas

Months 9-12
9-12 Meses

Water every 2 to 4 weeks
Regar cada 2 a 4 semanas

Benefits of Trees

BENEFITS CORRELATE TO TREE SIZE AND AGE

Capture & Cleans Rainwater

100 trees can capture & store
~139,000 gallons of rainwater per year

1 medium tree can intercept & clean
2,300 gallons of stormwater runoff per year

Clean the Air

100 trees remove 53 tons of CO₂
& 430 lbs of other pollutants per year

Cool the Air

Shaded surfaces may be 20-45°F
cooler than unshaded surfaces

Save Energy

Strategically placed shade trees
can ↓ annual AC costs by 56%

Improves Public Health

↓ Crime

URBAN FOREST BENEFITS

Western Redbud
15-20 ft.

Jacaranda
40-50 ft.

California Sycamore
80 ft.

The older and larger the tree, the greater the benefit

TREE SIZE AND AGE

Source: First Step, Developing an Urban Forest Management Plan for the City of Los Angeles

In the face of our changing climate & environment,
communities must be **engaged** & at the **core of planning** for our future





Quality of Life

'When it comes to "social cohesion" nature is much more important than age, gender, education and income combined'

BioScience Journal (11/2015) reporting on research undertaken by Cardiff University



The LA River Master Plan is using
Nature & Community-Based Solutions
to Restore Ecologic Function to the LA River.
→ an Inviting, healthier, more resilient system



Source: KCET.org

Urban Farms & Community Crop Swaps

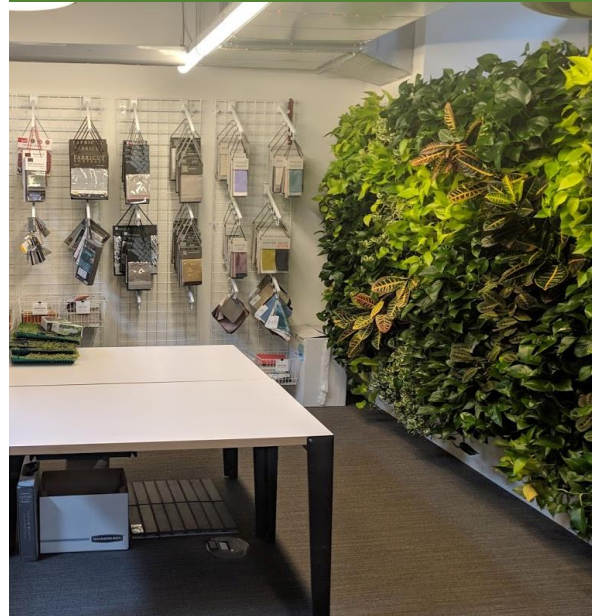
(↑ Food Security, Equity, Health & ↓ Foot-print)



Source: BCV arch

Living Walls & Vegetated Shade

(Cleans & Cools the Air, ↑ Health, ↓ Energy, ↓ Floods & Cleans H₂O, etc.)



We **CAN** Design the Future **We WANT**
Our Challenge is to **IMAGINE** It, **CREATE** It, & **SHARE** it



Illustration: "Imagining a Healthy, Sustainable Future for the LA River" by Perkins & Will



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<http://JenniferALentz.info/>

Aquarium of the Pacific

Education Coordinator

for Climate Resilient & Community Science Programs

<http://pacific.to/resilientLBaop>

Thank You



Links to Images & Data Referenced in this Presentation

- <http://apldca.org/wp-content/uploads/2018/08/G3-APLD-CA-Watershed-Approach.pdf>
- http://archive.phillywatersheds.org/img/GSDM/GSDM_FINAL_20140211.pdf
- <https://cannoncorp.us/project/21st-street-green-and-complete-street-improvements/>
- http://eng2.lacity.org/techdocs/emg/docs/lariver/LA_River_Reader_Guide.pdf
- https://perkinswill.com/wp-content/uploads/2019/05/Project_Urban-Ag-Greening_01-2880x1570.jpg
- <https://pig-blog.com/2013/05/15/bay-meadows-welcome-center-wins-at-bia-bay-area/>
- https://pw.lacounty.gov/wwd/web/Documents/conservation_tips.pdf
- <https://stormwater.wef.org/2015/11/los-angeles-homeowners-capture-stormwater-smart-cisterns/>
- <https://urbanize.la/sponsored/uli-los-angeles-partners-verdexchange-offer-resilient-livable-and-sustainable-urban-solutions>
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- <https://www.arup.com/perspectives/publications/research/section/cities-alive-green-building-envelope>
- https://www.cityplants.org/wp-content/uploads/2018/12/10939_LA-City_Plants_FirstStep_Report_FINAL_rev12-7-18.pdf
- <https://www.kcet.org/earth-focus/gamechanging-la-river-study-released-442-million-plan-recommended>

Links to Rebates

