Designing w/ Water

Josiah Cain

Director of Innovation, Sherwood Design Engineers, *Moderator*

Robin Grossinger

Senior Scientist, San Francisco Estuary Institute; Co-Director, Resilient Landscapes Program

Zach Gallagher

PE, Executive Vice President, Natural Systems Utilities

Peter Haase

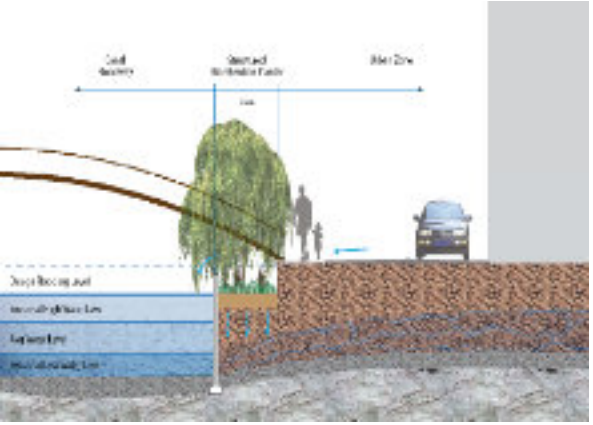
PE, Principal Engineer, Fall Creek Engineering

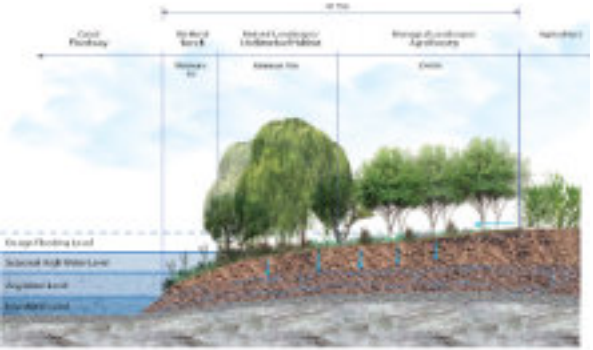
SUSTAINABLE SILICON VALLEY

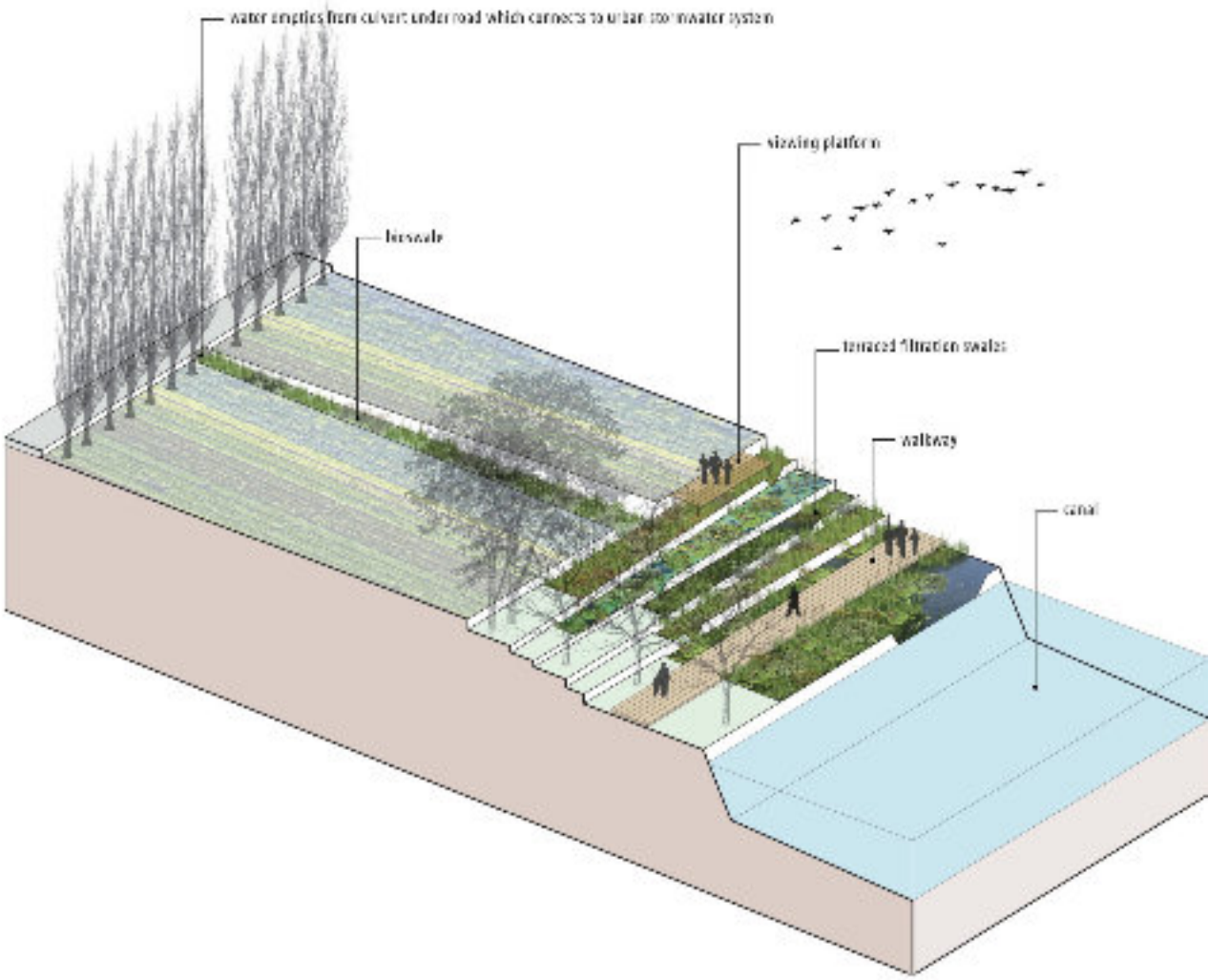
SHERWOOD
DESIGN ENGINEERS

CANAL TYPOLOGIES

Run–offwill be treated through a series of terraced filtration swales before entering the canals







SHERWOOD
DESIGN ENGINEERS

URBAN HEAT ISLAND EFFECT

MITIGATION STRATEGIES: COOL ROOFS / IRRIGATI

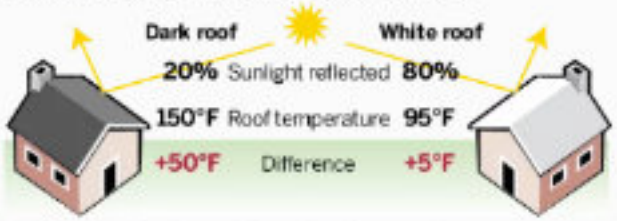
Strategies applied throughout a neighborhood can lead to reduced ambient temperatures, resulting in annual cooling cost savings up to $10 / square meter.

Table 3.2. Summary of annual water usage, energy consumption, and total cost of all study irrigation schemes.

	No-irrigation	Daily constant	Soil-moisture-controlled	Soil-temperature-controlled
Water usage (m^3 m^{-2})	0	1.04	1.09	1.79
Energy consumption (kWh m^{-2})	1405.8	1335.7	1336.3	1321.6
Annual total cost ($ m^{-2})	151.29	143.28	143.32	142.44

SAVINGS FROM COOLER ROOFS

A dark-colored roof absorbs greater heat than roofs of white or reflective materials. Buildings with the latter would often see 10-15% in energy savings in reduced air conditioning costs. Here are the temperature differences during a 90°F day:



Estimated savings in irrigation water

In addition to energy savings, cooler roofs could reduce irrigation water usage by lowering the temperatures in the neighborhood.

County	Savings	Savings in millions of gallons per day	Population	Savings in gallons per capita per day
Los Angeles	9.1%	-83	10,120,000	-8.2
Orange	7.9	-30	3,146,000	-9.7
San Bernardino	7.3	-29	2,113,000	-13.8
Stanislaus	7.3	-7	531,997	-12.7
San Francisco	7.3	-2	852,469	-1.8
San Joaquin	7.2	-8	715,597	-11.9
Sacramento	7.1	-20	1,482,000	-13.8
Santa Clara	6.6	-19	1,895,000	-10.2
Alameda	6.6	-13	1,611,000	-8.3
Placer	5.5	-6	371,694	-15.4
Solano	5.5	-5	431,131	-11.9
San Diego	5.3	-37	3,263,000	-11.2
Contra Costa	5.3	-14	1,111,000	-12.6
San Mateo	5.1	-7	758,581	-9.6
Riverside	4.8	-29	2,329,000	-12.4
Napa	4.5	-2	141,667	-13.1
Marin	4.1	-4	260,750	-15.3
Sonoma	4.0	-5	500,292	-10.7

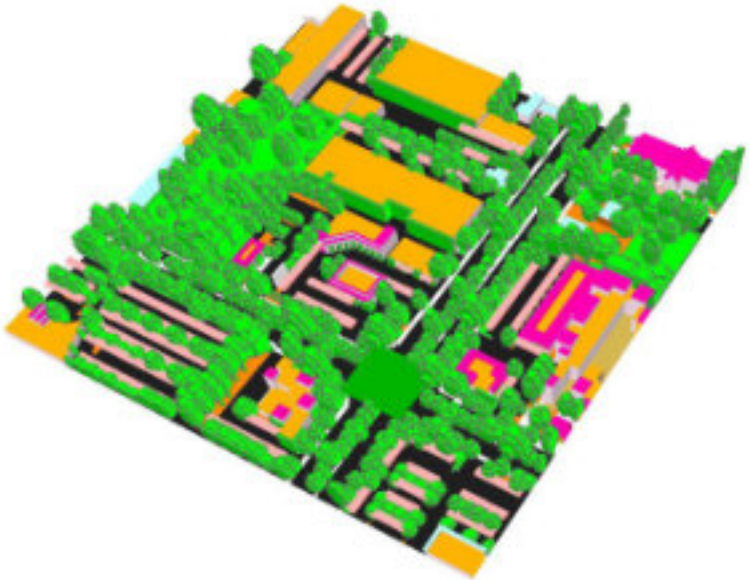
Source: Berkeley Lab, Department of Energy, Pouya Vahmani and Andrew Jones, Lawrence Berkeley National Laboratory

BAY AREA NEWS GROUP

URBAN HEAT ISLAND STRATEGIES

SURFACE AREA COMPOSITION:

27.6%	TREE CANOPY
21.7%	BUILDING FOOTPRINT
9.4%	PERMEABLE SURFACE
12.9%	VEGETATED SURFACE
34.4%	PARKING LOT
5.2%	SIDEWALKS / WALKWAYS
16.4%	STREET
7%	SOLAR
2%	PVC SAIL CLOTH
0.4%	GREEN WALL / FACADE



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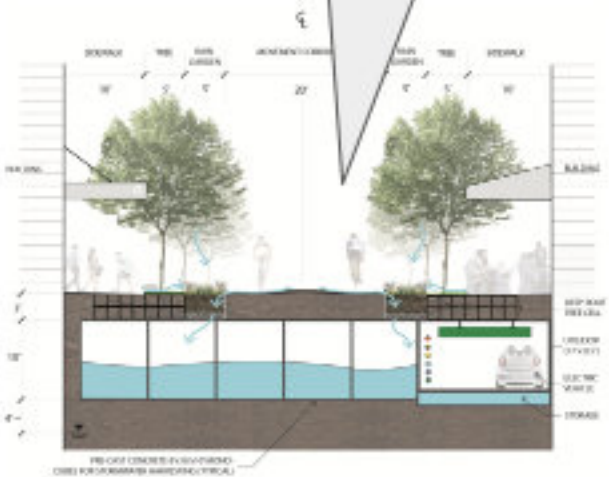
Resource Infinity Loop

Organizing an EcoDistrict around a resource platform reinforces the Innovation Loop and provides opportunity for iteration and inclusion of circular resource economies. This becomes a platform for automation, ioT, communication, logistics, and sharing of public and private flows within the district.

'Bionic Street' combines ecology, technology, infrastructure for highly functional active/passive systems.



Utilidor for easily accessible private ROW provides interface with public utility and District.

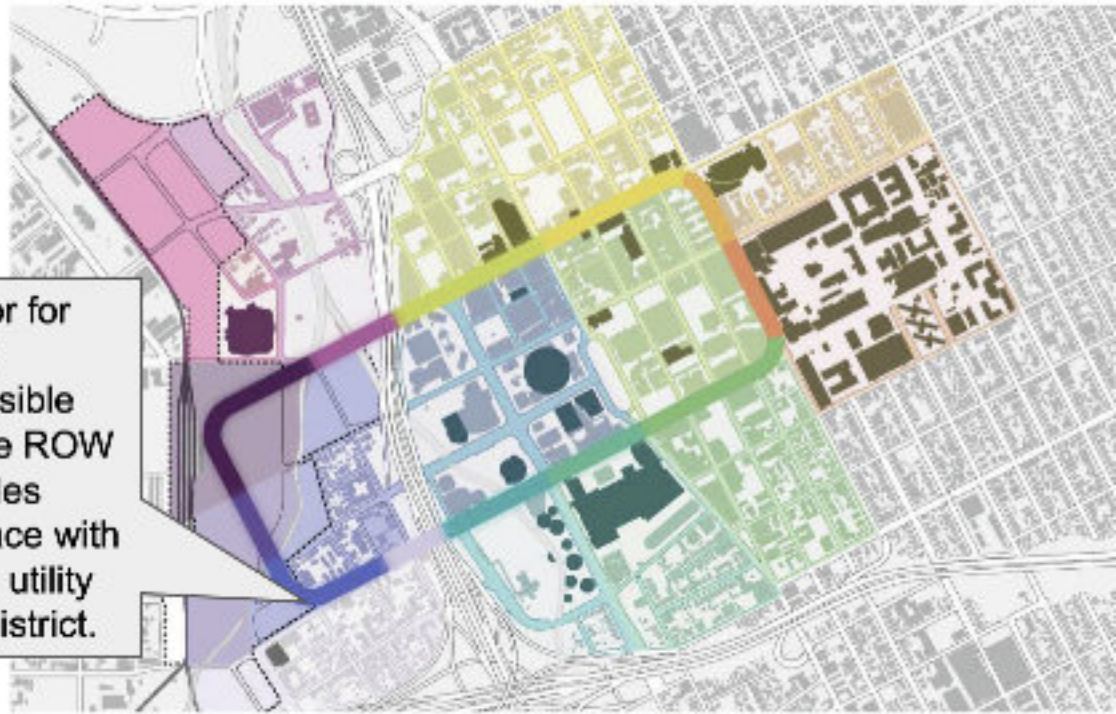


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Image: Grimshaw Architects

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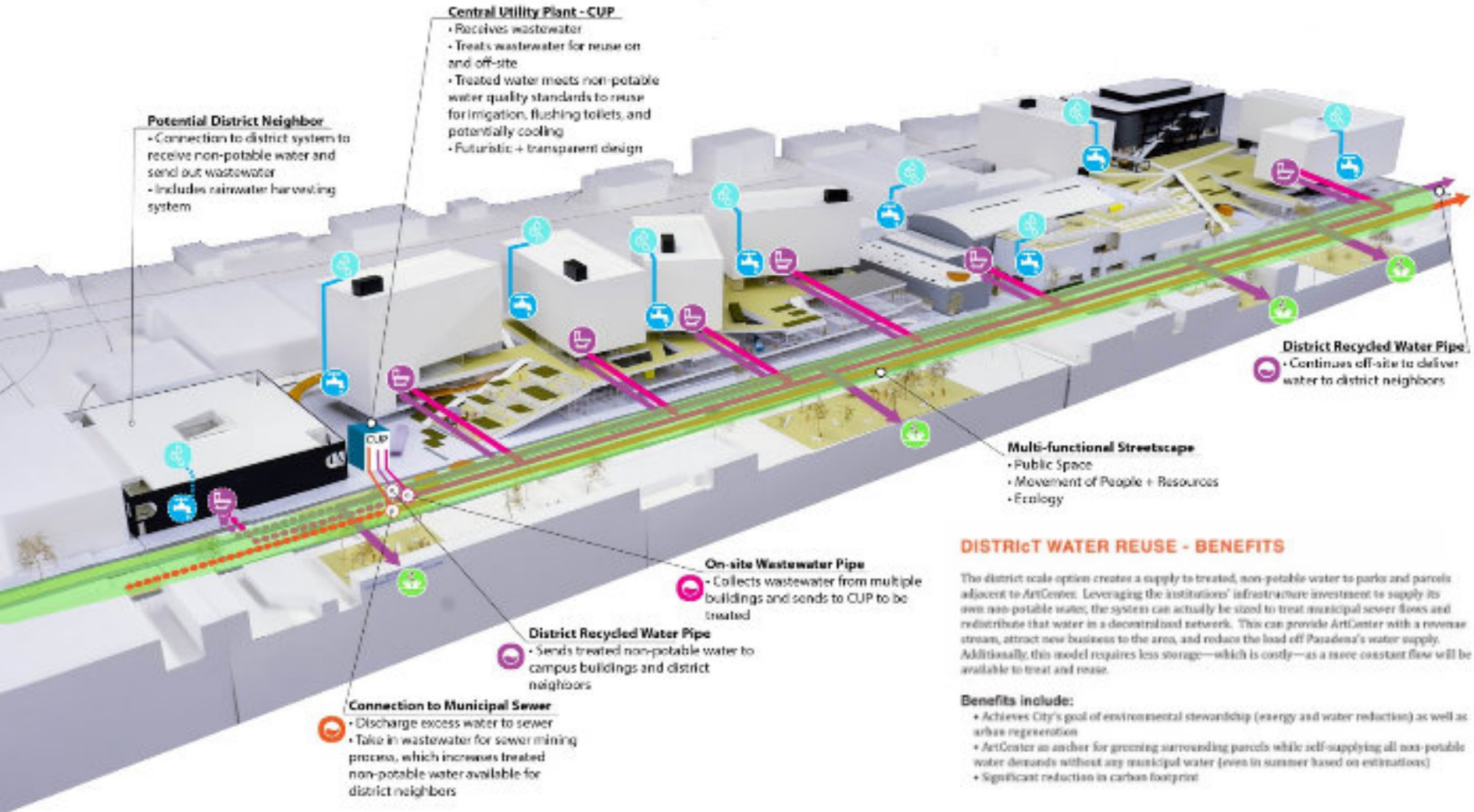


DISTRICT WATER REUSE - BENEFITS

The district scale option creates a supply to treated, non-potable water to parks and parcels adjacent to ArtCenter. Leveraging the institutions' infrastructure investment to supply its own non-potable water, the system can actually be sized to treat municipal sewer flows and redistribute that water in a decentralized network. This can provide ArtCenter with a revenue stream, attract new business to the area, and reduce the load off Pasadena's water supply. Additionally, this model requires less storage—which is costly—as a more constant flow will be available to treat and reuse.

Benefits include:

- Achieves City's goal of environmental stewardship (energy and water reduction) as well as urban regeneration
- ArtCenter as anchor for greening surrounding parcels while self-supplying all non-potable water demands without any municipal water (even in summer based on estimations)
- Significant reduction in carbon footprint


ISLAIS PARK
BG + DNC - SHERWOOD

Designing Cities with Nature






Robin Grossinger

San Francisco Estuary Institute

SSV Rains to the Bay

May 29, 2019

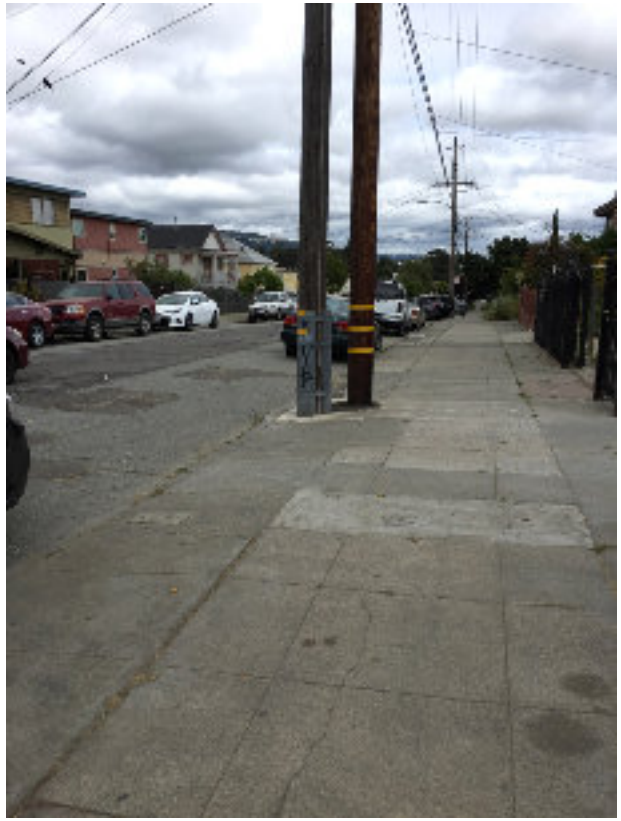
SFEI | AQUATIC SCIENCE CENTER

SAN FRANCISCO ESTUARY INSTITUTE & THE AQUATIC SCIENCE CENTER

Cities aren't great for people

- Air pollution
- Contamination and other pollutants
- Lack of social cohesion
- Urban heat island
- Sedentary lifestyles
- Crowding
- Noise & light pollution
- Flooding and other hazards

McDonald et al. 2018



Urban nature is part of the solution

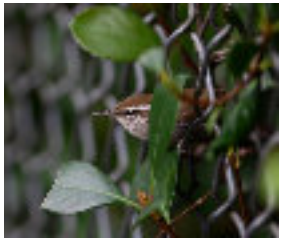
Physical health

- In LA children with a park within 500 m of home had lower BMI and better health outcomes (Wolch et al. 2011)
- US counties with higher sprawl → less walking and higher BMI (Ewing et al. 2003)

Mental health

- Proximity to nature reduces stress (lots of studies)
- In the workplace, less job stress, fewer sick days (Bjornstad et al. 2016)
- England → 50% less depression, 43% less stress in neighborhoods with 20% forest cover. 56% less anxiety at 30% forest cover (Cox et al. 2017)





Start with biodiversity

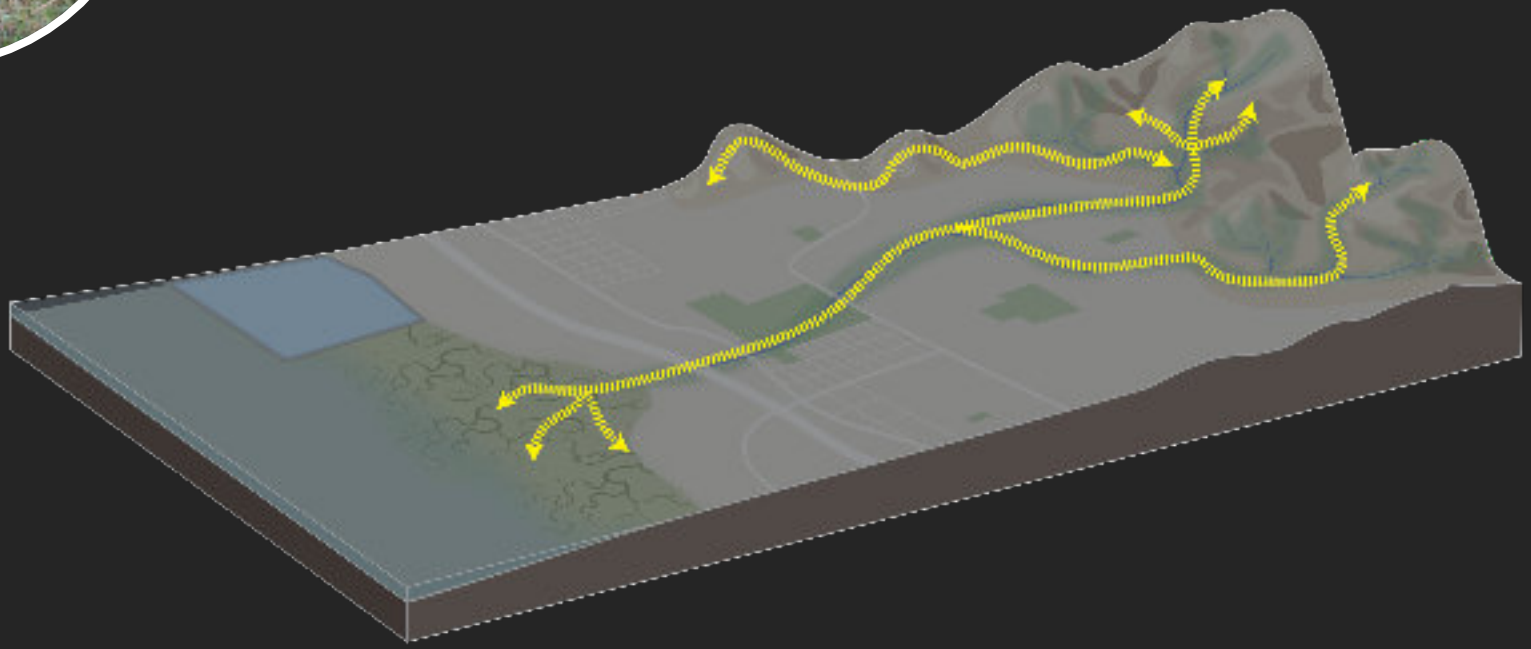
The New York Times Magazine

FEATURE

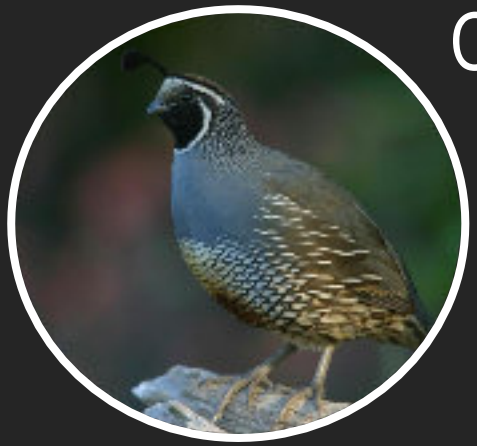
The Insect Apocalypse Is Here

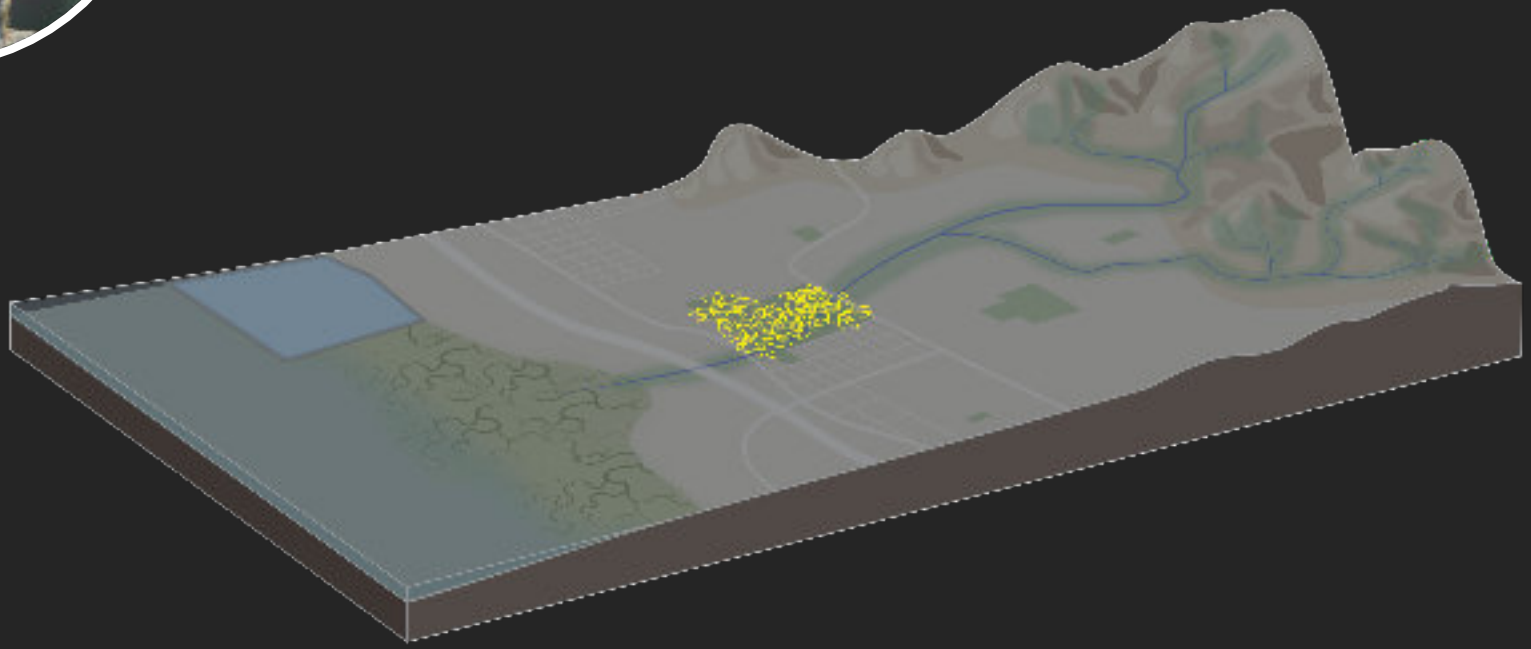
What does it mean for the rest of life on Earth?

Bobcat *(Lynx rufus)*

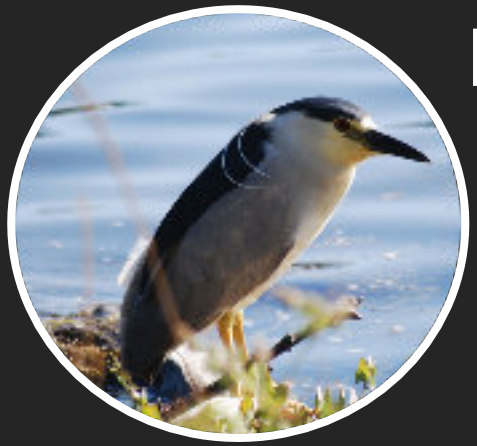


California Quail *(Callipepla californica)*

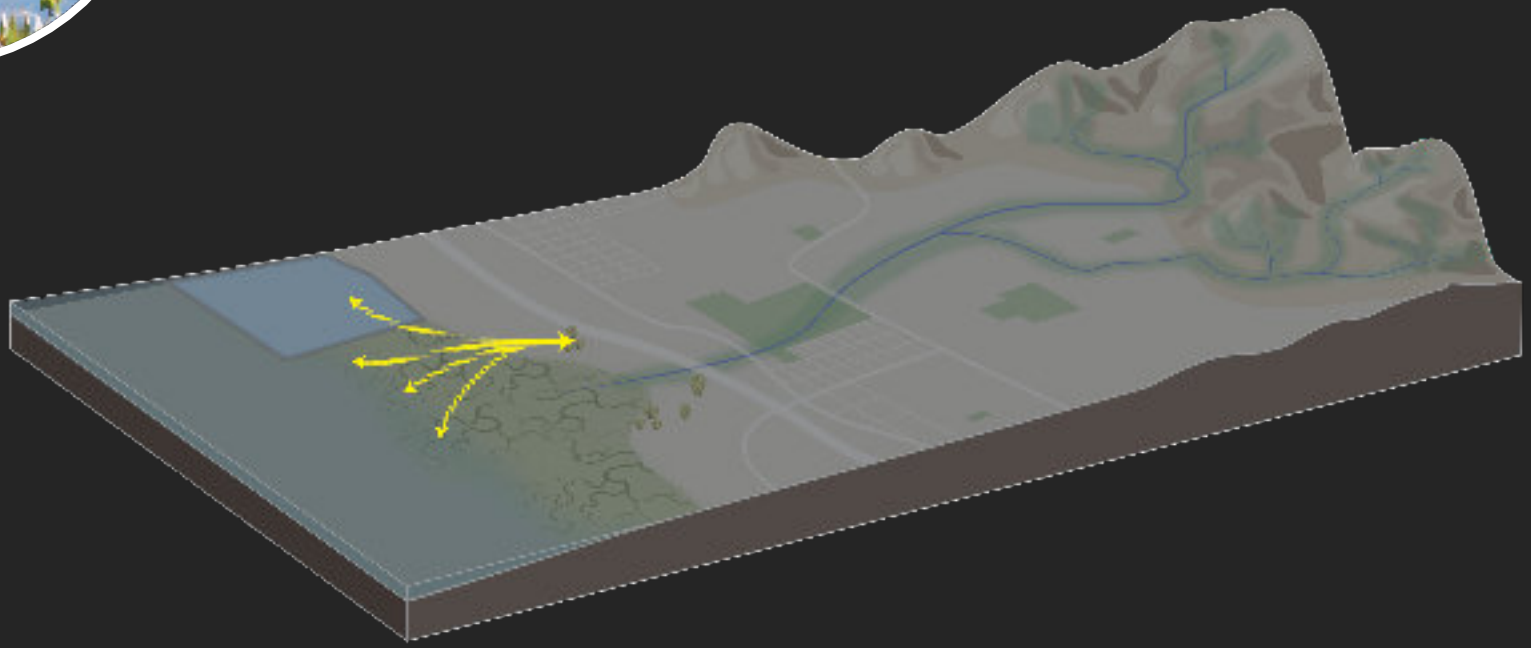




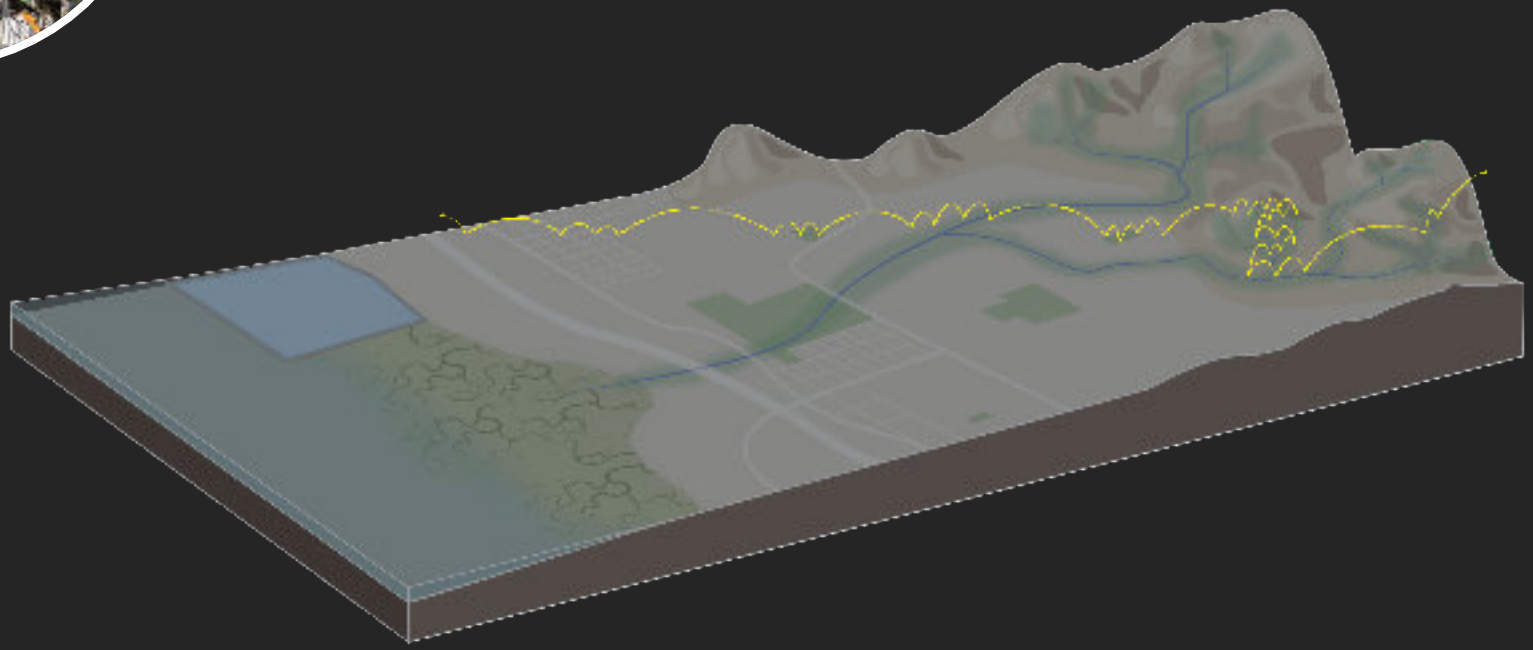
Acorn woodpecker *(Melanerpes formicivorus)*

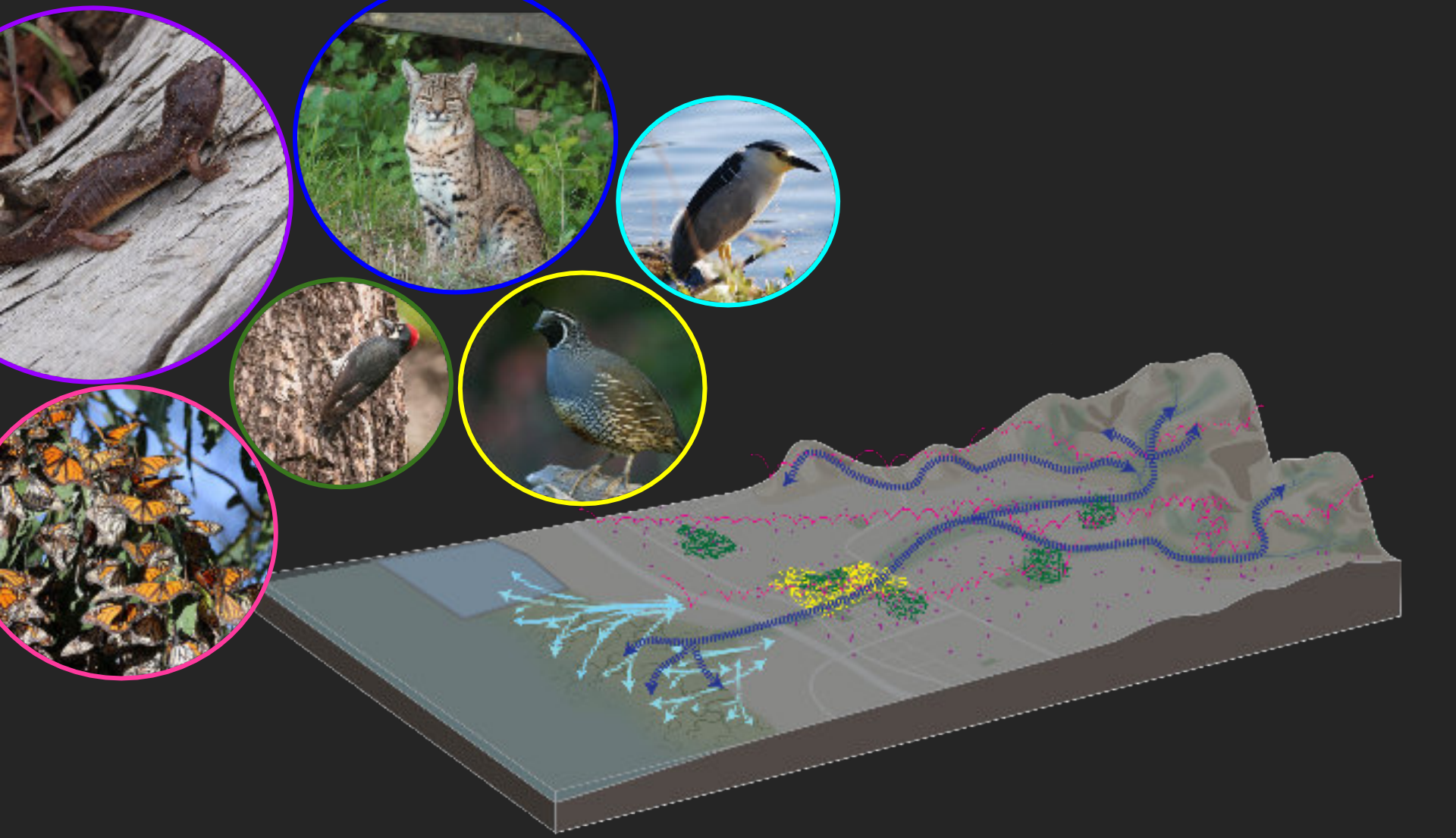


Black crowned night heron *(Nycticorax nycticorax)*



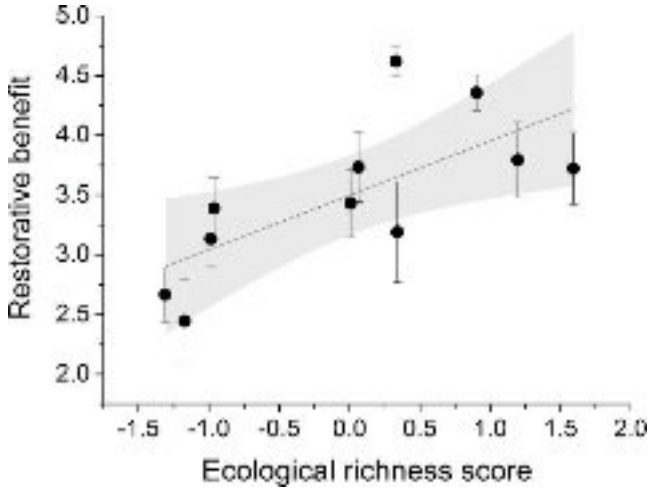
Monarch butterfly *(Danaus plexippus)*





Improving access to biodiverse nature makes communities healthier

- Green spaces provide a **wide variety of benef ts** including improved mental, physical, and social health, recreation opportunities, pollution control, aesthetic experience and greater social interaction
- Nature access is vital in supporting a healthy work environment where **people can 'switch-off'**
- **Large, accessible, & ecologically rich** □□parks deliver the most benef ts to the most people
- Creating new, high-performing green spaces has the potential to **improve the social and mental well-being** of urban communities



□ □ Wood et al. 2018

Urban Biodiversity Framework

MANAGEMENT

SPECIAL RESOURCES

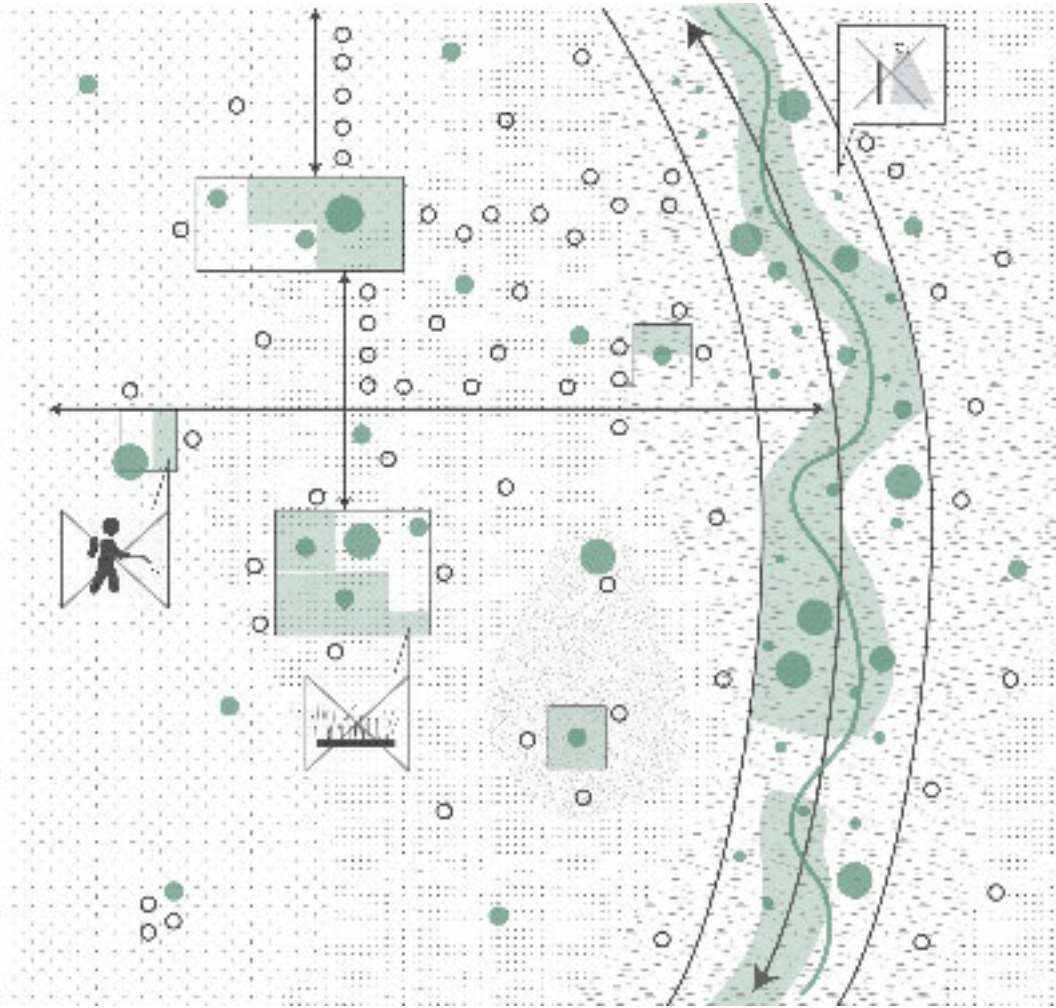
NATIVE VEGETATION
(diversity and abundance)

HABITAT DIVERSITY

MATRIX QUALITY

CONNECTIONS

PATCH SIZE



Integrated network to maximize benefits

SF Bay Shoreline Adaptation Atlas

- Released May 2
- SFEI +SPUR

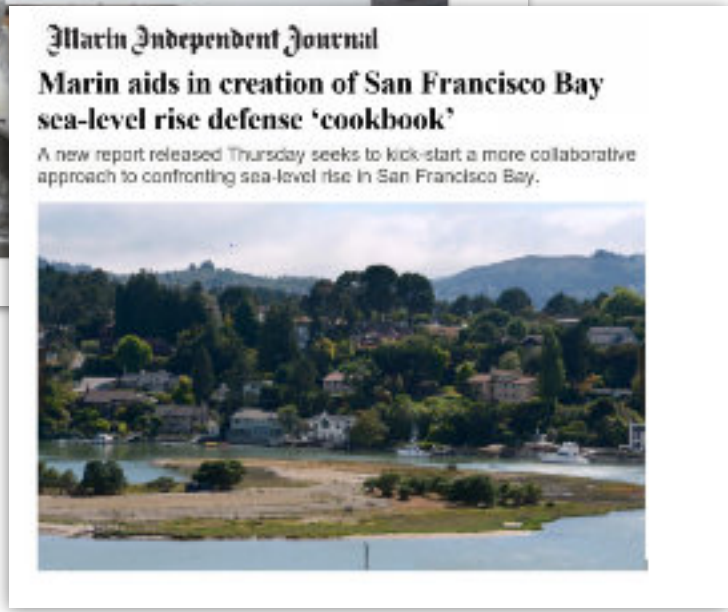
San Francisco Chronicle

Blueprint to battle Bay Area sea-level rise focuses on natural solutions

The Mercury News

San Francisco Bay: New plan to combat sea level rise

Airports, roads, office buildings, sewage treatment plants at risk



Marin Independent Journal

Marin aids in creation of San Francisco Bay sea-level rise defense 'cookbook'

A new report released Thursday seeks to kick-start a more collaborative approach to confronting sea-level rise in San Francisco Bay.

A science-based framework to identify effective adaptation strategies....

...that are appropriate for their particular settings and that take advantage of natural processes.

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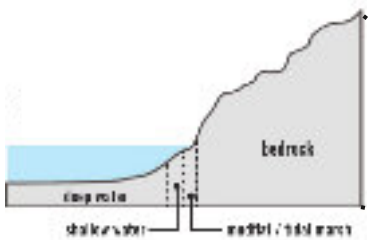
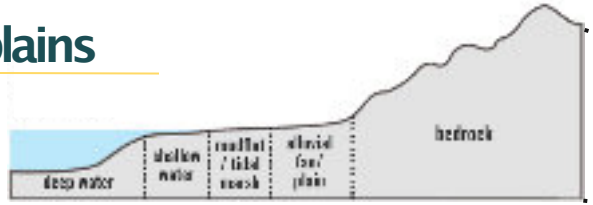
Geomorphic Unit Types

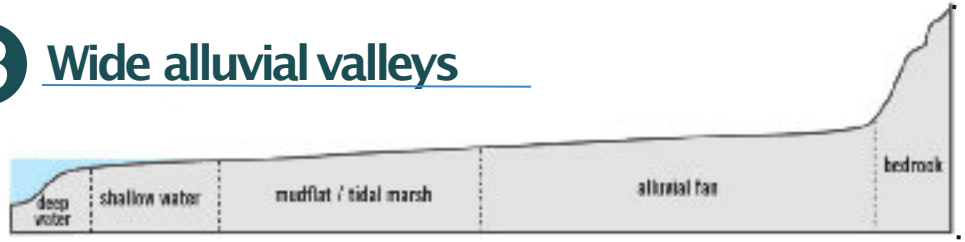
1 Headlands & small valleys

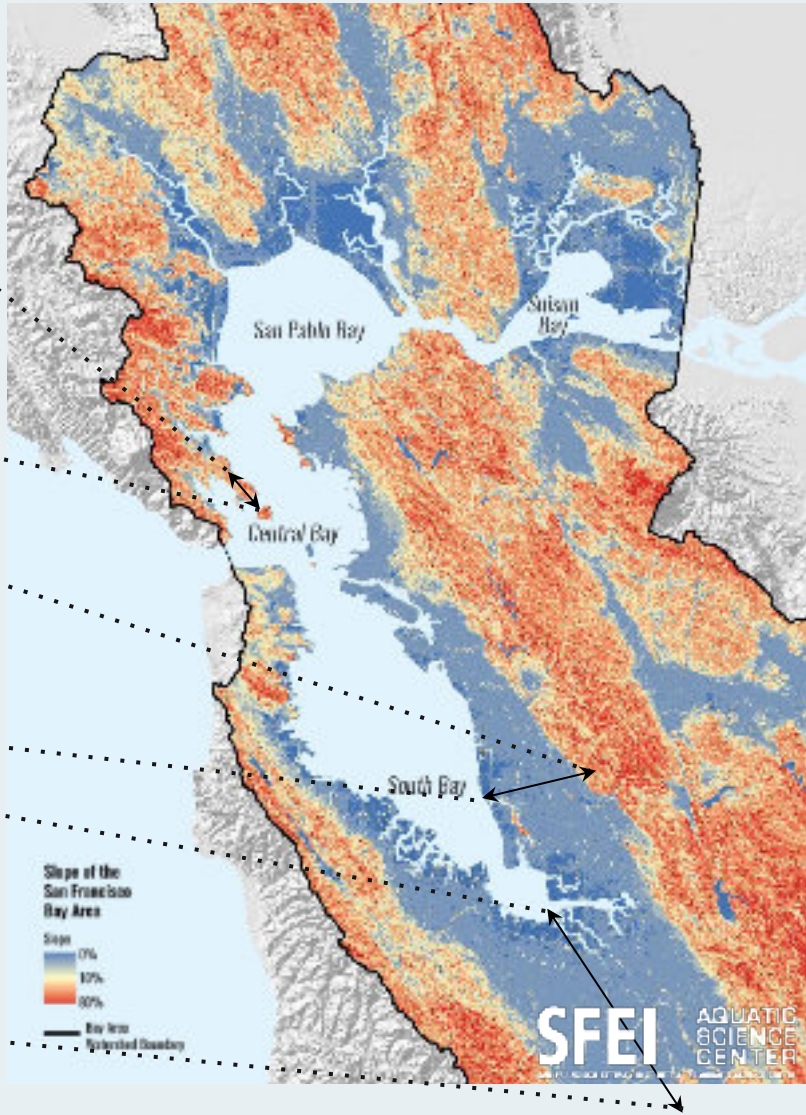


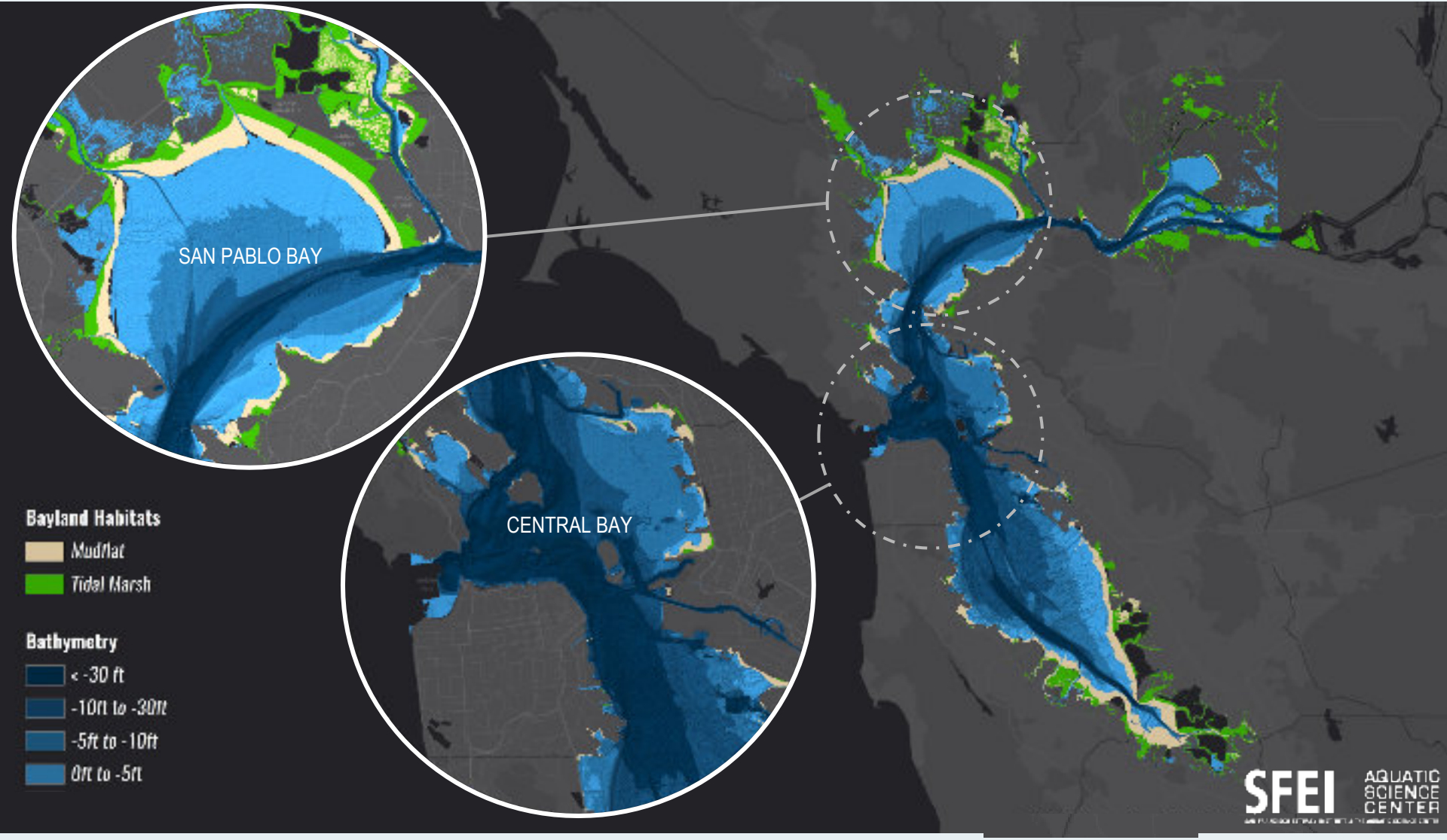
2 Alluvial fans & plains



3 Wide alluvial valleys






SAN PABLO BAY
CENTRAL BAY
Bayland Habitats
Mudflat
Tidal Marsh
Bathymetry
< -30 ft
-10ft to -30ft
-5ft to -10ft
0ft to -5ft
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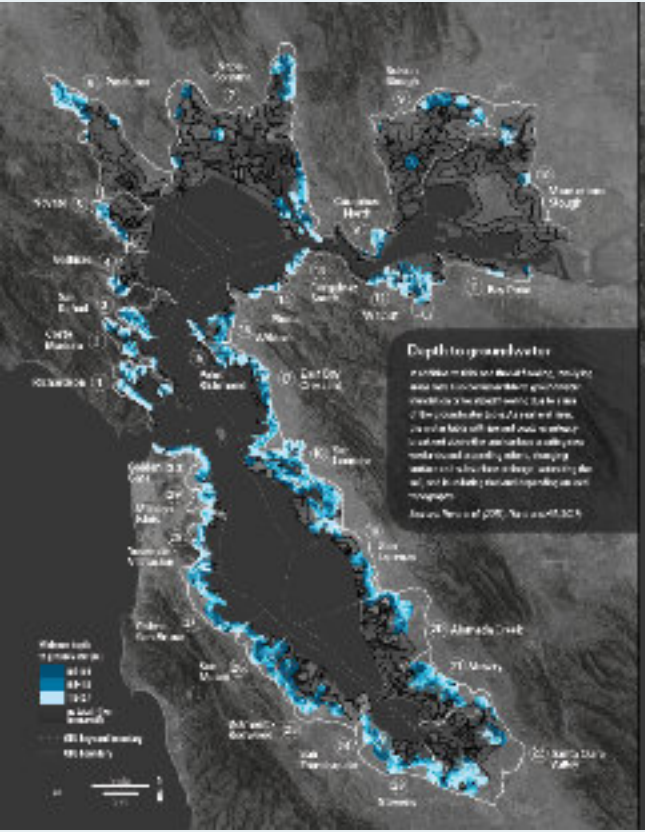
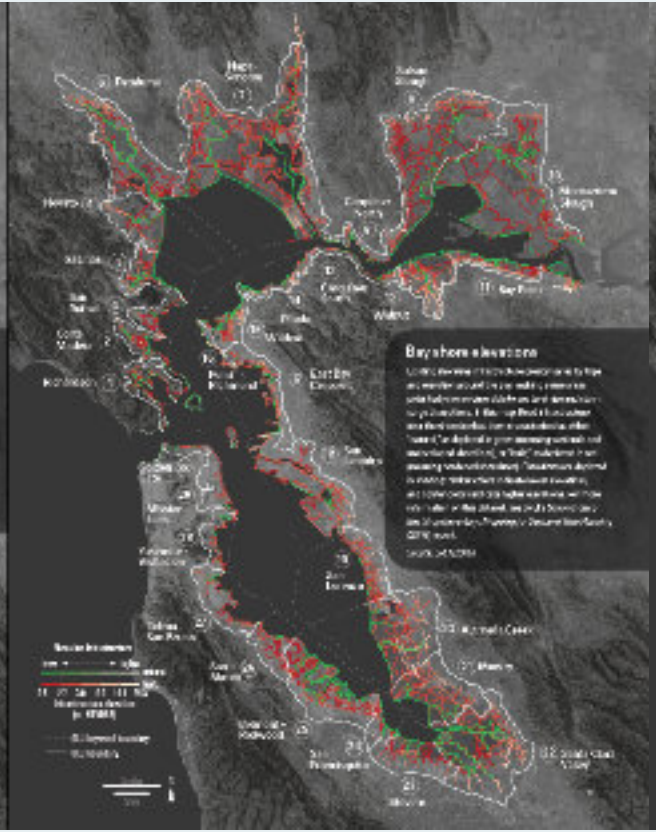
AQUATIC SCIENCE CENTER

Vulnerability

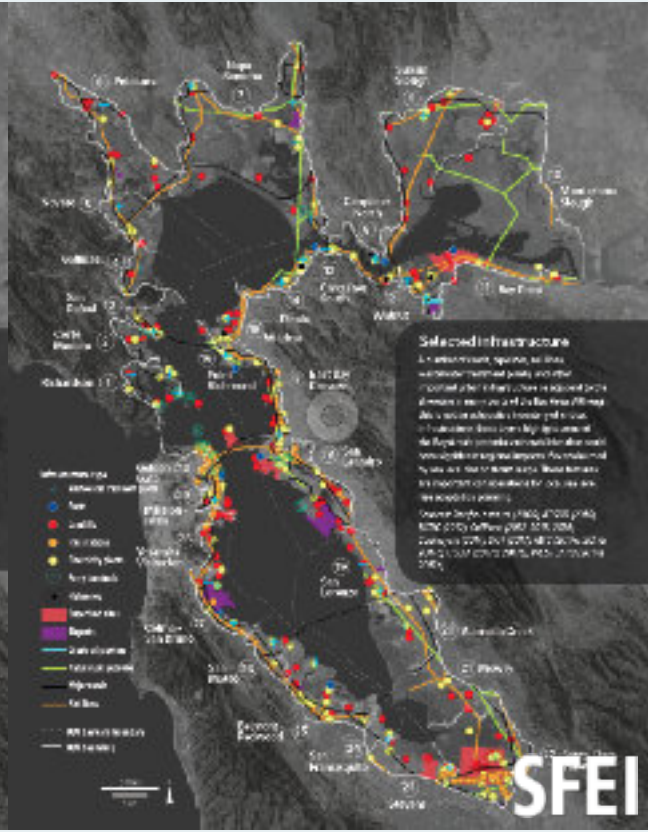
Depth to groundwater



Bay shore inventory



Infrastructure



Adaptation measures

Nature-based measures

- Nearshore reefs
- Submerged aquatic vegetation (eelgrass)
- Beaches (sand, cobble, shell)
- Tidal marshes
- Polder management
- Ecotone levees
- Migration space preparation
- Creek-to-bayland reconnections
- Green stormwater infrastructure

Regulatory, financial, policy tools

- Zoning and overlay zones
- Setbacks, buffers, and clustering
- Building codes and building retrofits
- Rebuilding and redevelopment restrictions
- Conservation easements
- Tax incentives and special assessments
- Geologic Hazard Abatement District
- Transfer of Development Rights
- Buyouts

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Suitability

of nature-based measures

Suitability Rating

- ○ Limited suitability
- ◔ Some suitability
- ● High suitability

	Nearshore reefs (p. 65)	Submerged aquatic vegetation (eelgrass) (p. 69)	Beaches (p. 72)	Tidal marshes (p. 76)	Polder management (p. 80)	Ecotone levees (p. 84)	Migration space preparation (p. 88)
1. Richardson	●	●	●	◔	○	◔	○
2. Corte Madera	●	●	●	◔	◔	◔	◔
3. San Rafael	●	●	●	◔	◔	◔	○
4. Gallinas	◔	●	○	●	●	◔	●
5. Novato	○	○	○	●	●	◔	●
6. Petaluma	○	○	○	●	●	○	●
7. Napa - Sonoma	○	○	○	●	●	◔	●
8. Corquinez North	○	○	○	●	○	◔	●
9. Suisun Slough	○	○	○	●	●	◔	●
10. Montezuma Slough	○	○	○	●	●	○	●
11. Bay Point	○	○	○	●	●	◔	●
12. Walnut	○	○	○	●	●	●	●
13. Corquinez South	○	○	○	◔	○	●	●
14. Pinole	●	○	●	◔	○	◔	○
15. Wildcat	●	●	●	●	◔	●	●
16. Point Richmond	●	●	●	○	○	○	○
17. East Bay Crescent	●	●	●	◔	○	●	○
18. San Leandro	○	●	●	◔	◔	○	○
19. San Lorenzo	○	●	●	●	◔	●	◔
20. Alameda Creek	○	○	●	●	●	●	●
21. Newry	○	○	○	●	●	●	●
22. Santa Clara Valley	○	○	○	●	●	●	●
23. Stevens	◔	○	○	●	●	◔	◔
24. San Francisquito	●	○	○	●	◔	●	◔
25. Belmont - Redwood	○	○	●	●	●	●	○
26. San Mateo	○	●	●	◔	◔	◔	○
27. Colma - San Bruno	○	●	●	◔	○	◔	○
28. Yosemite - Visitacion	●	●	●	○	◔	○	○
29. Mission - Islais	○	●	●	○	○	○	○
30. Golden Gate	○	○	●	○	○	○	○

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Nature's Boundaries

Operational Landscape Units

Areas with shared geophysical and land use characteristics ***suited for a particular suite of nature-based measures***

- ***Bigger than a project***
- ***Bigger than a City***
- ***Smaller than a County***

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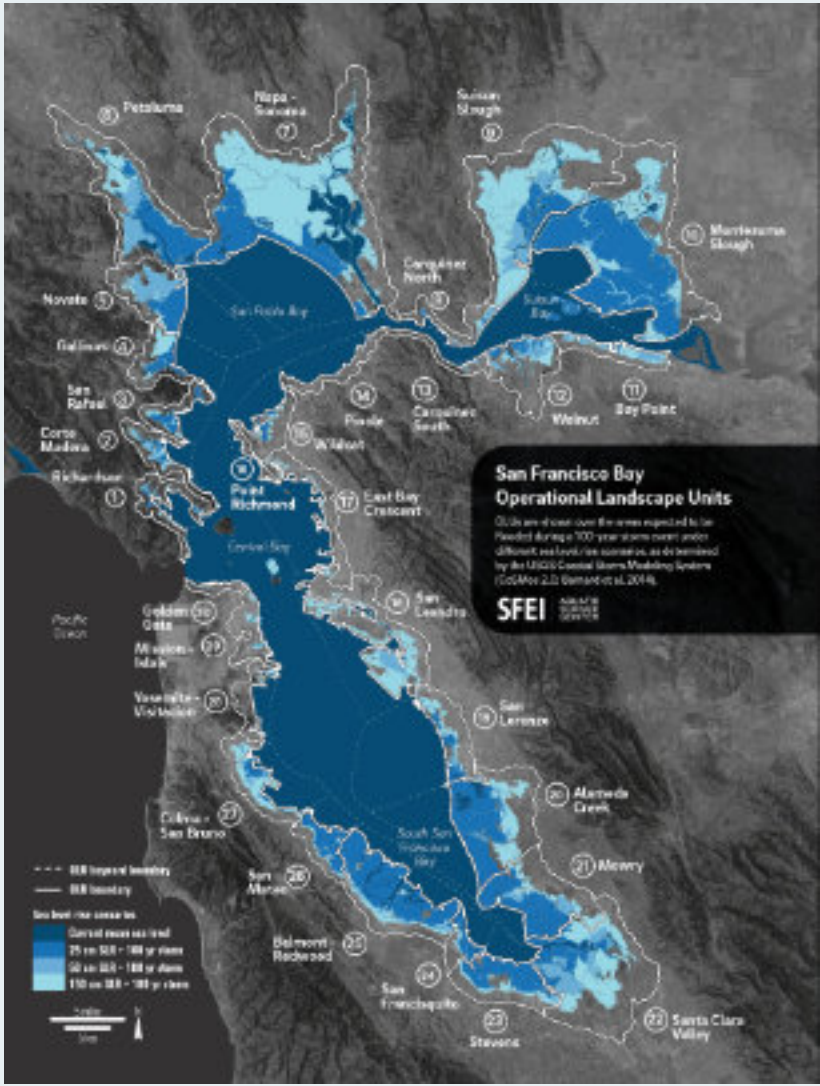
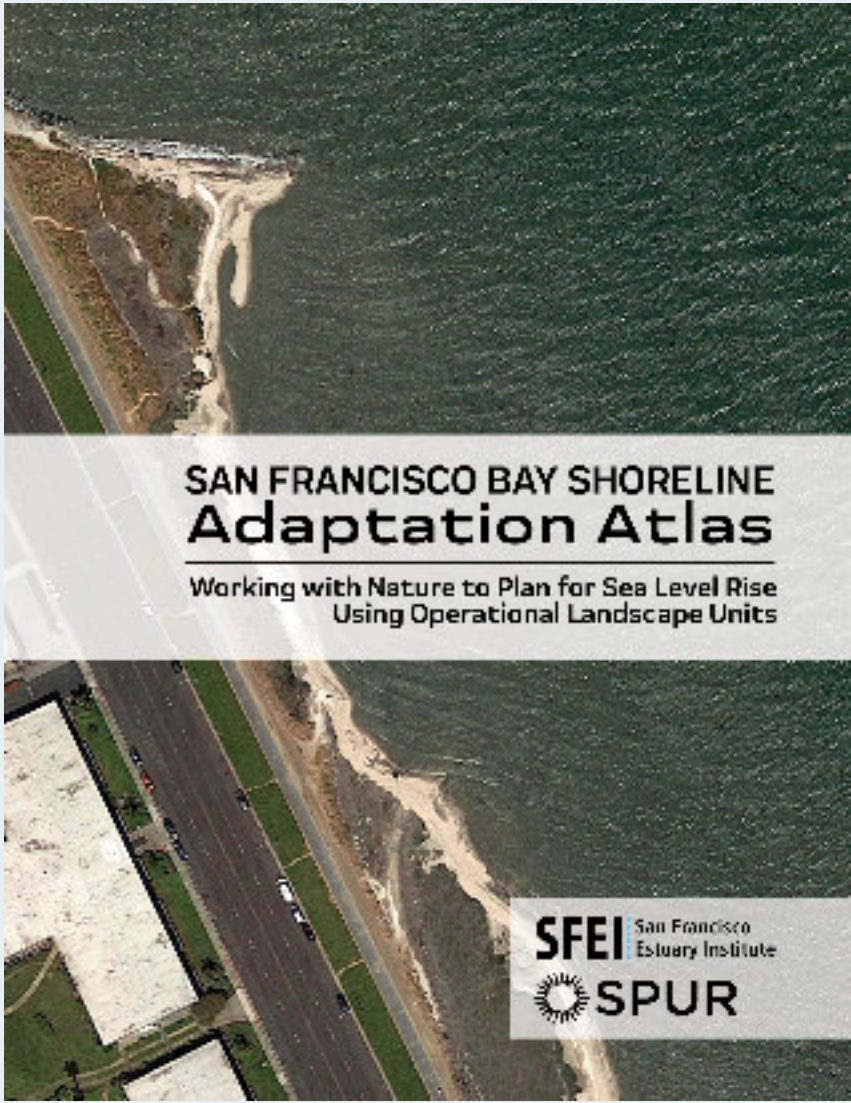
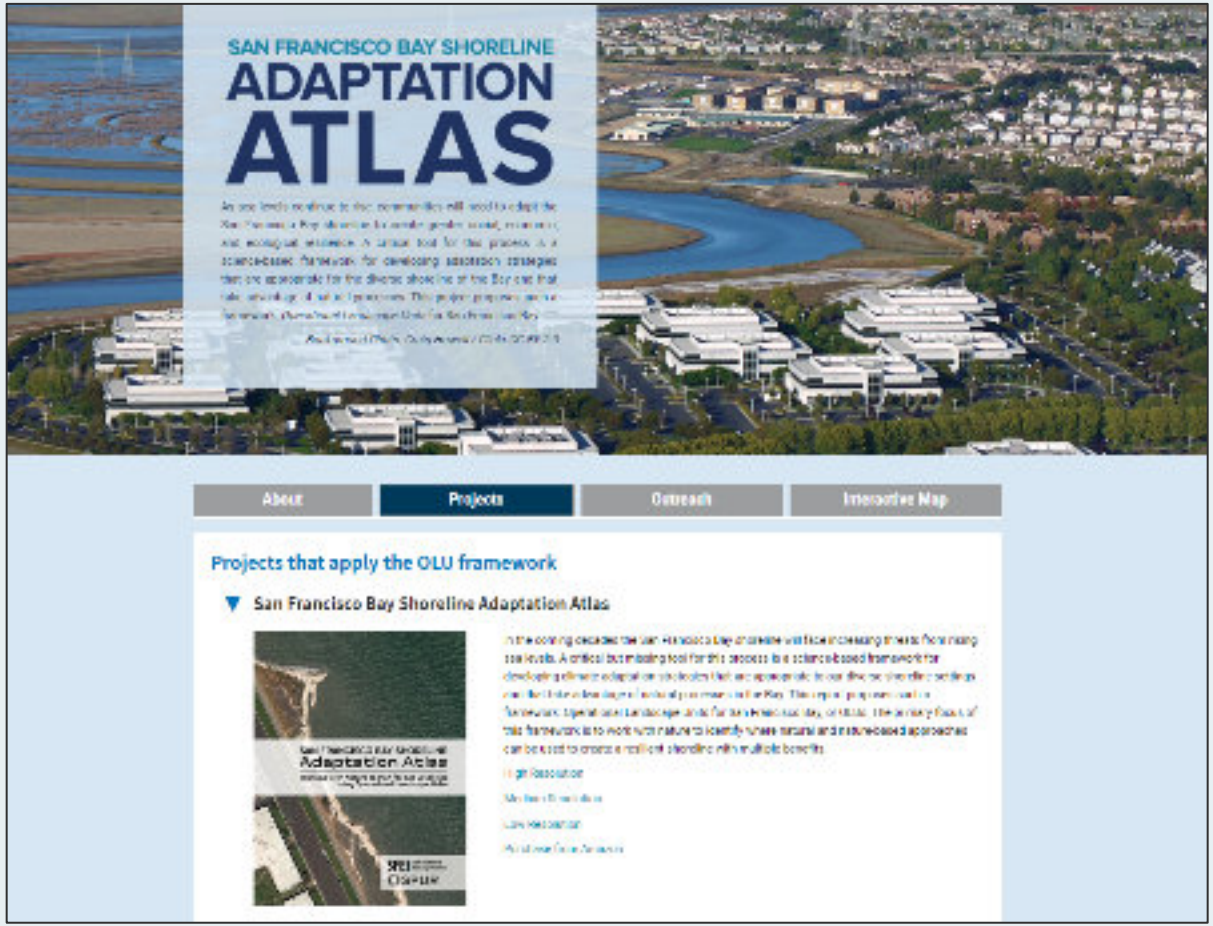


Who is using this?

- **BCDC using OLUs as their unit of analysis for ART Bay Area**
- **San Mateo and Marin Counties using OLUs to gather stakeholders, begin adaptation planning, create scenarios of future shorelines**
- **Local cities doing adaptation planning**



Download the report at
sfei.org/adaptationprojects



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NATURAL SYSTEMS UTILITIES

A BETTER WAY

Leading the country in onsite water treatment and reuse solutions

May 29th, 2019

30+ Year Onsite Water Reuse History

1st Pharmaceutical Onsite Water Reuse system in the US.

250,000+ GPD on-site water reuse system for New England Patriots at Gillette Stadium

District scale redevelopment with in-building **water reuse** & **thermal energy recovery** systems at Durst Halletts Point

1980

Princeton, NJ

East Amwell, NJ

Battery Park, NY

New York, NY

New York, NY

Alberta, Canada

Queens, NY

Mountain View, CA

2020

1st public school water reuse system implemented at Copper Hill

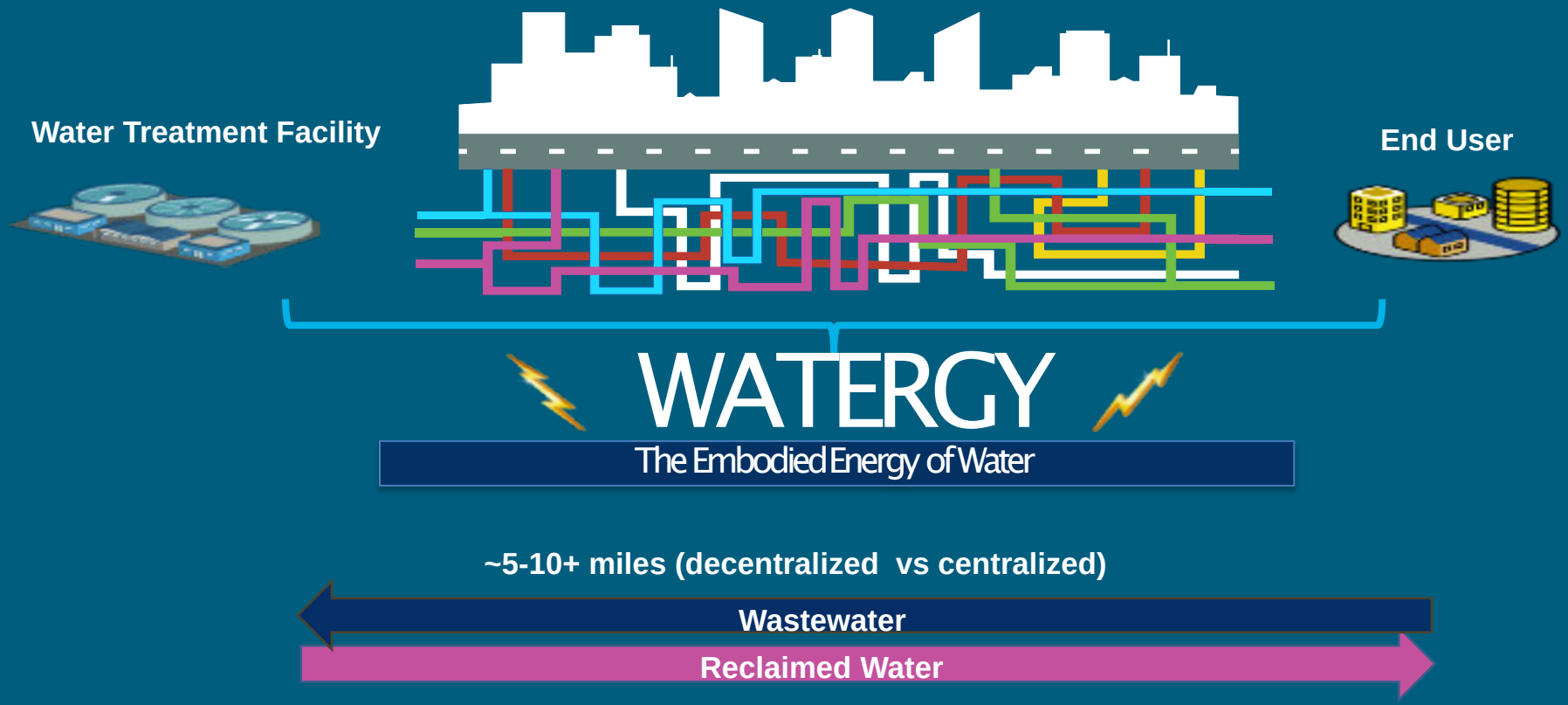
1st in-building water reuse system for residential high-rise in the US

40,000+ GPD water treatment & reuse for flushwater, cooling, irrigation & laundry at New School University

Integrated **water reuse** & **heat recovery** at MacDonald Island

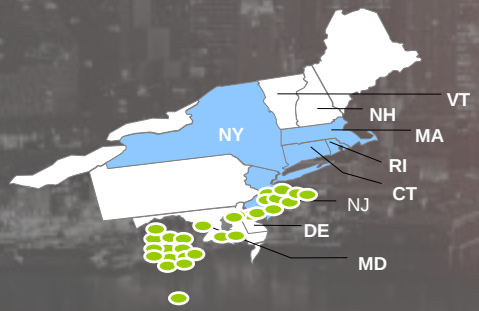
Microsoft Silicon Campus
1st Net Zero Water Tech Campus

Decentralized & Centralized Infrastructure Synergy



Resiliency of Onsite/Decentralized Systems

Lessons Learned from Super-storm Sandy



= NSU project location

80 systems within area impacted by Super-Storm Sandy.

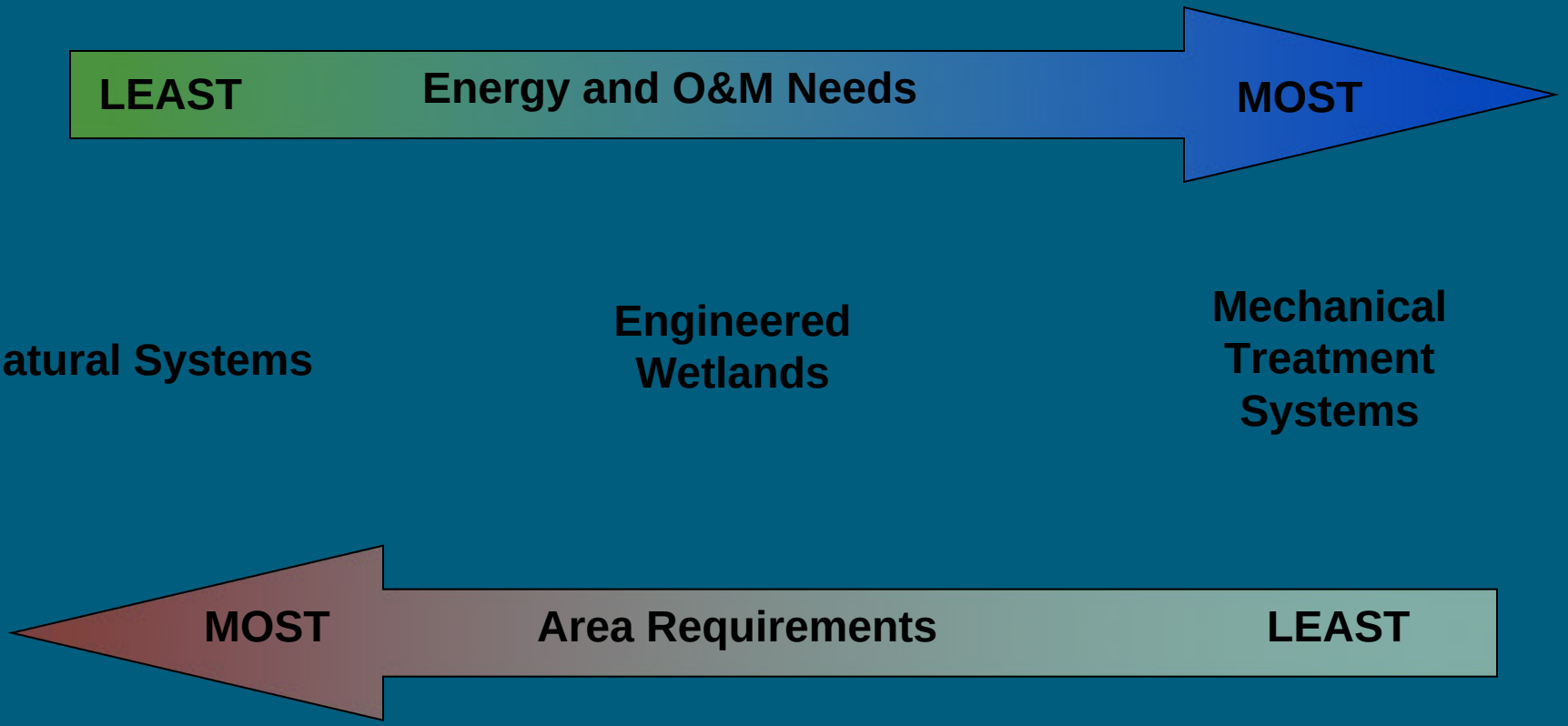
<u>ZERO</u> onsite facilities exceeded eff uent permit requirements while many centralized facilities were down for weeks or longer discharging untreated sanitary wastewater into the local water bodies.

Case Study of Integrated Systems: Battery Park, NYC

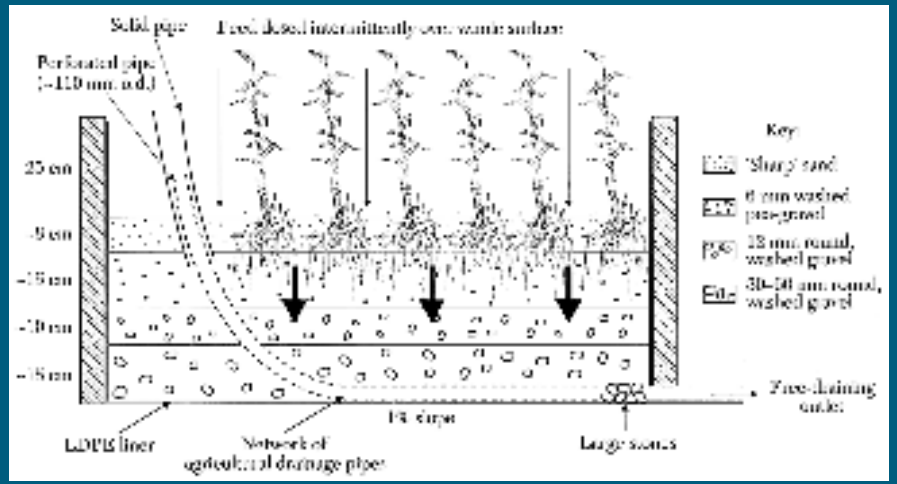
- **Six (6)** in-building water reuse systems serving **eight (8)** buildings in BPC.
- **>2,000 residents** who are capable of reusing ~**200,000 gpd** of renewable water sources
- **15 years** of operating data. **ZERO permit exceedances** and **ZERO user complaints / public health concerns**
- Achieving **>55% Water Use Reduction.** Reduced strain on municipal/centralized infrastructure
- Achieving **>65% Sewer Discharge Reduction.** Reduced environmental impacts due to combined sewer overflows
- **Net-Zero** and **net-positive** energy systems now possible with thermal energy recovery
- **Improved resiliency** in wastewater treatment and water supply

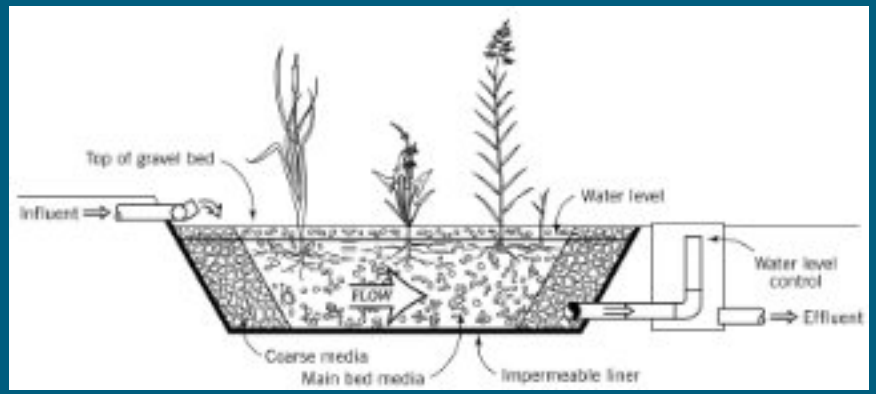
Source: Perkins Eastman

Natural vs Mechanical Systems



Designing with Nature (Wetland Systems)





Microsoft –Silicon Valley (Hybrid System)

15 acres, 643,000 SF
2,000 Employees

Onsite Water Reuse

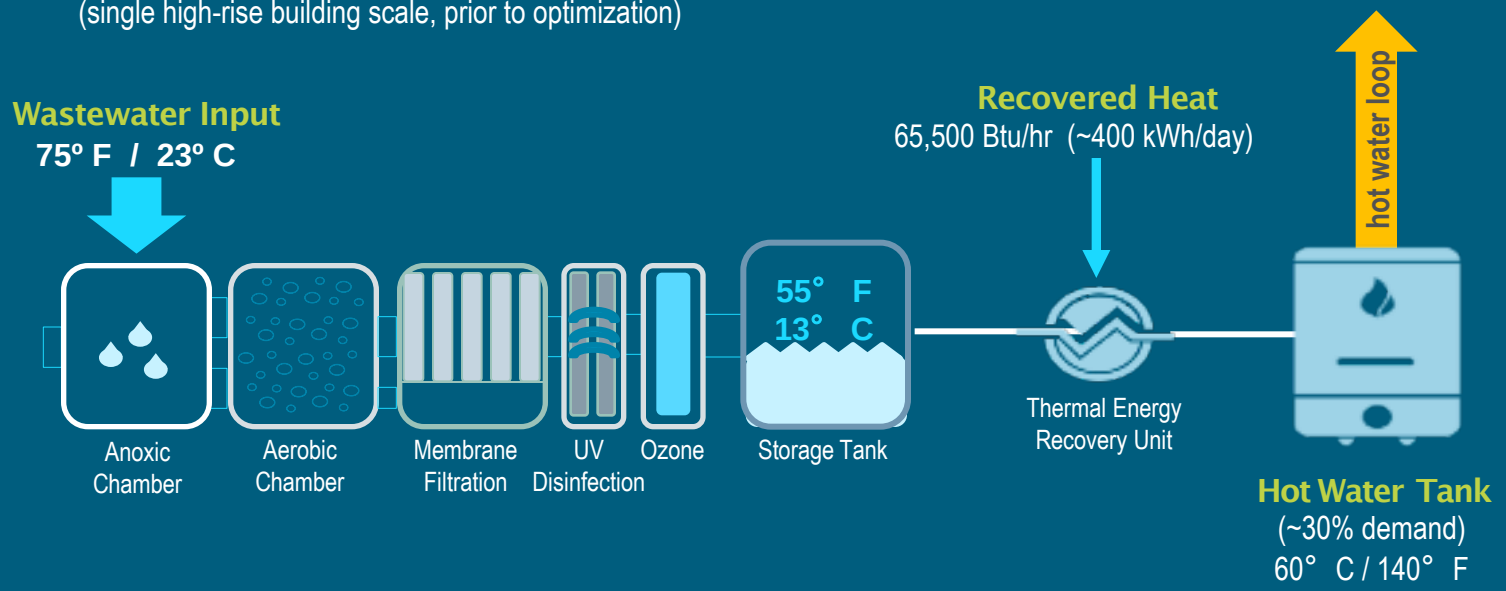
- Wastewater Treatment and Reuse
- Rainwater Treatment and Reuse
- 55% Water Use Reduction
- 4 MGY Potable Use Savings
- 100% of wastewater reused onsite (Net Zero Non-Potable Water Use)

Project Drivers

- Regional water challenges
- Creating a strong connection to the local community
- Employee Experience
- LBC / LEED / WELL

Water-Energy Nexus (Onsite Thermal Energy Recovery)

Electric Energy for Treatment
5% of building demands or 350 kWh/day
(single high-rise building scale, prior to optimization)



Water reuse systems can now become **net energy neutral** and net energy positive at the high-rise building scale or larger

Peter Haase

PE, Principal Engineer, Fall Creek Engineering

FALL CREEK ENGINEERING

SHERWOOD DESIGN ENGINEERS COMPANY

SUSTAINABLE SILICON VALLEY

Designing w/ Water

Josiah Cain

Director of Innovation, Sherwood Design Engineers, *Moderator*

Robin Grossinger

Senior Scientist, San Francisco Estuary Institute; Co-Director, Resilient Landscapes Program

Zach Gallagher

PE, Executive Vice President, Natural Systems Utilities

Peter Haase

PE, Principal Engineer, Fall Creek Engineering

SUSTAINABLE SILICON VALLEY