

REDEFINING AND EXPANDING RESTORATION OPPORTUNITIES FOR URBAN AREAS

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www.uedlab.yale.edu

REDEFINING AND EXPANDING RESTORATION OPPORTUNITIES FOR THE CITY

- Expanding the practice
- Defining aesthetics and function
- Linking restoration ecology with communities

EXPANDING THE PRACTICE

Shifting focus to where funding exists and expanding the scope



Invasive species management



Habitat restoration

Traditional Restoration



Architecture and building systems



Stormwater Green infrastructure

Industry and infrastructure replacement

Planting for public health



Public parkland

Proposed Restoration

Restoration ecologists are increasingly recognizing the need to expand their approaches making this shift but also in a process of defining how restoration ecological functions.



Top photo by A. Eckert. Bottom by S. Smith

What are ways that we can expand restoration into other practices

- Increasing the role of restoration ecologists in society will require taking on more risk and ethical challenges at multiple levels (project siting and scope, stakeholder and local negotiations, project design and aesthetic).
- bridge across theory and practice / basic and applied science: the world needs more restoration ecologists.
- Restoration ecologists can learn from other fields already involved in building projects (e.g. engineers and designers).

Indian Bend, Scottsdale AZ

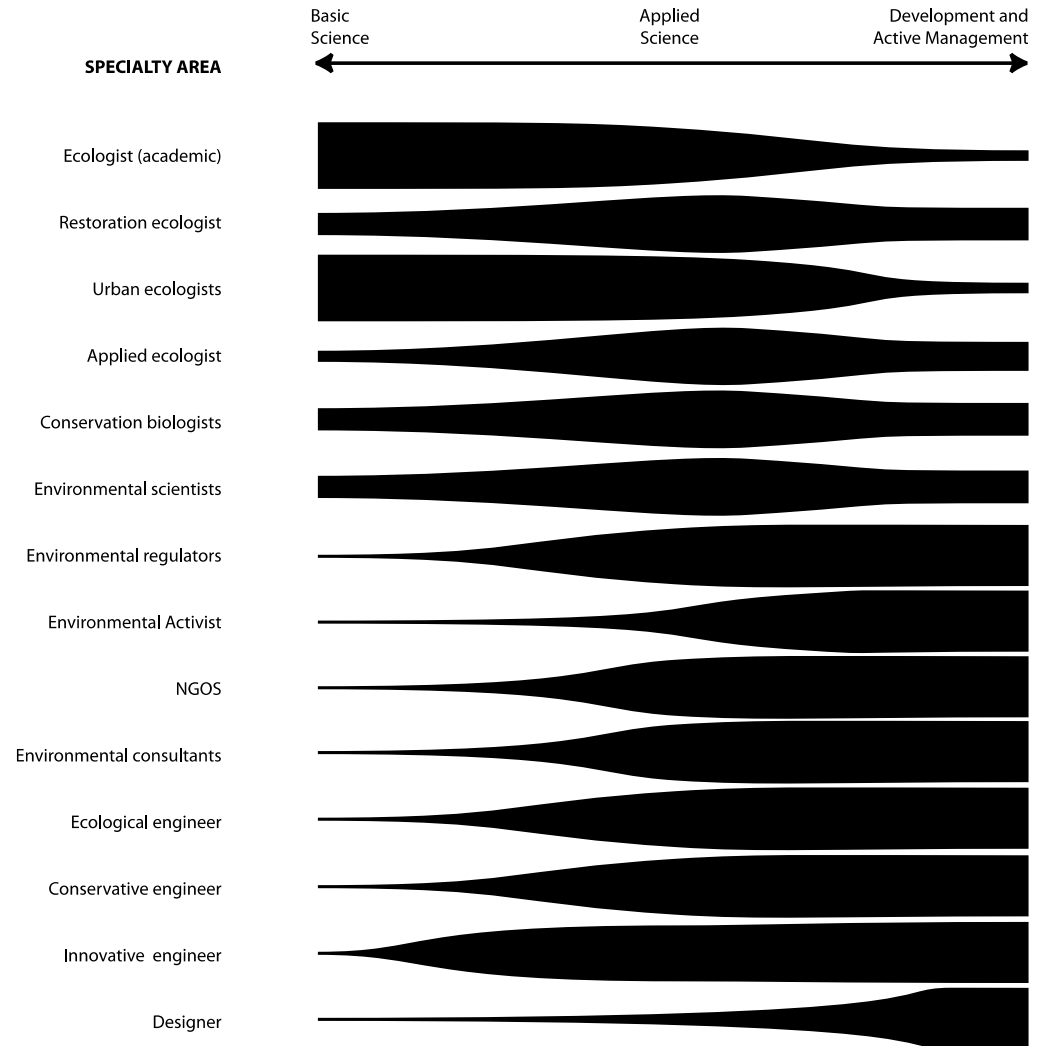
Coordinating with city infrastructure and altered conditions and maintenance challenges and needs



Restoration ecology is uniquely placed

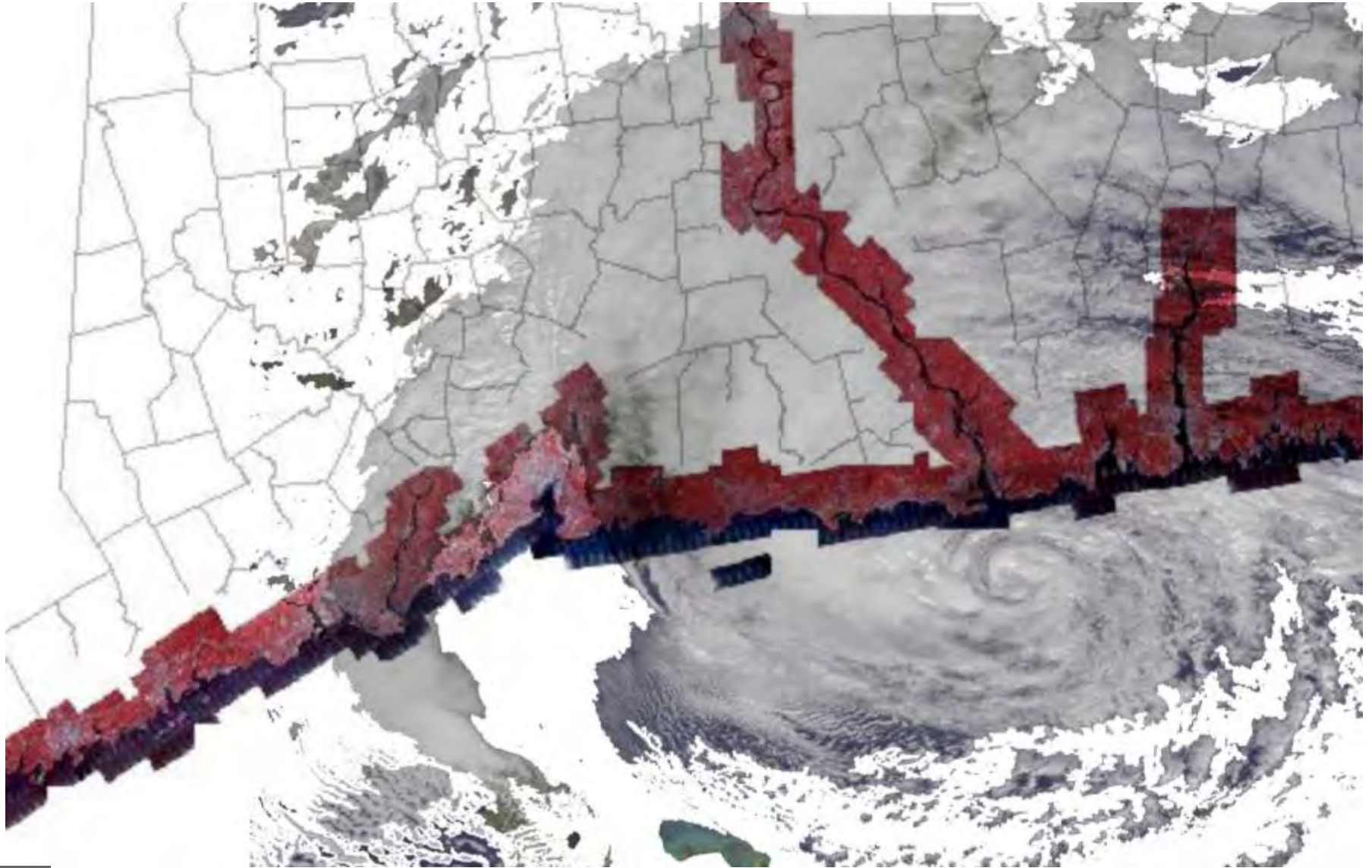
- provides some of the best answers within a complex and often poorly understood systems.
- Builds on agriculture and construction practices.
- Seeks to apply theory and scientific knowledge and research.
- Restoration ecology has a unique heritage and breadth of practice.

Applied Science to Project Development Spectrum



EXPANDING THE PRACTICE

Coastal Adaptation



Vulnerable coastal areas



1) CRITICAL INFRASTRUCTURE LOCATED ON LOW-LYING BANKS OF ESTUARIES



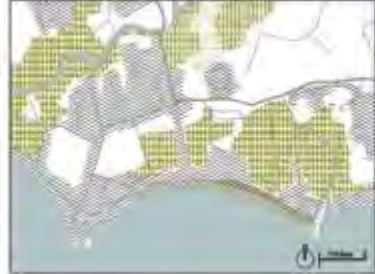
2) MARSH FRINGE/FILL WITH LOW DENSITY DEVELOPMENT



3) VULNERABLE CONNECTIVITY: POTENTIALLY ISOLATED PENINSULAS AND IMPOUNDED MARSHES



4) EXPOSED BEACH BACKED BY MARSH



5) DENSE URBAN AREAS IN LOW-LYING FLOODPLAINS



Manage risk → Create resilience

Status quo, problem solving, reactionary

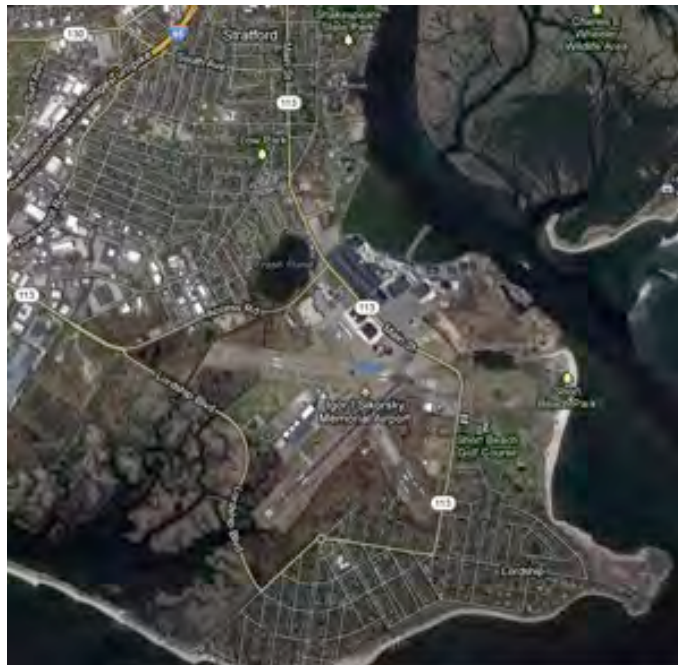


Interdisciplinary, innovative, preventative



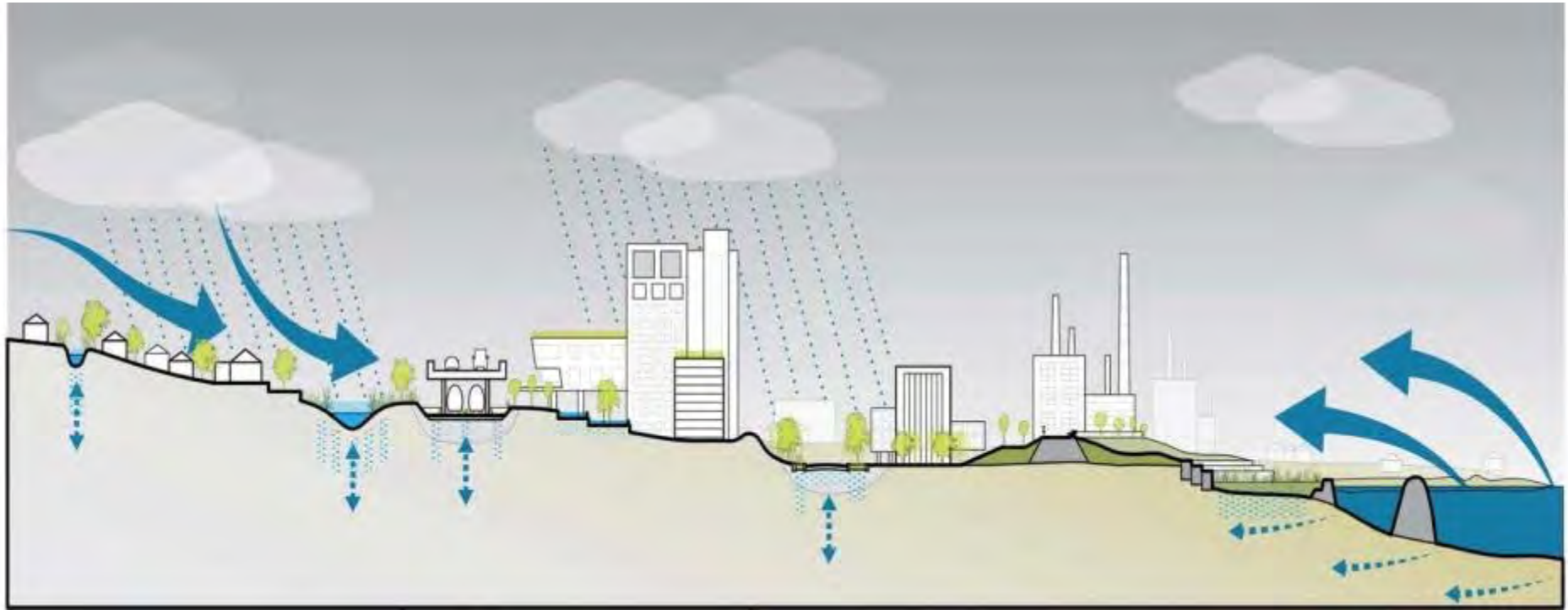
Giny Fullam - Irene

Sikorsky Airport



2080 Sea level rise & Marsh Migration NOAA / TNC

- High confidence
- Less confidence
- Open to migration
- Migration constrained



RIPARIAN WATERSHEDS

RIVER/WATERSHED
 RESTORATION STREAM
 DAYLIGHTING
 STREAM CAPACITY
 ENHANCEMENT PARK-TO-
 RIPARIAN CORRIDOR
 CONNECTIONS

URBAN STORMWATER

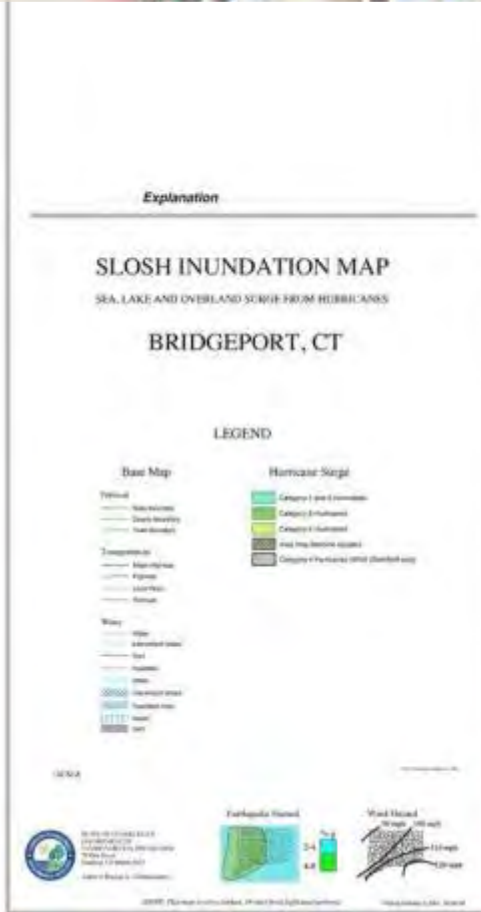
GREEN
 DRAINAGE CSO
 SEPARATION
 FLOOD-PROOF/ELEVATED
 BUILDINGS CROSS-CITY
 CONNECTIONS/
 NETWORKS

COASTAL STORMS & SEA LEVEL RISE

SHORELINE STABILIZATION
 AND ENHANCEMENT
 BERMS AND STORM SURGE BARRIERS
 CRITICAL FACILITIES PROTECTION
 RELOCATION OF FLOOD PLAIN
 DEVELOPMENT



CLAIM THE EDGE, CONNECT THE CENTER

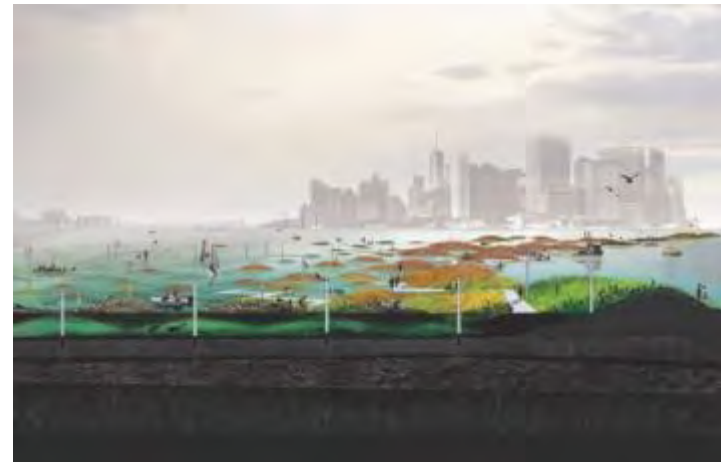


EXPANDING THE PRACTICE



Example of innovation

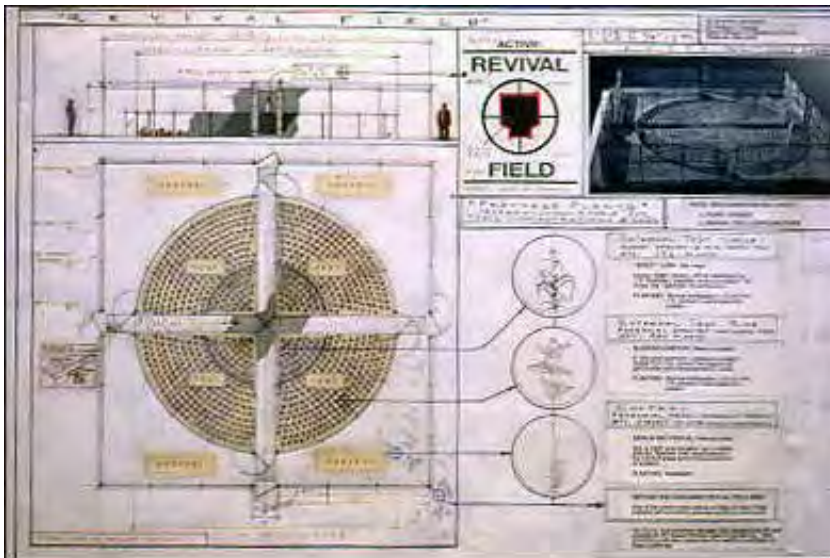
Scape – Oyster ‘scape MOMA Rising Currents Exhibit



EXPANDING THE PRACTICE

Growing Our Expertise and Making Compromises

- Take risks and identifying where to compromise
- Work collaboratively with interdisciplinary teams
- Rethink reference ecosystems and historic landscapes to guide their approach
- Develop multifunctional landscapes with restoration as a component
- Build restoration into multiple areas (e.g. infrastructure)

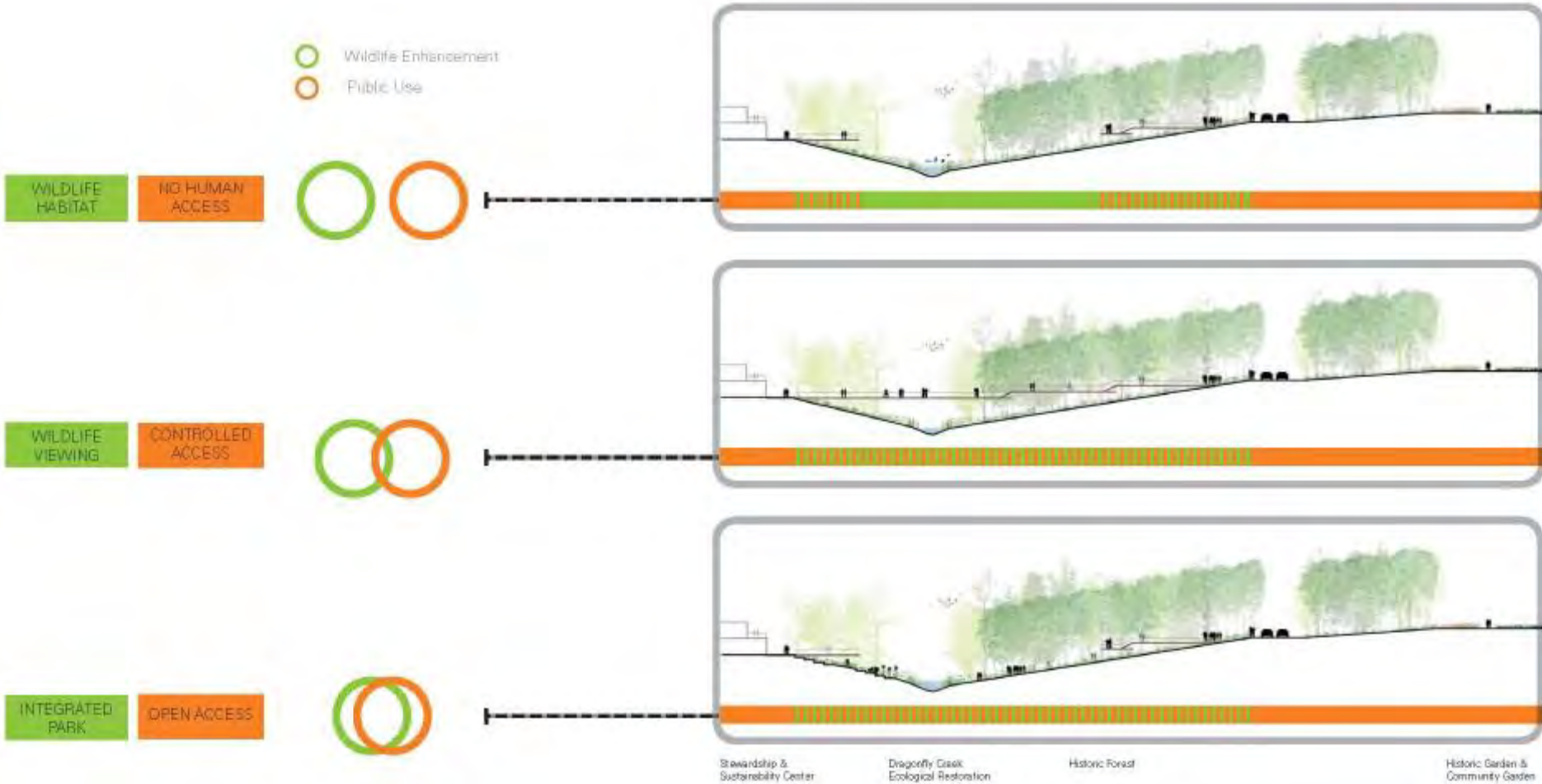
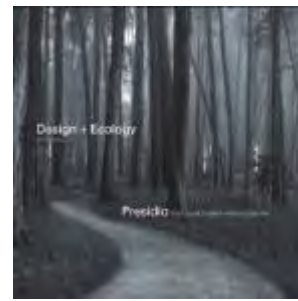


Revival Field, Mel Chin

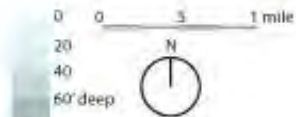
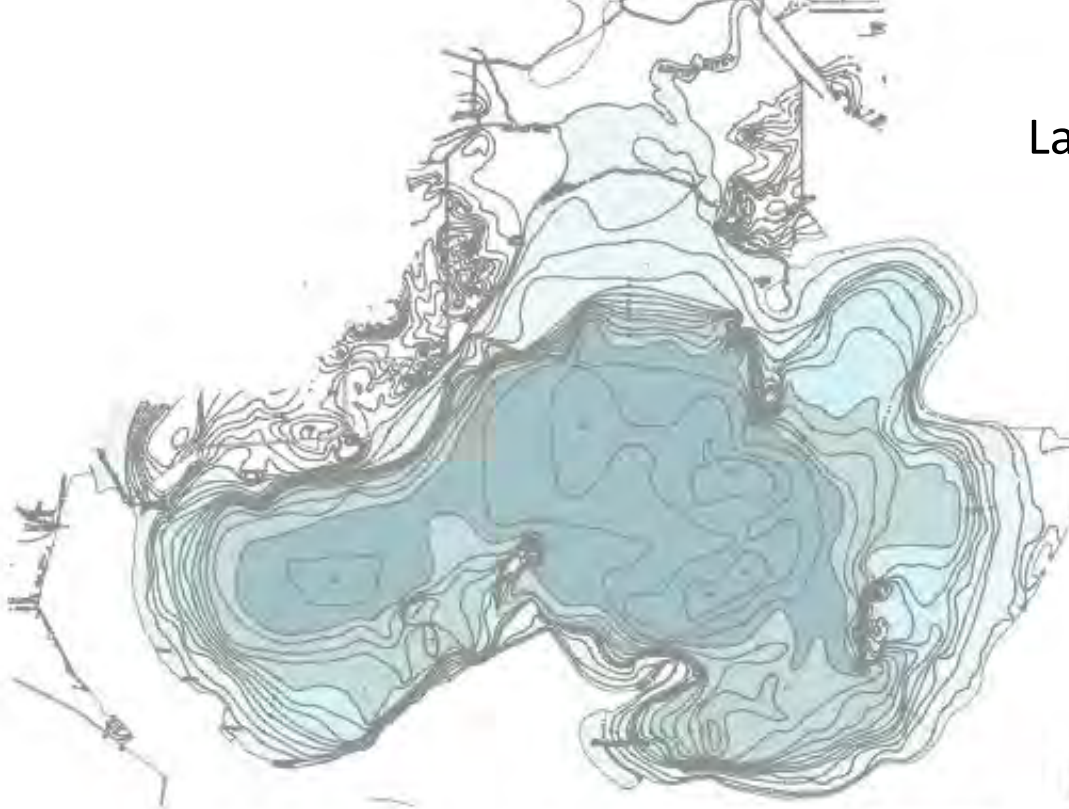


EXPANDING THE PRACTICE

Exploring Compromises



Lake Mendota, Madison Wisconsin



adapted from 1900
birge map

birge and juday era (1924-41)

lter research program

eurasion water milfoil invasion

spiny waterflea invasion

lake homeowners groups

rusty crayfish invasion

rainbow smelt invasion

recreational fishing

treaty rights agreement

CWH removal

attempt at agriculture

CWH restoration

burning of slash

intensified lake-shore development

logging of pines

lake-based tourism

clear-cut logging of hardwoods

forest regrowth and rotational forest harvesting



DEFINING AN AESTHETIC AND FUNCTION

DEFINING AESTHETIC AND FUNCTION

Defining what they should look like and how should they function? What expectations do we have for restoration



OLENTANGY RIVER WETLAND RESEARCH PARK



TURENSCAPE PROJECT



CEDAR CREEK



JENA PROJECT, SWITZERLAND



BOS PARK, CORNELIS VAN EESTEREN & JACOBA MULDER



MVVA GM PLANT



MVVA ARC Wildlife Bridge



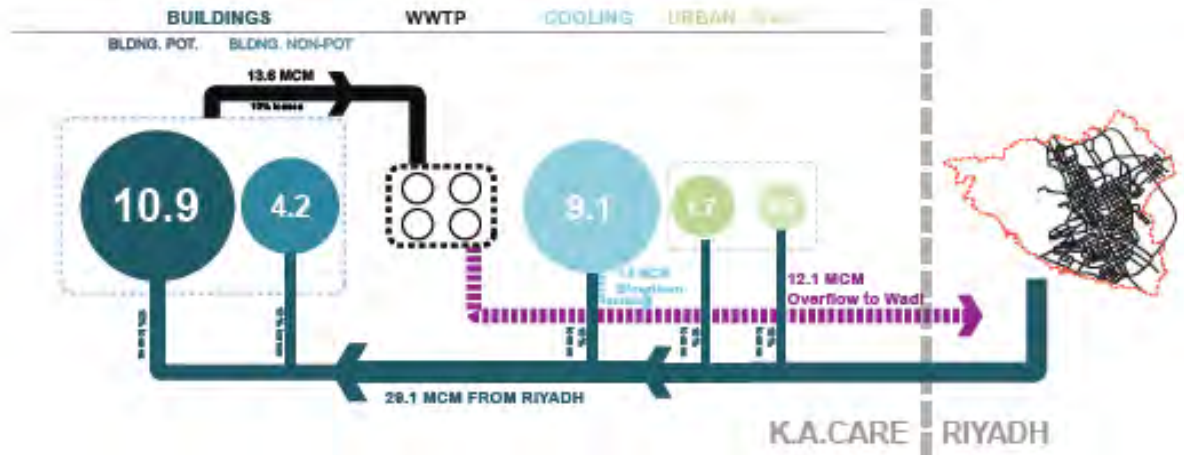
Project Information:

- AREA TBD buildings
- 200,000 occupants
- planning phases

KOETTER | KIM & ASSOCIATES

Illustrative Master Plan
Kacare, Saudi Arabia

DEFINING AN AESTHETIC AND FUNCTION



Water lost to the overhead atmosphere as *cooling tower make-up* water, may surpass 40%

Can we irrigate first and then evaporate?

Modified green walls can provide useful heat rejection via the same evaporative and convective processes at play in cooling towers

BENEFITS	COSTS
Chilled Water	Intense energy demands
	Biocides for legionnaires disease
	Corrosion inhibitors for blowdown
	Fan energy demands
	One time use of potable water



COOLING TOWER
recirculate water with the sole purpose of heat rejection

VS



King Fahd Bin Abdul Aziz University



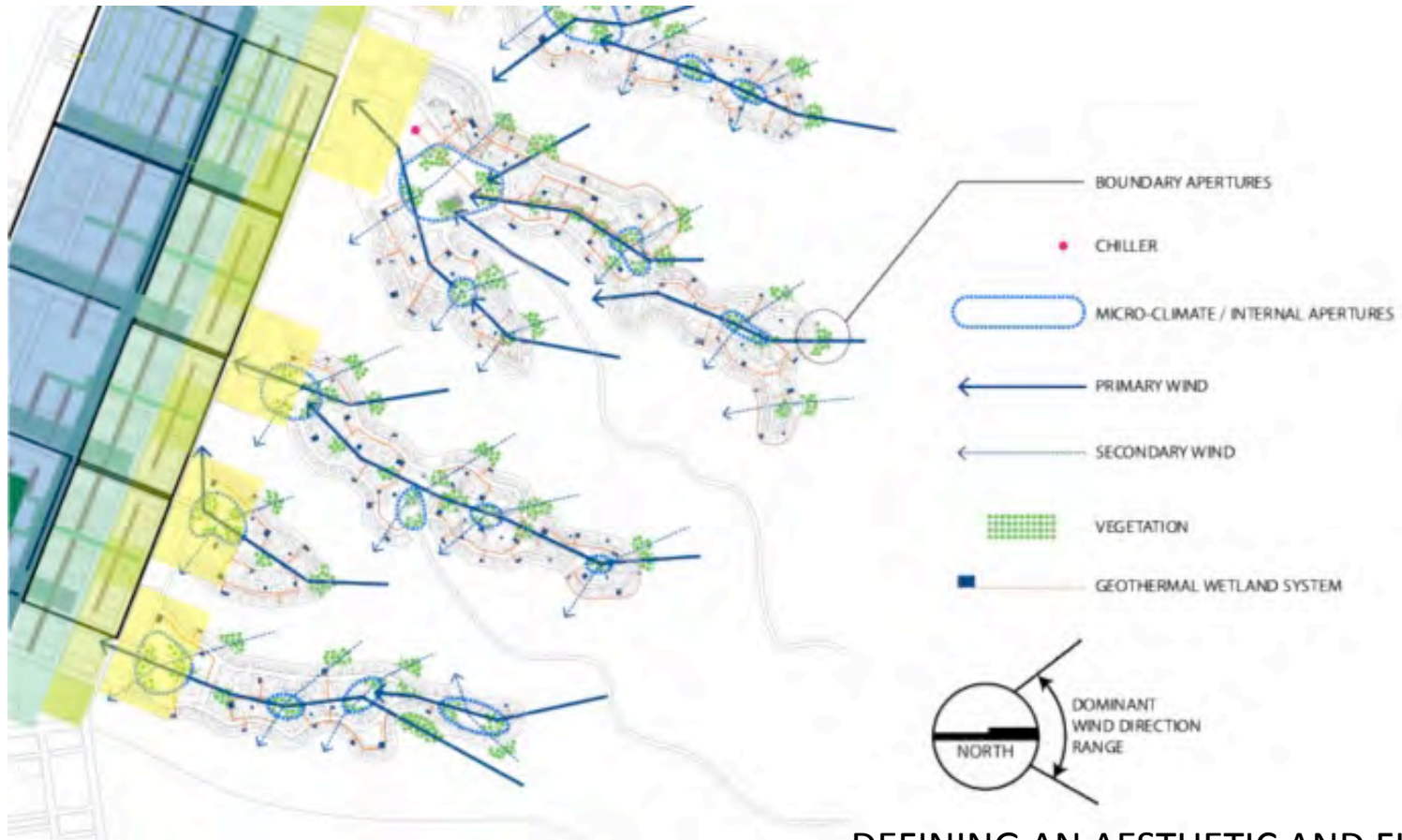
BENEFITS	COSTS
Chilled Water	Maintenance
Water Quality treatment	Real estate
Micoclimate moderation	Pumping energy demands
urban heat island	

thermoGREEN WALL (tGW)
perform heat rejection along with the strategic (pre) use of recirculated water for energy and water conservation and operational and cost benefits



Developing a Functional Aesthetic

- What are the drivers for people
- Does form follow function?

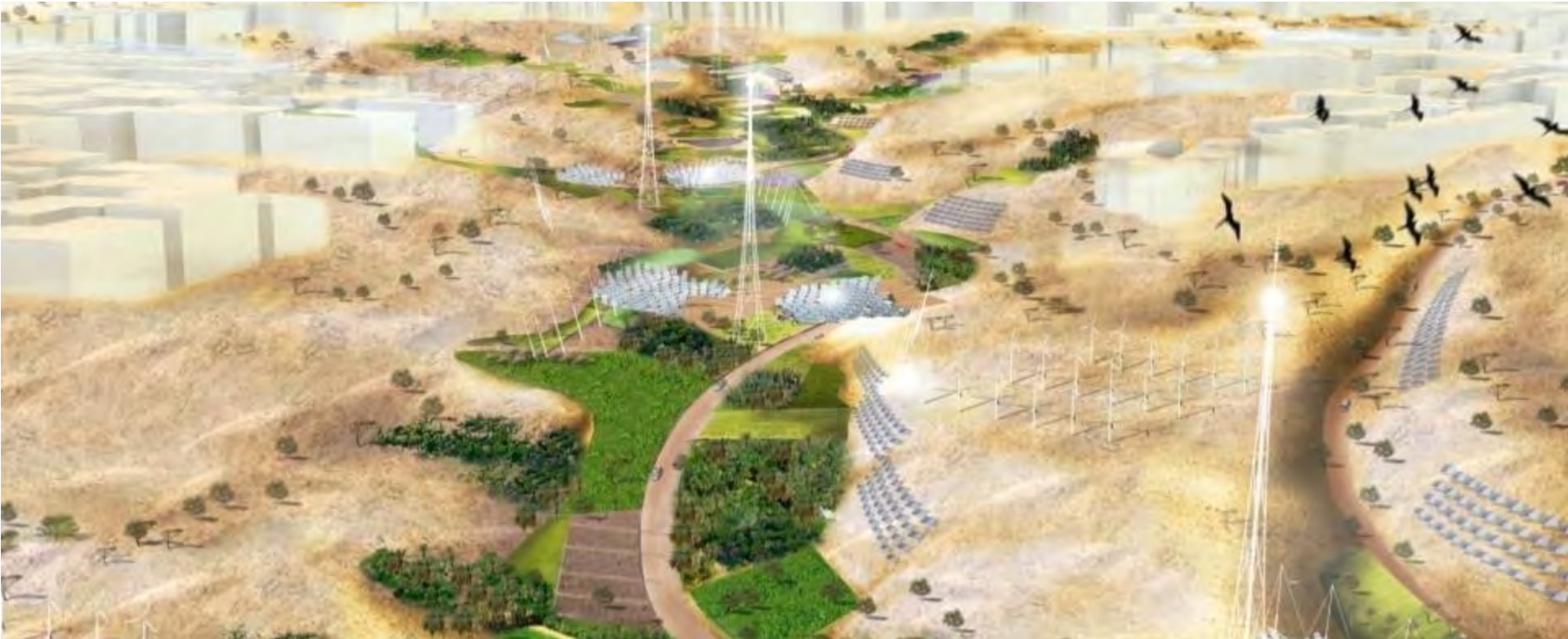


DEFINING AN AESTHETIC AND FUNCTION

ENGINEERED LANDSCAPES

Kitchen garden/urban agriculture
Evapotranspiration gardens
Urban water parks
Energy landscapes

Boundary aperture groves for cooling air
Collective green infrastructure networks
Intensified recharge and infiltration gardens
Vertical green walls and wetlands for heat rejection
Microclimate corridors and gardens
Constructed wildlife resource habitats
Restored ecosystems

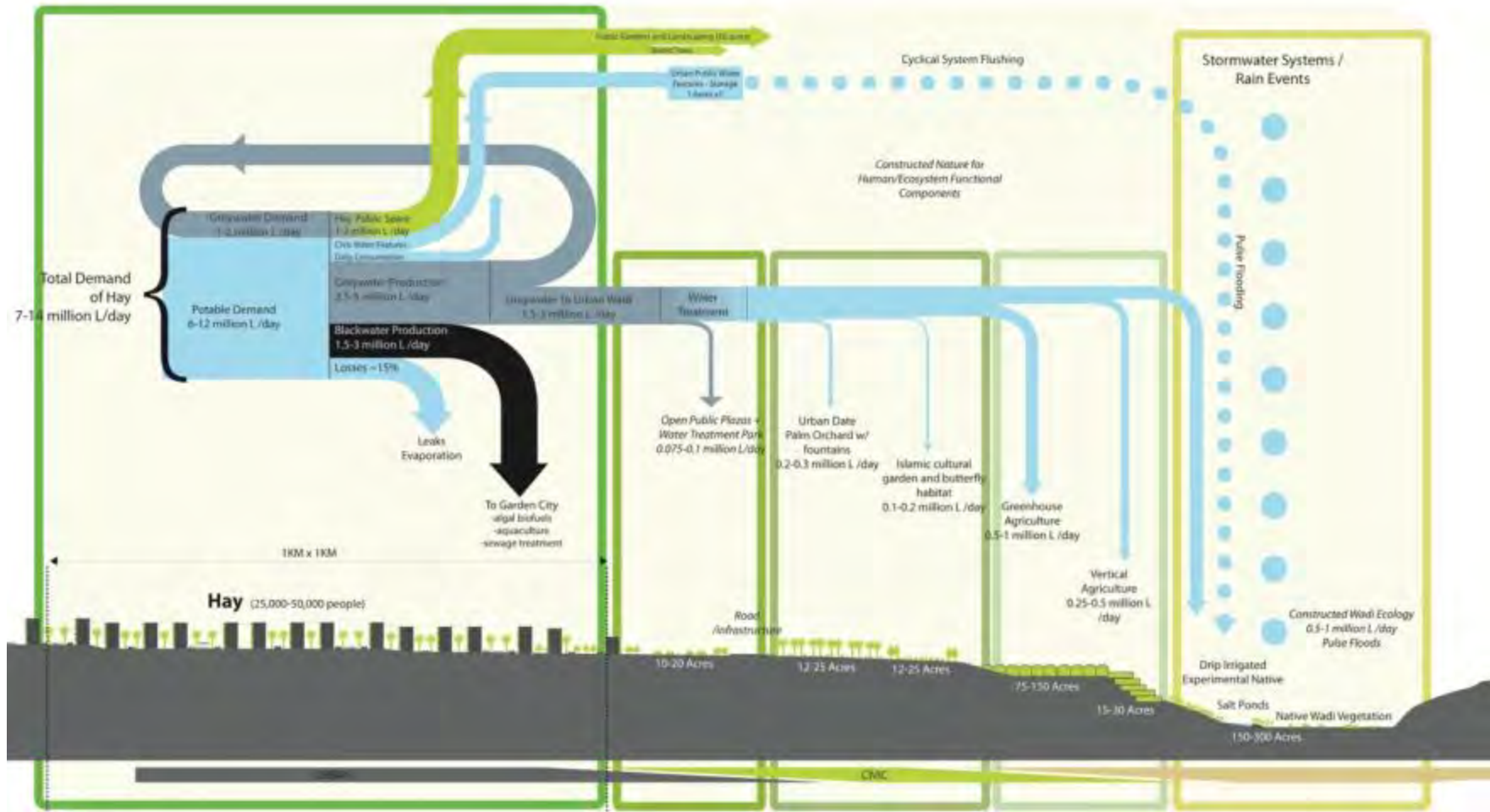


KOETTER | KIM & ASSOCIATES

Transformation of Wadis

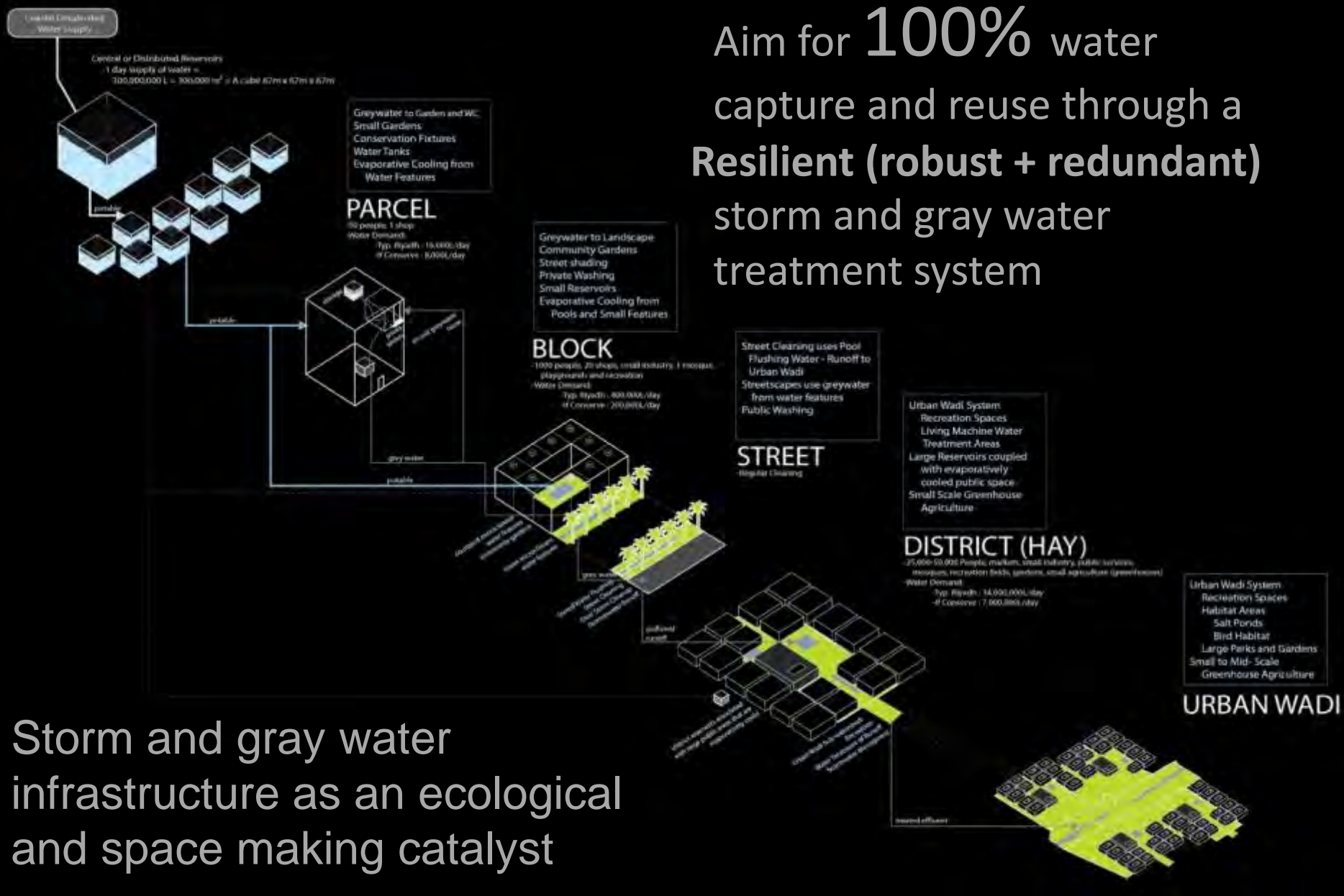
DEFINING AN AESTHETIC AND FUNCTION

Developing an urban design that overlaps programmatic uses with water-based landscapes to store, use and reuse storm and gray water to activate the site



DEFINING AN AESTHETIC AND FUNCTION

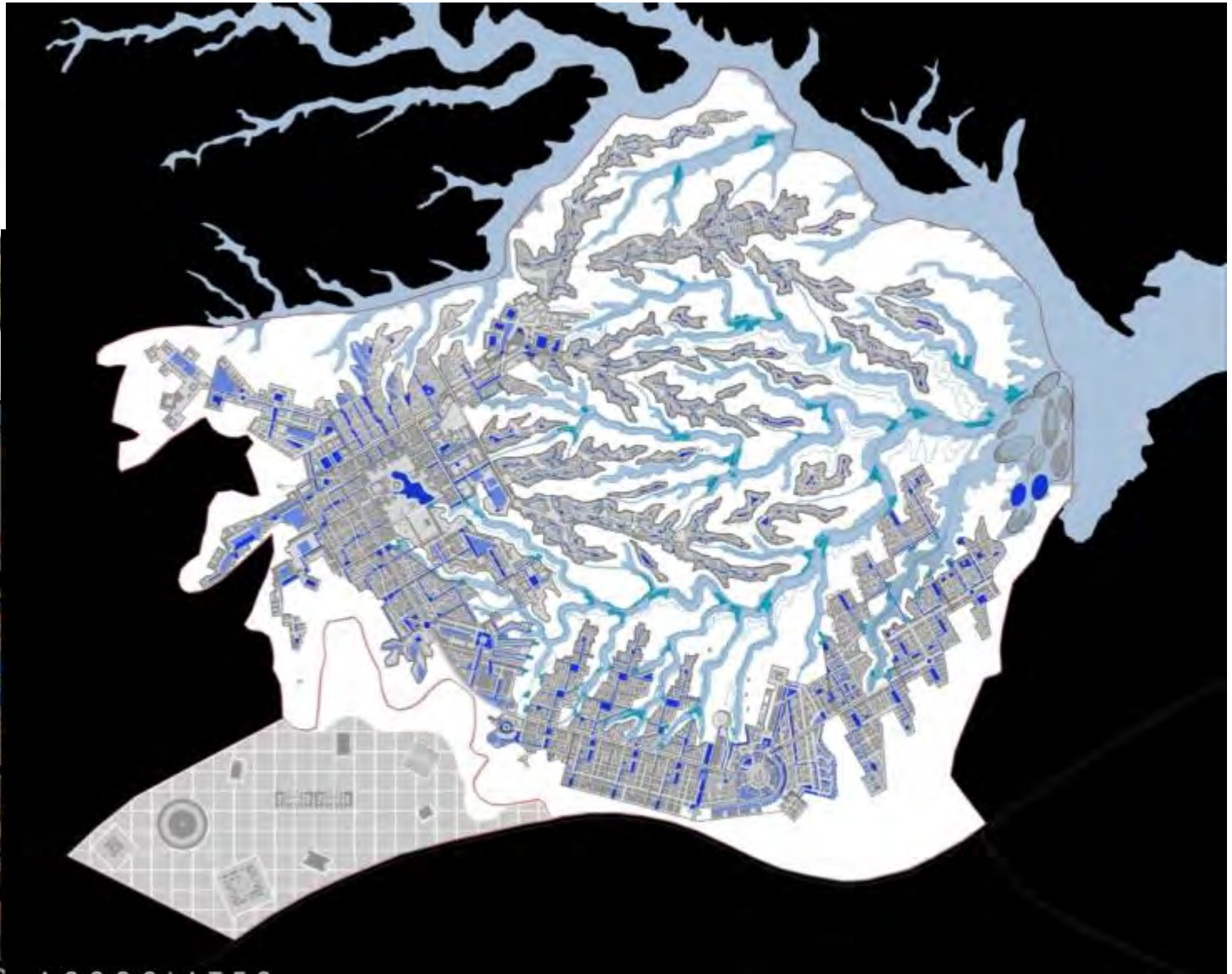
Aim for **100%** water capture and reuse through a **Resilient (robust + redundant)** storm and gray water treatment system



Storm and gray water infrastructure as an ecological and space making catalyst

WATER SYSTEMS

- BIO RETENTION POND
- TREATMENT WETLAND
- STORMWATER COLLECTION POND
- BIO-FALAJ
- WATER TREATMENT PLANT
- WATER STORAGE
- WATER CHANNELS



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Water Systems

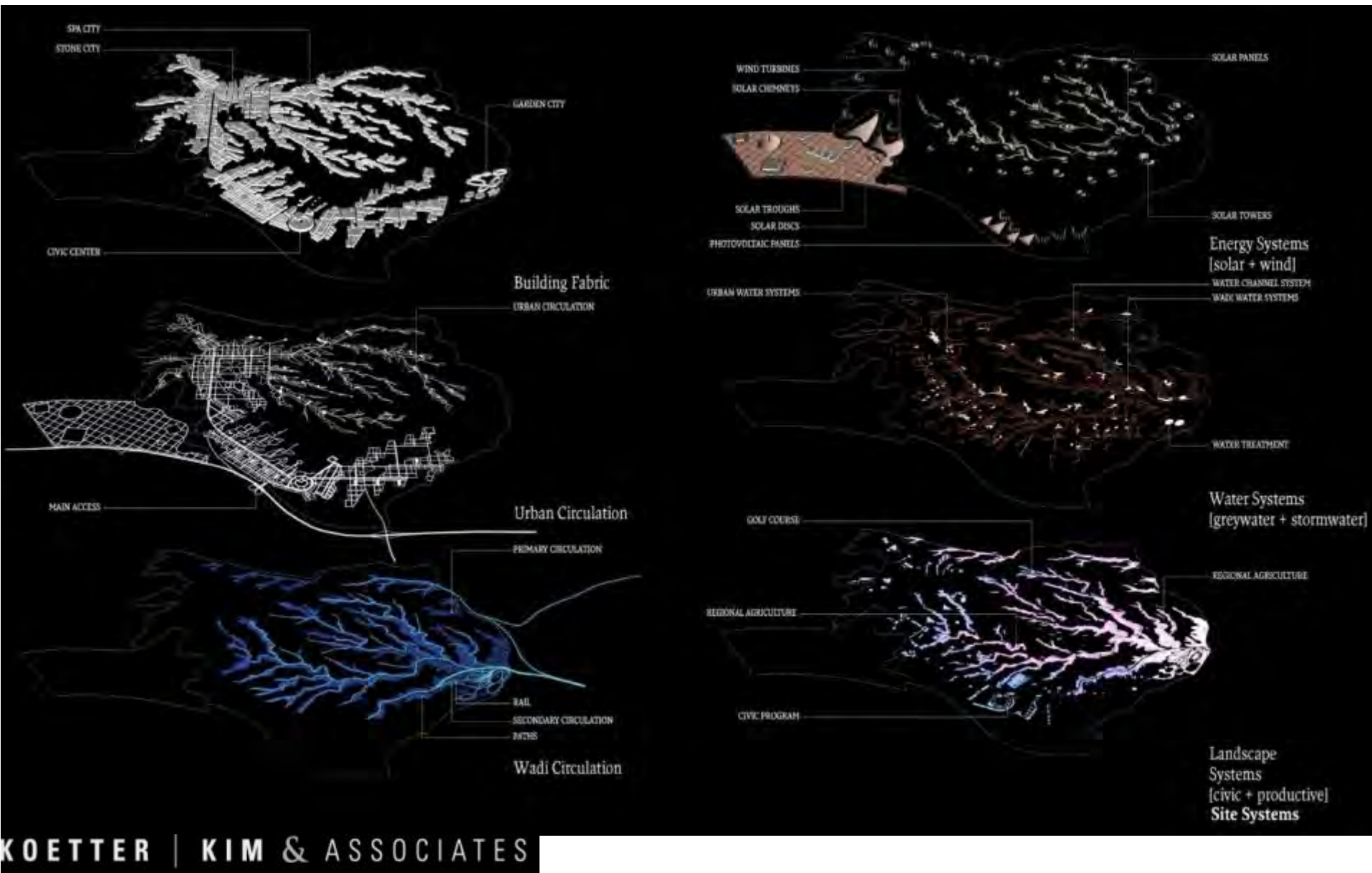
DEFINING AN AESTHETIC AND FUNCTION



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Green Plan

DEFINING AN AESTHETIC AND FUNCTION



Site Systems

DEFINING AN AESTHETIC AND FUNCTION

Convincing people to adopt something new



DEFINING AN AESTHETIC AND FUNCTION

Urban Stressors

- Defining ecosystem function
 - Wide range of urban influences (million trees slide)



DEFINING AN AESTHETIC AND FUNCTION

Defining Ecosystem Functions

Defining the role of historic reference landscapes in an altered world

Dead Run 5 (Baltimore)



- 373 acres
- 34.2 percent impervious
- 138 subcatchments

System dominated by overland and streams; Disjoint sewer network

CDS-51 (Chicago)



- 782 acres
- 59.1 percent impervious
- 782 subcatchments

System dominated by sewer network

DEFINING AN AESTHETIC AND FUNCTION

Dealing with Complexities and Ethical Conundrums

- Defining ecosystem function
 - Vegetation (source / sink)
 - Role of invasives (valuing invasives)



Deformed green frogs from Quebec. Collins 2009



A forester engages in efforts to eradicate the velvet tree *Miconia calvescens* in Hawaii.

Don't judge species on their origins

Conservationists should assess organisms on environmental impact rather than on whether they are natives, argue Mark Davis and 18 other ecologists.



Accidental ecosystems



- Florida Power and
- Light cooling canals



Figure 1. An urban coyote strolls through West Hills, a suburb of Los Angeles, California, in July 2002.

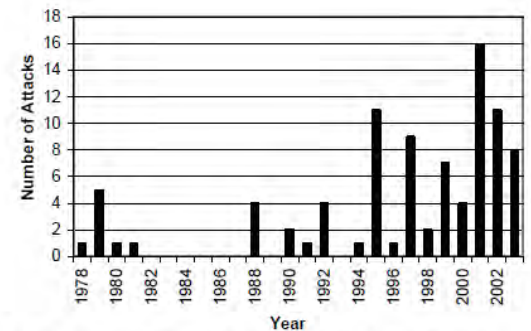


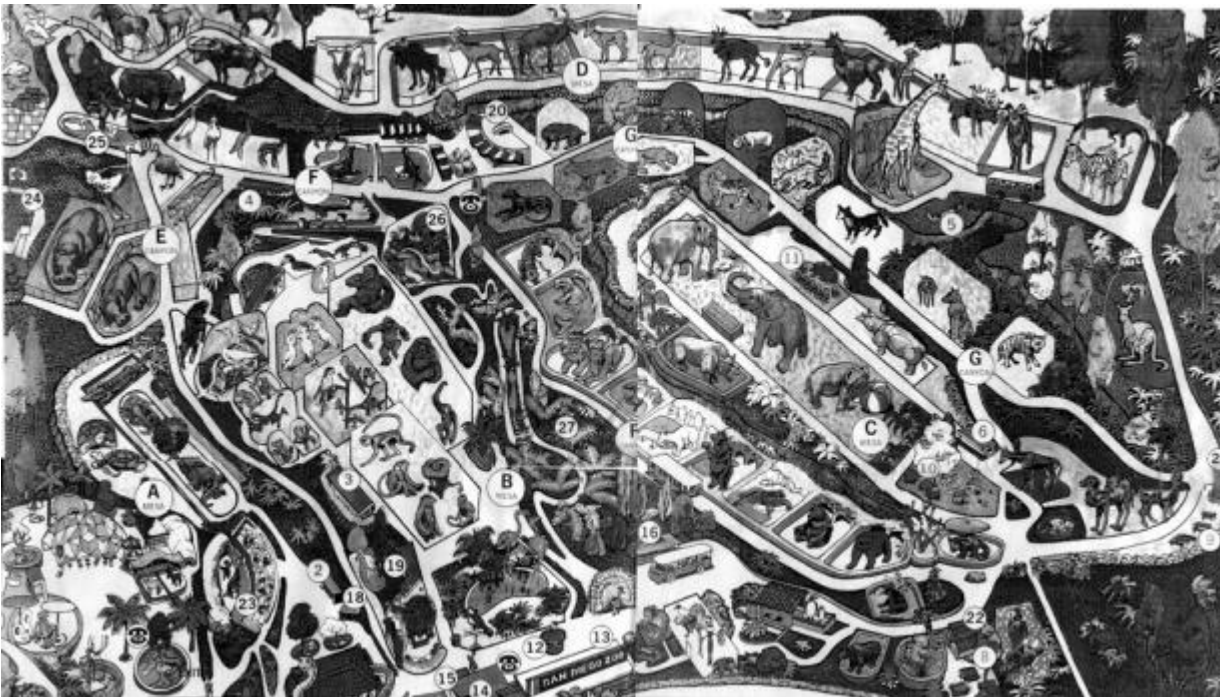
Figure 2. Coyote attacks on humans in California by year, 1978 - 2003.

Courtesy of the Santa Monica Mountains National Recreation Area, National Park Service
<http://aprodxn.com/laist/zfiles/LAist-mountain-lion-map.jpg>

From "Coyote Attacks: An Increasing Suburban Problem" by Timm et al, UC Davis

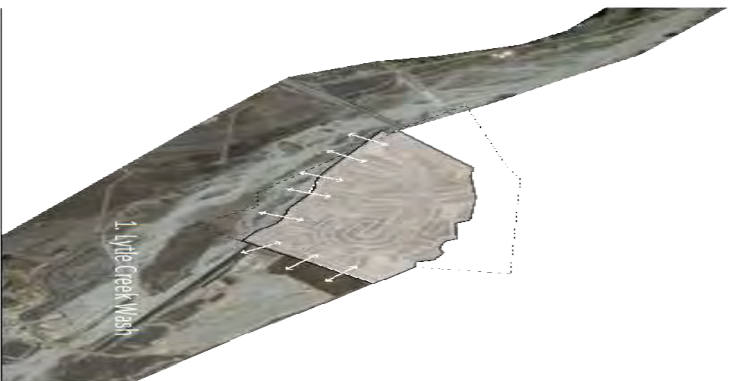


Versailles Menagerie.
Engraving by Perelle, 1650.

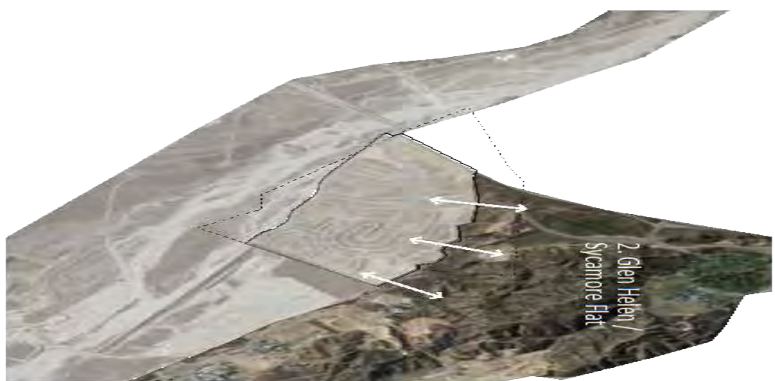


San Diego Museum Map

DEFINING AN AESTHETIC AND FUNCTION



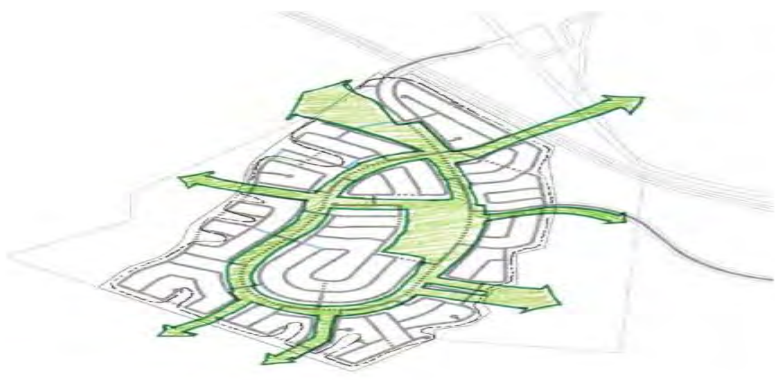
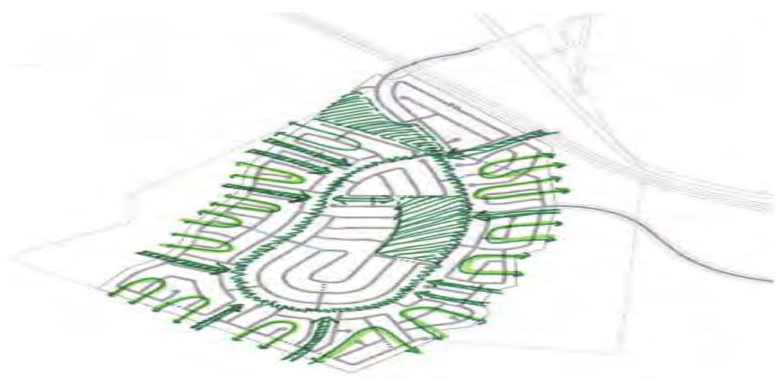
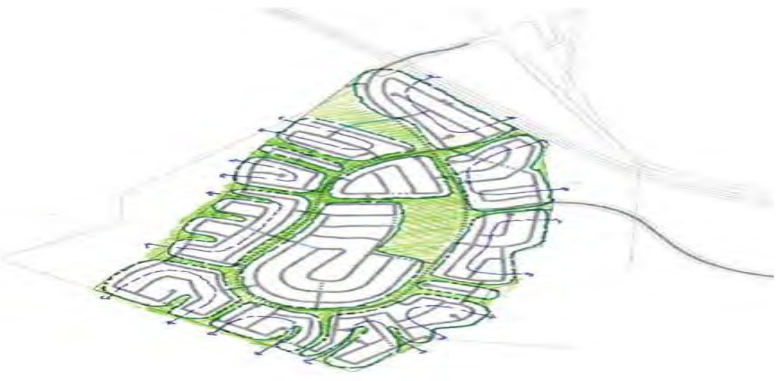
1. Habitat Restoration



2. Rewilding



3. Regional Corridors



1. HABITAT CORRIDORS

Four reference habitats

- A. Desert chaparral - coastal horned lizards, California thrashers, and western kingbirds
- B. Oak woodlands - acorn woodpeckers, western bluebirds, and ground squirrels
- C. Chaparral - puma, mountain lion/cougar, San Gabriel Mountains bighorn sheep, black bear, raccoon, quail, California thrashers, coyotes, and golden eagles
- D. Riparian - beavers, western lads, Pacific tree frogs, American dippers, orioles, and goldfinches

4. RESTORATION ECOLOGY

Riparian restoration from pockets in development:

RIPARIAN FOREST - Sycamore, oak riparian, southern cottonwood, willow riparian, southern sycamore, alder riparian (woodland)

RIPARIAN SCRUB - White alder, willow riparian, southern willow scrub, tamarisk scrub

These feed into resource rich habitats that use resources from the suburb to create and intensify ecosystems.

COASTAL RIVERSIDEAN SAGE SCRUB AND ALLUVIAL FAN SAGE SCRUB -

Habitats adapted to periodic flooding and erosion on the southern California flood plains, drought-deciduous shrubs and larger evergreen woody shrubs

3. REWILDING EXPERIMENTAL PLOTS

Large bound enclosures which allow the newly introduced animals (Pleistocene rewilding) space to roam and interact. Supported by adjacent housing which function as zoo-like enclosures - cages allow veterinarians access to the animals for periodic treatment and feeding.

3A
85 acres
Elephant

3B
95 acres
Cheetah

3C
95 acres
Lion

3D
60 acres
Oranger

3E
75 acres
Mountain Tapir

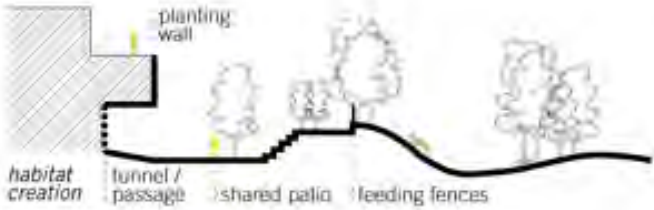
2. GRAY/BLACK WATER COLLECTION & TREATMENT

Decentralized treatment system creates an artificial tributary that spills through the site as a habitat resource and into the Lytle Creek Wash (4) developing the suburb and the occupants into a positive urban fringe ecosystem engagement and management effort.



A. PERIPHERAL HOUSE

Boundaries, walls and controlled apertures, nesting interface with habitat restoration, maintenance of habitats



B. CORRIDOR HOUSE

Multilevel viewing, shared passages
Vertical landscapes to increase corridor width in tight areas



C. PRODUCTIVE BUILDING

Cultivation of nature to provide living materials to activate zoo enclosures



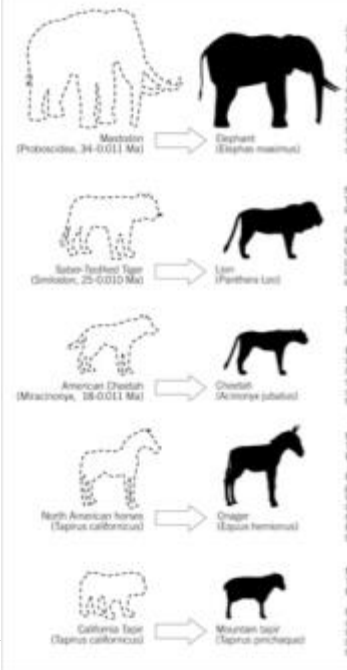
D. OBSERVATION HOUSE

Enclosure of constructed nature, Lookout and key part of suburban food web



E. ZOO CIRCUIT

Public network through buildings and landscape, provides circuit view of wildlife



Defining Ecosystem Functions

Expectations about successions and species recruitment

UED LAB Involving ecologists in shaping large-scale green-infrastructure projects
Alexander J. Felson, Emily J. Gilg, and Mark A. Bradford

MILLION TREES NYC
60% of the project on public land
800 hectares
Under construction 2007-2017
\$400 million



New York City Afforestation Plan (NY-CAP)
Willow Lake (n=102) 13000 trees & 5000 shrubs
Kissena Corridor Park (n=56)

Kissena Corridor Park, NY-CAP
Fifty-six 225 m² research plots
5000 trees & 1800 shrubs
Built 2009-2010
\$1.036 million

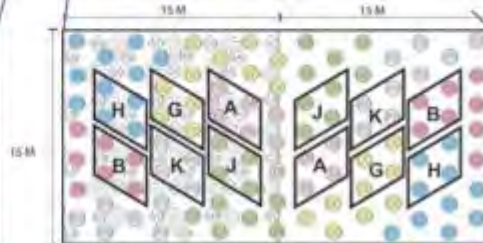
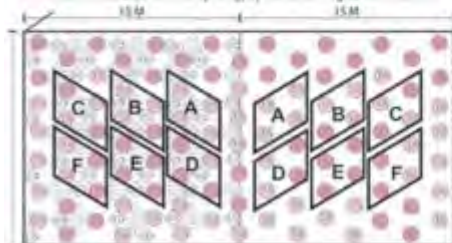


NATIVE TREES AND SHRUBS PLANTED IN PLOTS

- Tilia americana*
- Quercus rubra*
- Carya* sp.
- Prunus serotina*
- Quercus alba*
- Celtis occidentalis*
- Cornus racemosa*
- Hamamelis virginiana*
- Lindera benzoin*
- Sambucus canadensis*
- Viburnum dentatum*

Low tree species richness (2 species), by low (only trees) vs. high (with shrubs and herbs) stand complexity, by no versus organic amendment.

High tree species richness (2 species), by low (only trees) vs. high (with shrubs and herbs) stand complexity, by no versus organic amendment.



BioScience.

A Forum for Integrating the Life Sciences
November 2013 American Institute of Biological Sciences Vol. 63 No. 11



DEFINING AN AESTHETIC AND FUNCTION

SITE SELECTION: GIS METHODOLOGY

TOP/DOWN APPROACH



Canopy Coverage



Ownership



Habitat Connectivity
(Corridors + Nodes)



Proximity to Forever
Wild Sites

COMBINED + WEIGHTED RANKINGS:



1. Urban Ecological Emphasis
DPR Land Only



2. Urban Ecological Emphasis
All Other Public Land



3. Community Scale Emphasis
All Public Land



SITE SELECTION: AGENCY OUTREACH

BOTTOM/UP APPROACH

FIELD KNOWLEDGE INTEGRATION

- NRG Knowledge
- Input from Boroughs
- Input from Gateway National Park
- Input from non-DPR agencies including: DOT, DEC



Knowledge Exchange

- ① 100th St - 12th Ave (Vacation site)
- ② 100th St - 12th Ave - Transfer lot Louis Area - Suffering from poor drainage & area has an abundance of dead trees.
- ③ 100th St - 12th Ave - Gateway Park Wild Life area - Accessible with the Grand Central Plaza
- ④ 100th St - 12th Ave - Union Turnpike - Open lawn - Accessible via Grand Central Plaza
- ⑤ 100th St - 12th Ave - Union Turnpike - Accessible via Grand Central Plaza
- ⑥ 100th St - 12th Ave - Union Turnpike - Accessible via Grand Central Plaza
- ⑦ 100th St - 12th Ave - Union Turnpike - Accessible via Grand Central Plaza
- ⑧ 100th St - 12th Ave - Union Turnpike - Accessible via Grand Central Plaza
- ⑨ 100th St - 12th Ave - Union Turnpike - Accessible via Grand Central Plaza
- ⑩ 100th St - 12th Ave - Union Turnpike - Accessible via Grand Central Plaza
- ⑪ 100th St - 12th Ave - Union Turnpike - Accessible via Grand Central Plaza
- ⑫ 100th St - 12th Ave - Union Turnpike - Accessible via Grand Central Plaza
- ⑬ 100th St - 12th Ave - Union Turnpike - Accessible via Grand Central Plaza
- ⑭ 100th St - 12th Ave - Union Turnpike - Accessible via Grand Central Plaza
- ⑮ 100th St - 12th Ave - Union Turnpike - Accessible via Grand Central Plaza
- ⑯ 100th St - 12th Ave - Union Turnpike - Accessible via Grand Central Plaza
- ⑰ 100th St - 12th Ave - Union Turnpike - Accessible via Grand Central Plaza
- ⑱ 100th St - 12th Ave - Union Turnpike - Accessible via Grand Central Plaza
- ⑲ 100th St - 12th Ave - Union Turnpike - Accessible via Grand Central Plaza
- ⑳ 100th St - 12th Ave - Union Turnpike - Accessible via Grand Central Plaza

PRM Site Input



Queens PRM Meeting

DEFINING AN AESTHETIC AND FUNCTION



DEFINING AN AESTHETIC AND FUNCTION

DESIGNED EXPERIMENTS / URBAN ECOLOGY

Spatial

Modular

Efficient

Temporal

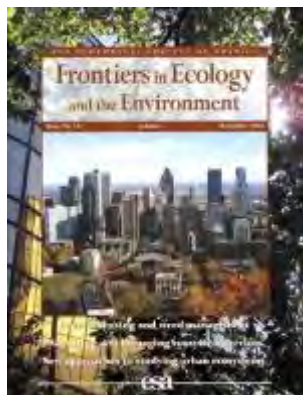
Statistical

Geometric

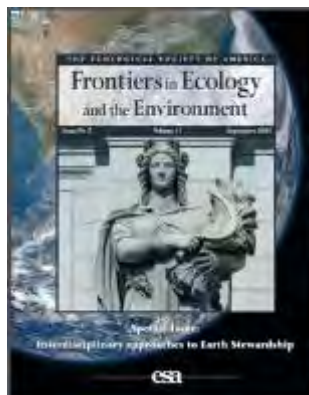
Functional



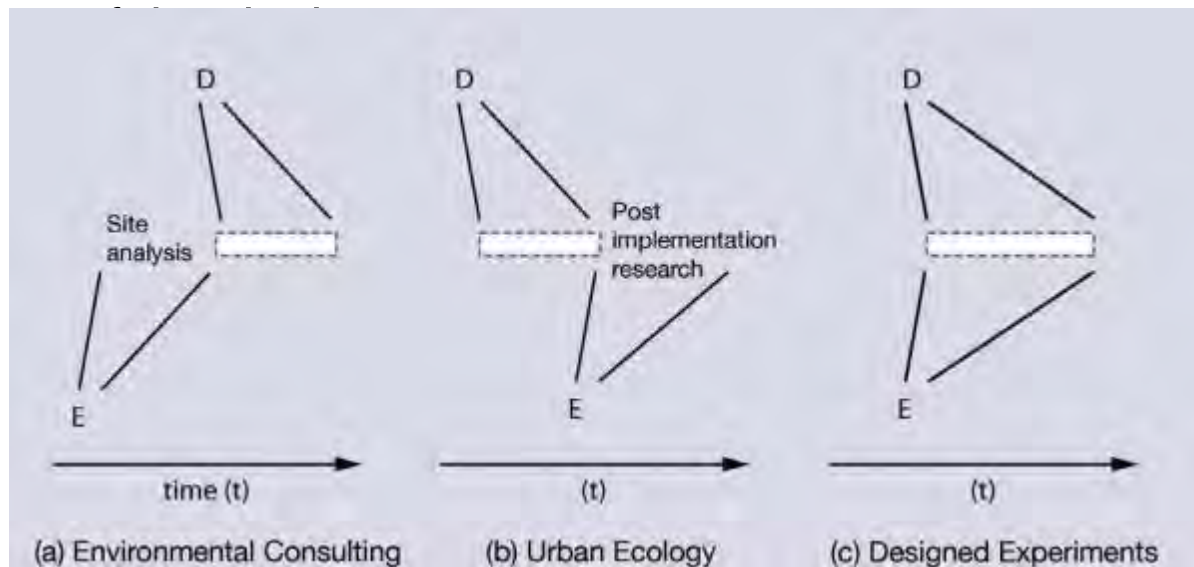
- Facilitates research by increasing sites
- Helps ecologists negotiate the complexity of working in cities
- Establishes a dialogue between ecologists and designers
- Embeds hypothesis driven research as a driver

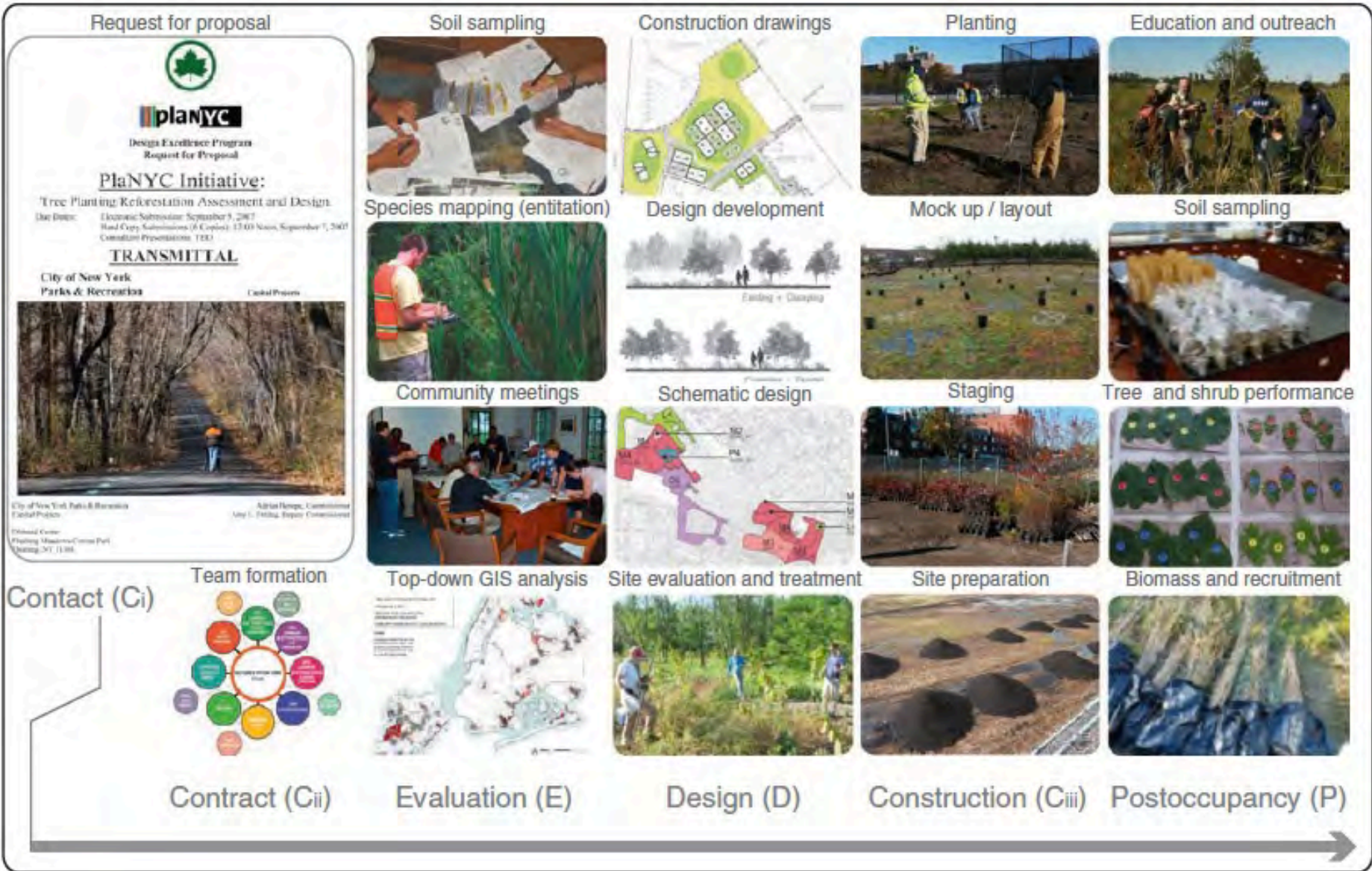


Felson and Pickett 2005



Felson et al. 2013





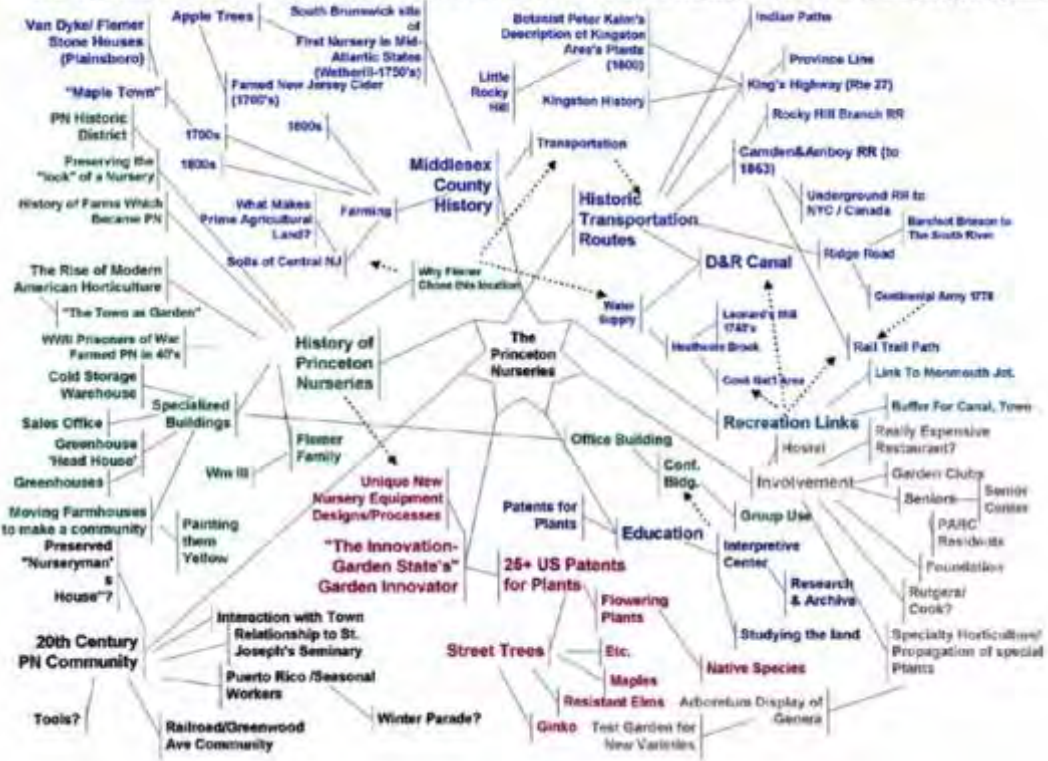


Defining Social layers and functions



Confidential Project
Masterplanning and ecological design strategies

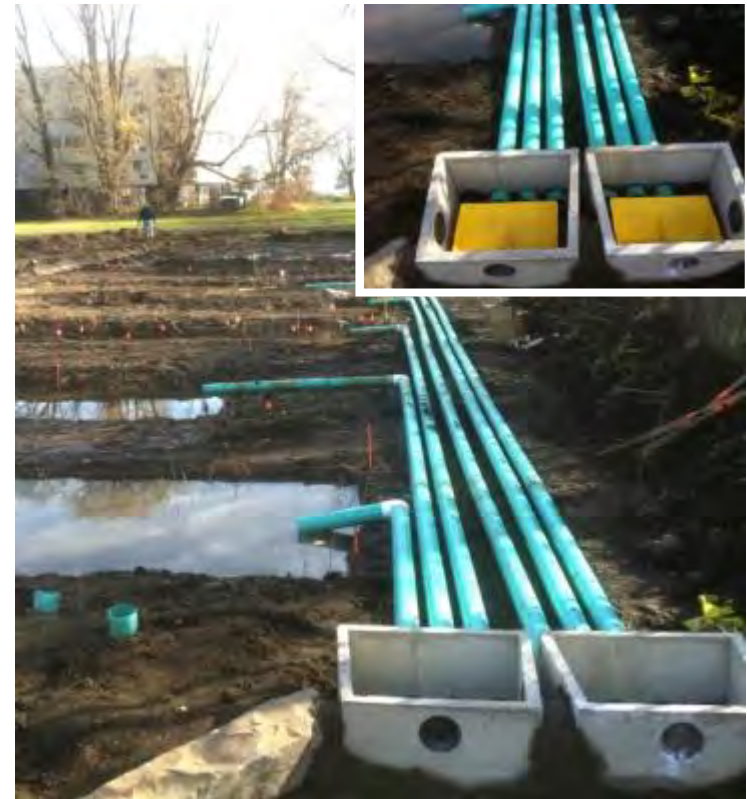
This "Mind Map" shows a variety of related ideas we have about the Princeton Nursery Property, somewhat grouped together.



DEFINING AN AESTHETIC AND FUNCTION

Restoration and Community

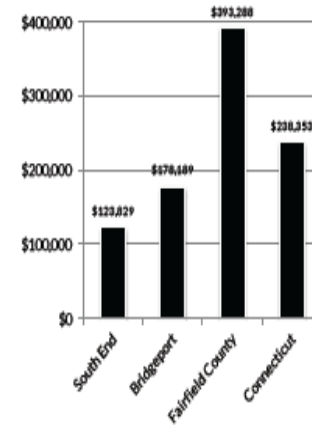
Using restoration as a means of building community process focused on coastal resilience. Communicating restoration concepts to the public and getting community buy-in



Seaside Village Bridgeport, CT



Median Home Value



Source: US Census, 2010, City of Bridgeport, 2014

7,321

South End NRZ population, projected to increase to 7,708 by 2017.

\$16,535

2012 South End NRZ per capita income, 53% less than CT and 60% less than Fairfield County.

2.6

Average household size in the South End.

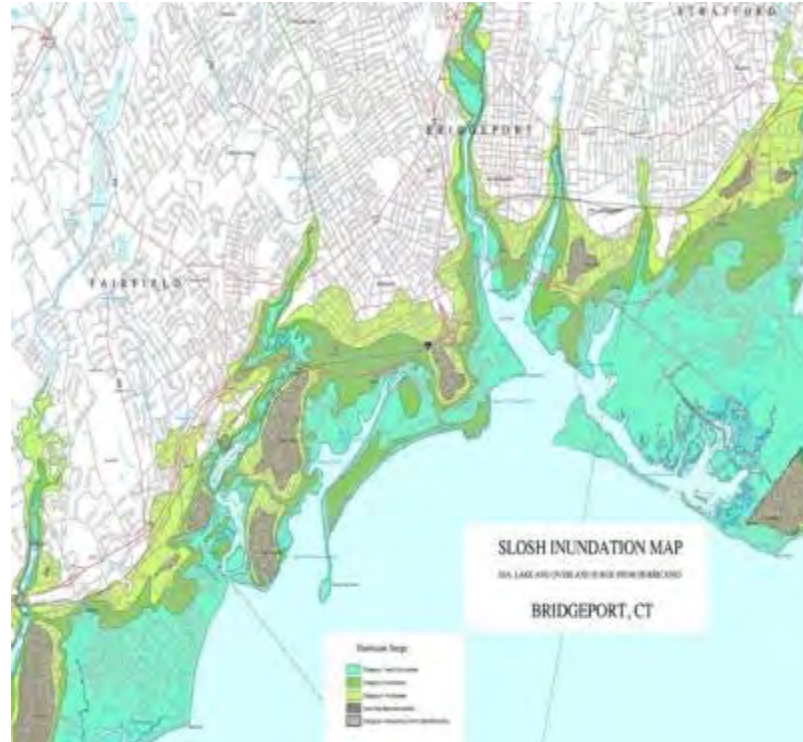
66.2%

Percentage of structures in the South End built before 1940.

\$124K

Median home value in the South End, 69% lower than those in Fairfield County.

2014 South End Neighborhood Revitalization Zone Strategic Plan



Integrating ecological performance & function

Using community process as a means of expanding restoration options and implementing through bottom up efforts



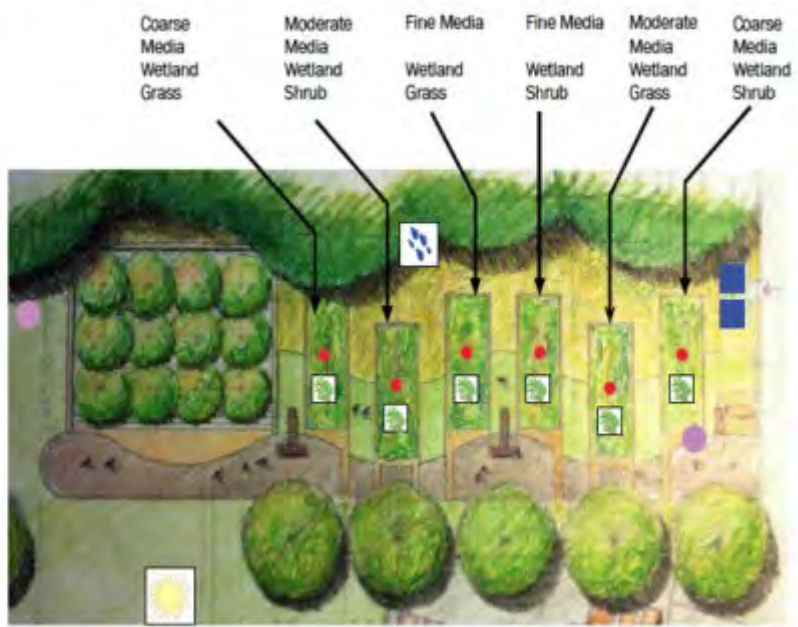
SUB-BASINS & SURFACE WATER FLOW
4.05.2010

SEASIDE VILLAGE, BRIDGEPORT, CT
SCALE: 1" = 100'



RESTORATION AND COMMUNITY

Data Collection



Varying compositions of sand/soil/compost ratio
 Media A ratio = 90/5/5
 Media B ratio = 85/5/10
 Media C ratio = 70/15/15



Pang, S (MESC) '15. Influence of plant community and media composition on the water budgets of coastal rain gardens

Benoit Lab
 UEDLAB





RESTORATION AND COMMUNITY



2.18.2011	11.8.2011	10.25.2012	7.18.2014
6.30.2011	11.9.2011	11.25.2012	7.28.2014
8.2.2011	11.12.2011	12.12.2012	10.18.2014
10.6.2011	5.25.2012	9.29.2013	6.15.2015
10.26.2011	6.8.2012	10.26.2013	6.24.2015
11.3.2011	8.8.2012	6.4.2014	



RESTORATION AND COMMUNITY

Path Installation







Education

CITIES THAT WORK FOR PEOPLE AND ECOSYSTEMS A DEMONSTRATION PROJECT FOR THE APPLICATION OF ECOLOGICAL SCIENCE

Sustainability goals will be met only if we change the way science intersects society. The Ecological Society of America, through its Earth Stewardship Initiative, has organized a demonstration project of how ecology can help solve societal problems.

Working with the Ecological Society of America and multiple agencies in Baltimore over the last eight months we have developed a project,

connecting communities with ecologists, urban planners, designers, and students.

The initiative proposes co-design and co-management of urban environments to promote social and ecological resilience and health. The approach builds on the U.N. Millennium Development Goals to provide a vision for a sustainable and equitable future.



PARTNERS		FUNDERS	
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	www.earthstewardshipinitiative.com		



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2014 Earth Stewardship Initiative (ESI) Demonstration Project

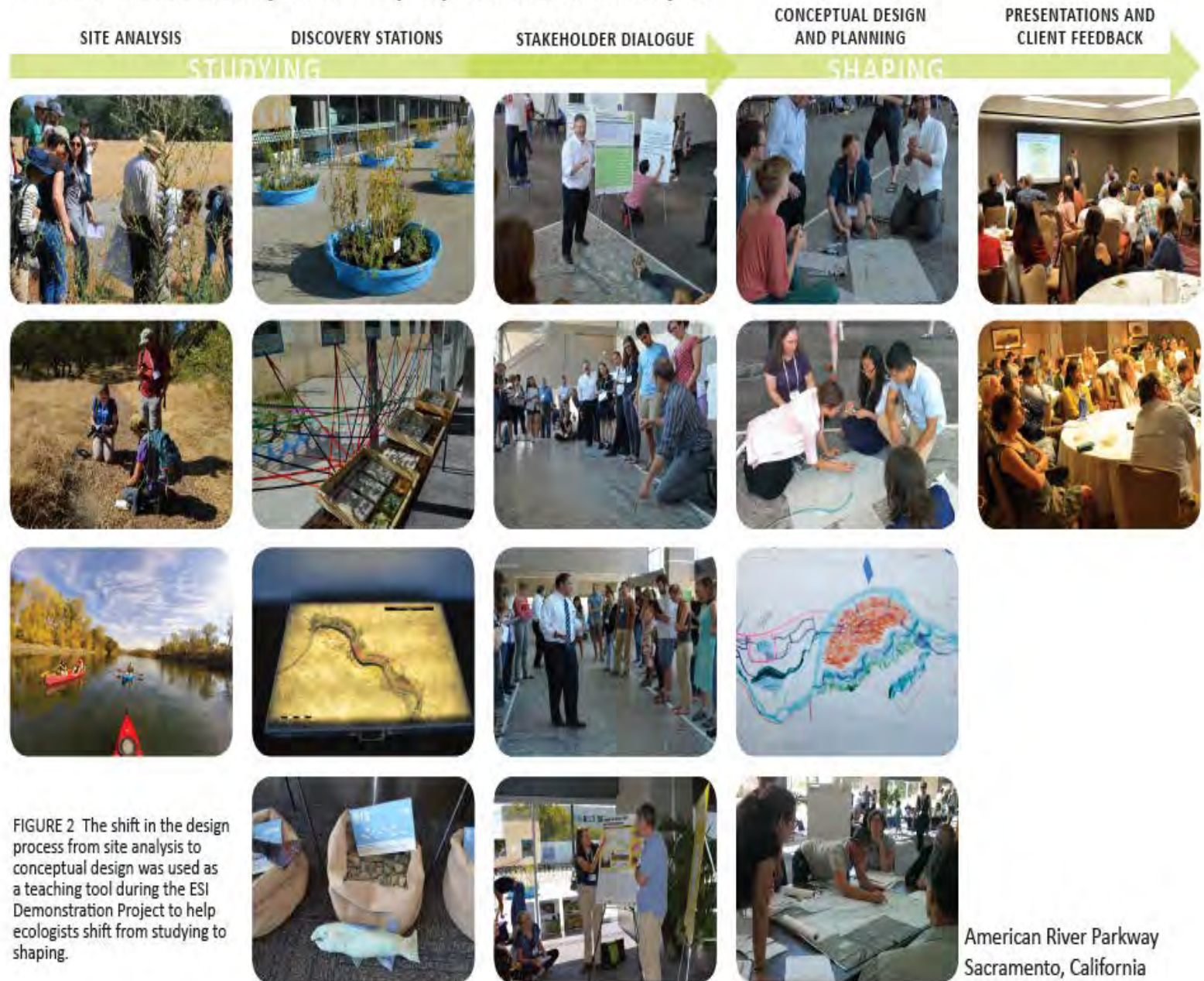
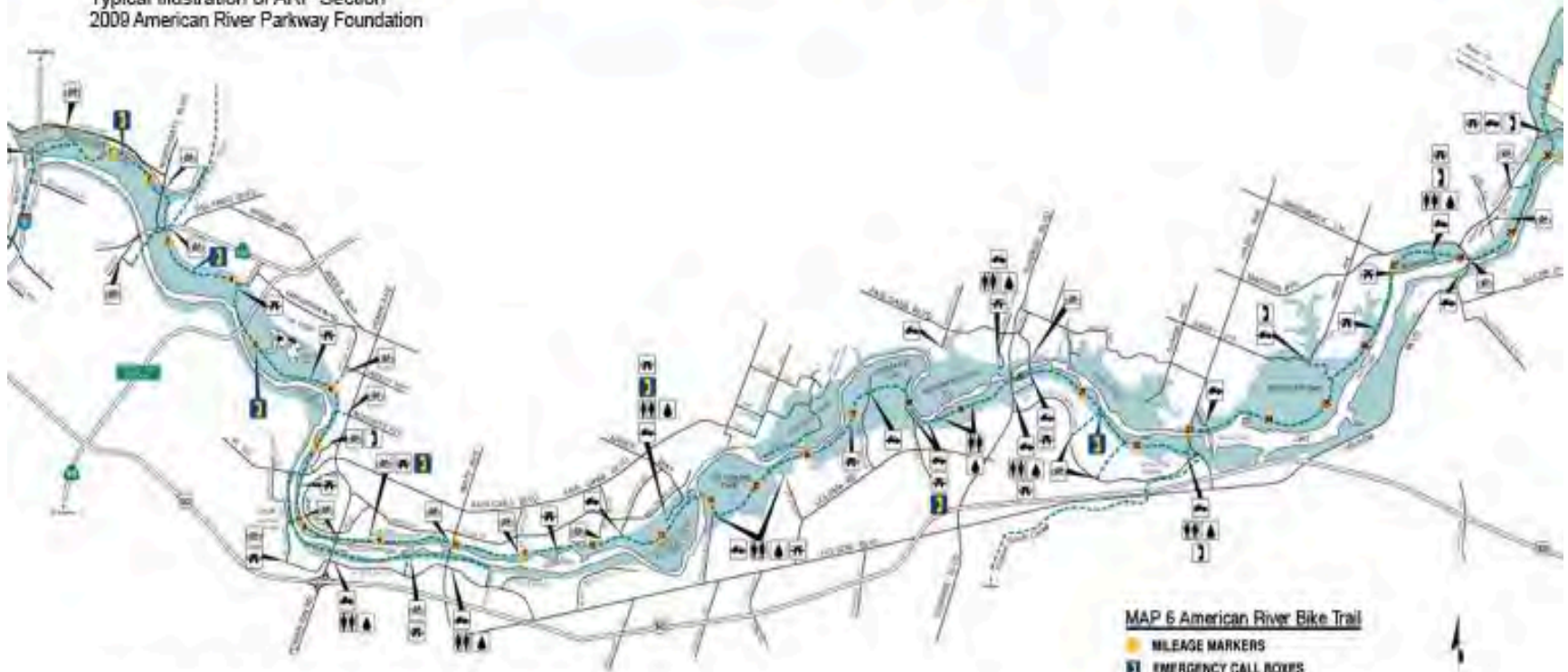


FIGURE 2 The shift in the design process from site analysis to conceptual design was used as a teaching tool during the ESI Demonstration Project to help ecologists shift from studying to shaping.

American River Parkway
Sacramento, California



Typical Illustration of ARP Section
2009 American River Parkway Foundation



American River Parkway Showing Recreational River Use.



Cities that work for people and ecosystems

A demonstration project for the integration of ecological research with community-based planning



Earth Stewardship Initiative Demonstration Project

Yale



MAHAN RYKIEL
ASSOCIATES INC

Biohabitats



Baltimore ESA Earth Stewardship Initiative 2015





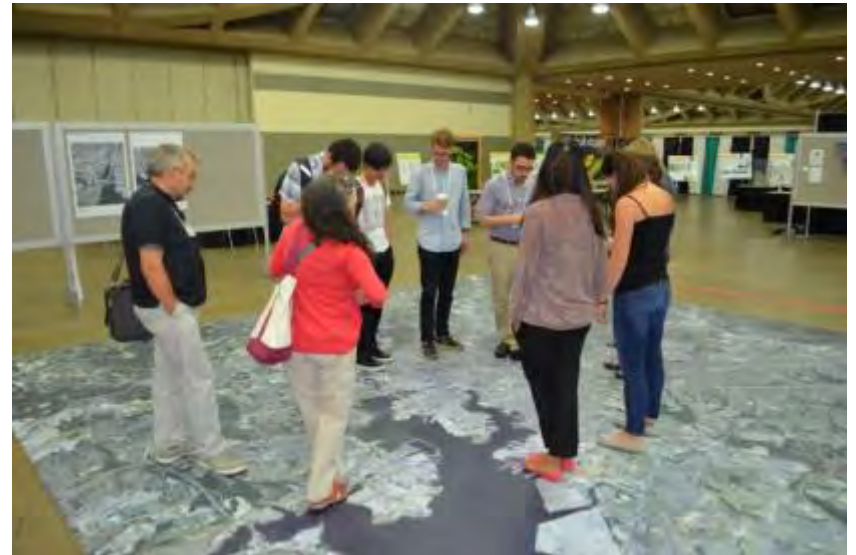
Baltimore ESA Earth Stewardship Initiative Bioblitz



Fellows from last year involved in this year



Baltimore ESA Earth Stewardship Conference Set up



Baltimore ESA Earth Stewardship Discovery Stations



Baltimore ESA Earth Stewardship City on the Map



Patterson Park community meeting



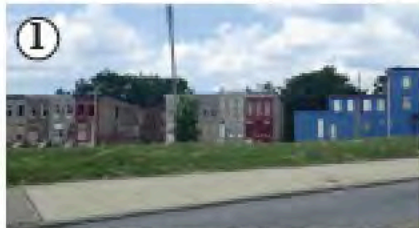
Upper Middle Branch community meeting



Baltimore ESA Earth Stewardship Community Charette



Project Sites and Themes



①
Gay Street looks at urban block revitalization as working landscapes for safe and active urban green space development.



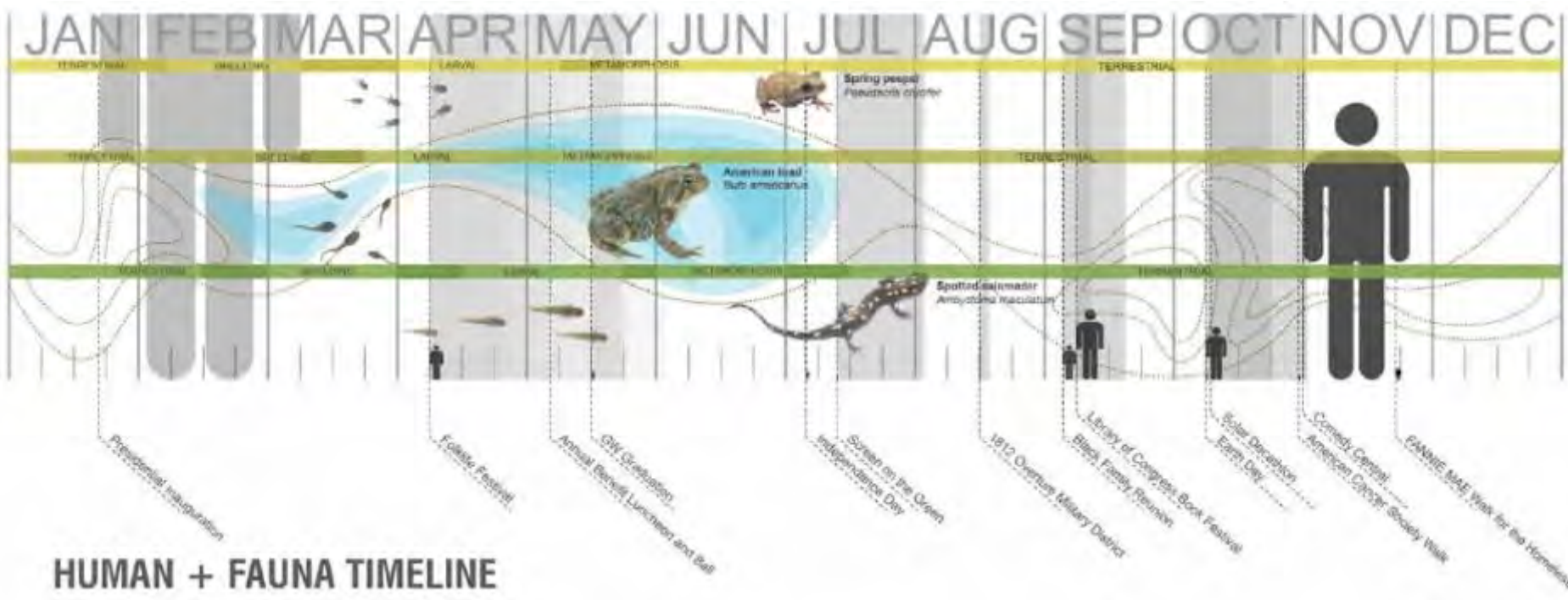
②
Harlem Park explores options for the inner block paving removal project to develop ecologically functional and resilient park landscapes.



③
Middle Branch connects watershed research and monitoring and performance metrics with coastal land development.



④
Patterson Park combines historic park design, recreation and maintenance costs with ecological design and management ideas.



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