Designing w/ Water

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Run-off will be treated through a series of terraced filtration swales before entering the canals.
URBAN HEAT ISLAND EFFECT
MITIGATION STRATEGIES: COOL ROOFS / IRRIGATION

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.

<table>
<thead>
<tr>
<th>Water usage (m³ m⁻²)</th>
<th>No-irrigation</th>
<th>Daily constant</th>
<th>Soil-moisture-controlled</th>
<th>Soil-temperature-controlled</th>
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<td>Energy consumption</td>
<td>(kWh m⁻²)</td>
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<td>Annual total cost</td>
<td>($ m⁻²)</td>
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</table>
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
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.
**CENTRAL UTILITY PLANT - CUP**
- Receives wastewater
- Treats wastewater for reuse on and off-site
- Trated water meets non-potable water quality standards to reuse for irrigation, flushing toilets, and potentially cooling
- Futuristic, transparent design

**POTENTIAL DISTRICT NEIGHBOR**
- Connection to district system to receive non-potable water and send out wastewater
- Includes rainwater harvesting system

**DISTRICT RECYCLED WATER PIPE**
- Continues off-site to deliver water to district neighbors

**MULTIFUNCTIONAL STREETSCAPE**
- Public Space
- Movement of People + Resources
- Ecology

**DISTRICT WATER REUSE - BENEFITS**
This district-scale option creates a supply of treated, non-potable water to parks and parcels adjacent to ArtCenter. Leveraging the institution’s 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 greening
- 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
Designing Cities with Nature

Robin Grossinger
San Francisco Estuary Institute

SSV Rains to the Bay
May 29, 2019
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
Bobcat \textit{(Lynx rufus)}
California Quail (Callipepla californica)
Acorn woodpecker \textit{(Melanerpes formicivorus)}
Black crowned night heron \textit{(Nycticorax nycticorax)}
Monarch butterfly  (*Danaus plexippus*)
Green spaces provide a wide variety of benefits 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 benefits to the most people.

Creating new, high-performing green spaces has the potential to improve the social and mental well-being of urban communities.

Improving access to biodiverse nature makes communities healthier.

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

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

1. Headlands & small valleys
2. Alluvial fans & plains
3. Wide alluvial valleys
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
Suitability of nature-based measures

<table>
<thead>
<tr>
<th></th>
<th>Nearshore reefs (p. 35)</th>
<th>Submerged aquatic vegetation (p. 59)</th>
<th>Beaches (p. 27)</th>
<th>Tidal marshes (p. 20)</th>
<th>Pellet management (p. 50)</th>
<th>Eutane leaves (p. 54)</th>
<th>Migration space preparations (p. 80)</th>
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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
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
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

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

30+ Year Onsite Water Reuse History

1980

Princeton, NJ

East Amwell, NJ

Battery Park, NY

New York, NY

Alberta, Canada

Queens, NY

Mountain View, CA

2020
Decentralized & Centralized Infrastructure Synergy

Water Treatment Facility

End User

~5-10+ miles (decentralized vs centralized)

Wastewater

Reclaimed Water

The Embodied Energy of Water

WATERGY
80 systems within area impacted by Super-Storm Sandy.

ZERO onsite facilities exceeded effluent 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

- LEAST: Energy and O&M Needs
- MOST: Area Requirements

Natural Systems
Engineered Wetlands
Mechanical Treatment Systems

Energy and O&M Needs
Area Requirements
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)

Wastewater Input
75° F / 23° C

Recovered Heat
65,500 Btu/hr (~400 kWh/day)

Anoxic Chamber
Aerobic Chamber
Membrane Filtration
UV Disinfection
Ozone
Storage Tank
Hot Water Tank
(~30% demand)
60° C / 140° F

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