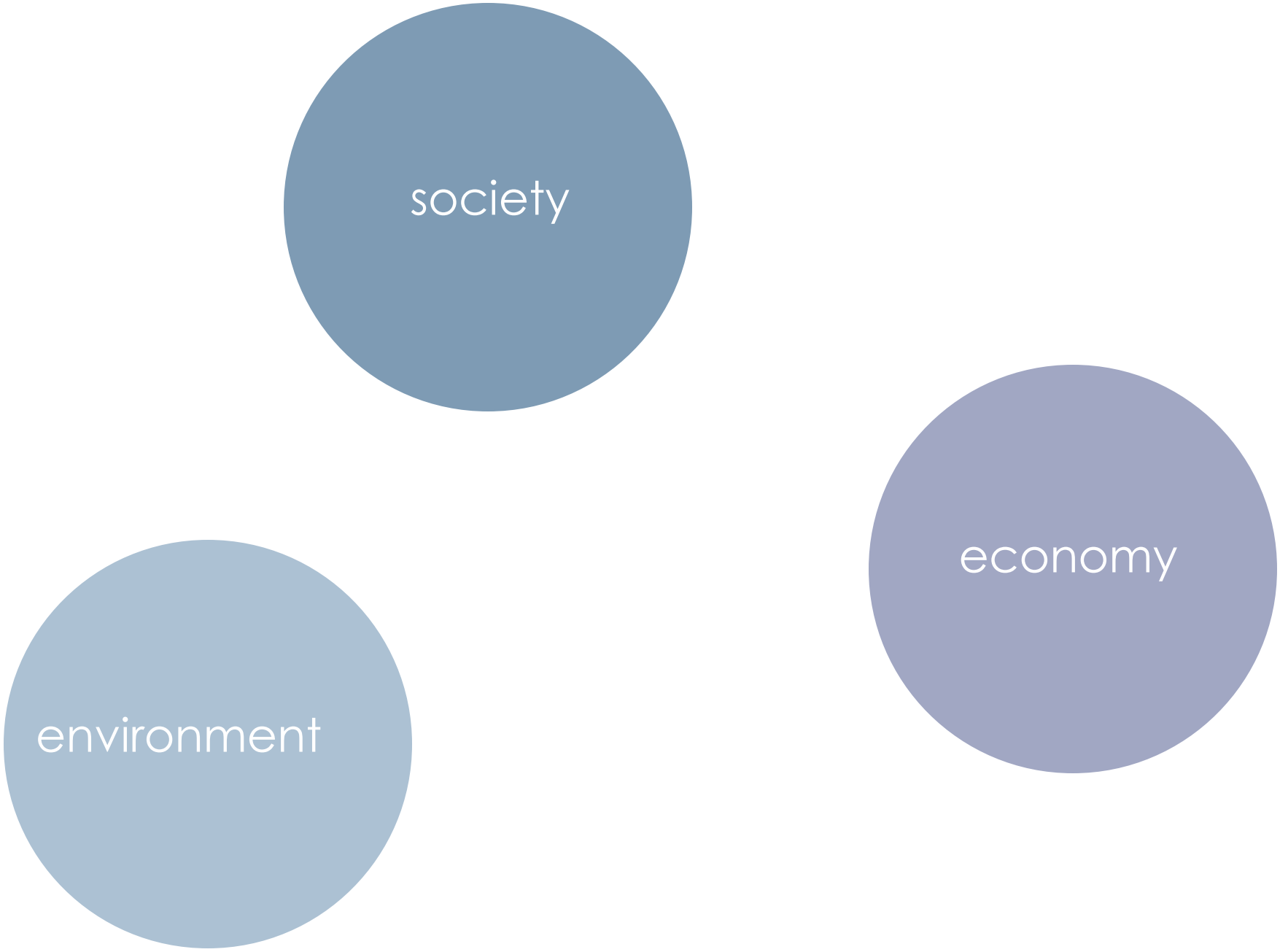
A Sustainable Solutions Framework for Planning and Urban Design

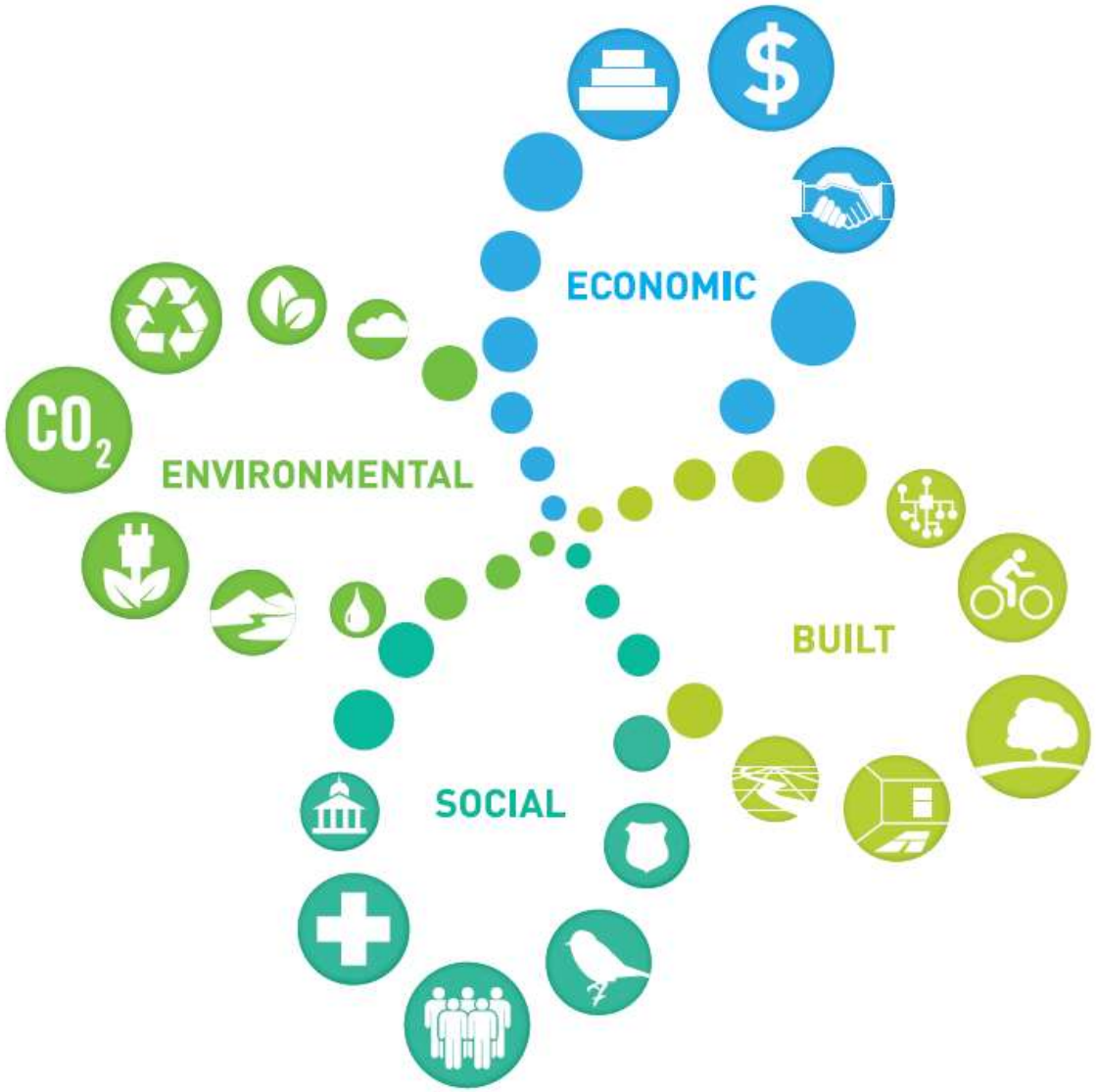
Sustainable Urban Design Symposium - MIT

Greg Havens – Sasaki Associates

6 May 2013


society
economy
environment

Sasaki's Sustainable Solutions Framework

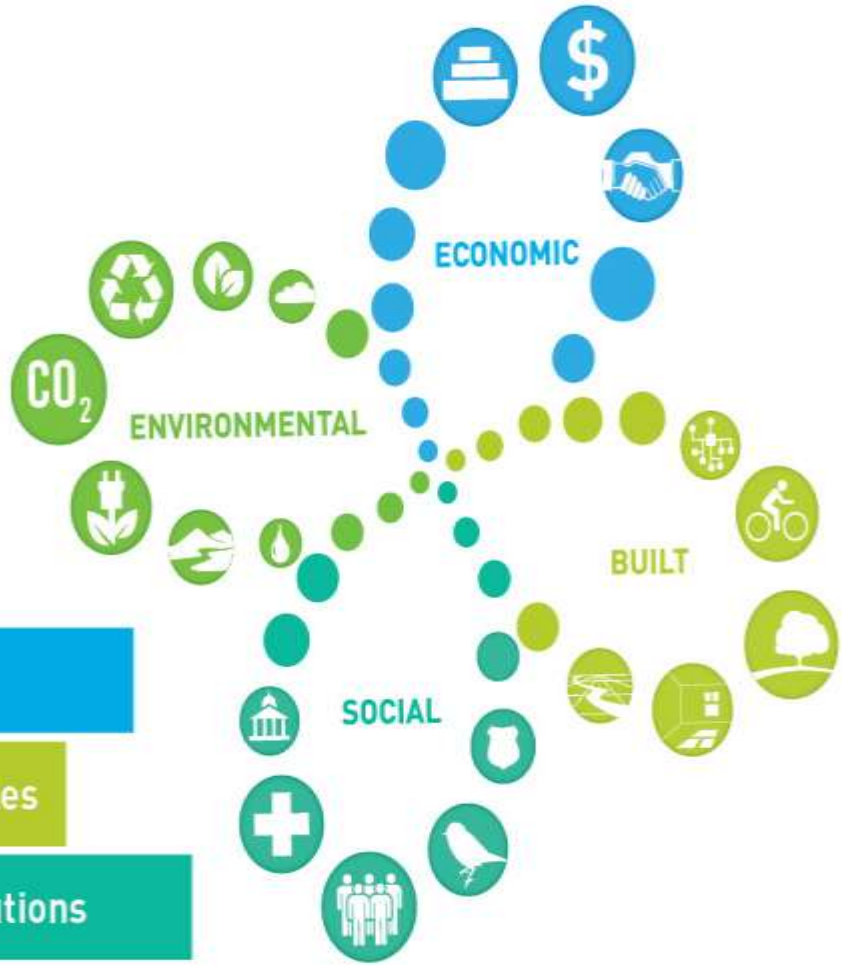


SASAKI'S SUSTAINABLE SOLUTIONS

At Sasaki, **we know our work will contribute to the resilience** of the world's built environment, natural environment, society, and economy. The decisions we make in our projects today will affect the ability of future generations to meet their needs.

Across the breadth of our practice and through the depth of our work, Sasaki provides **Sustainable Solutions at multiple scales**—the region, the city, the neighborhood, the campus, the building. Across these scales, we integrate multiple professions, including planning and urban design, landscape architecture, architecture, civil engineering, strategic planning, and interior design.

We believe the most **creative and enduring solutions** across the full spectrum of design challenges will emerge from a strong foundation in sustainability—the "triple bottom line" of the social, environmental, and economic conditions unique to each project.



our work contributes to resilience

our work provides sustainable solutions at multiple scales

our work results in creative and enduring design solutions

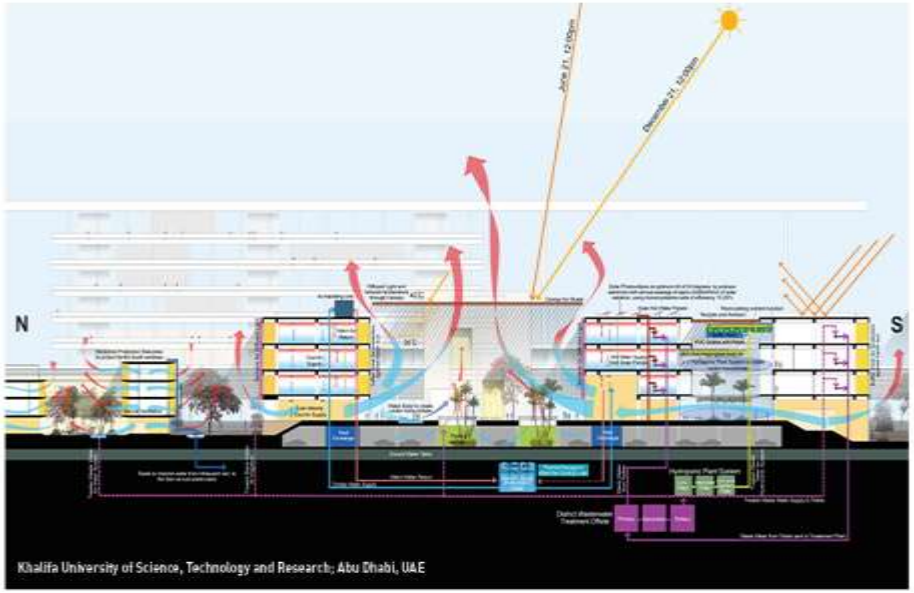
ENERGY

Sustainable environments utilize energy efficiently and limit the need for fossil fuels: Our goal is to plan and design high performance environments that promote the use of renewable energy.

University of California Davis, Graduate School of Management and Conference Center/Maurice J. Gallagher Jr. Hall (GSM); Davis, California

Integrated systems and BIM result in **74% energy savings**

A comprehensive approach to **building orientation, shade, ventilation, and water management**



Khalifa University of Science, Technology and Research; Abu Dhabi, UAE

Wind turbines along the waterfront **produce electricity**

Operable clerestory windows provide daylight and promote natural ventilation

Corpus Christi Bayfront, North Bayfront Park; Corpus Christi, Texas

University of California Santa Barbara, Student Resource Building; Santa Barbara, California

Sasaki Associates, Inc.; Watertown, Massachusetts

34% electricity reduction achieved through lighting retrofits

Plymouth State University, Welcome Center & Ice Arena; Plymouth, New Hampshire

Geothermal heat pump system **reduces energy use by 30%**

.54W/sf, 46% better than energy code, at **no additional cost**

Photovoltaic energy and shading strategy

Dubai Aerospace University, Master Plan; United Arab Emirates

National Grid, New England Main Office; Waltham, Massachusetts

CO_2 CLIMATE

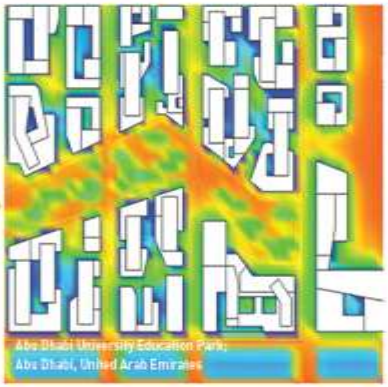
Sustainable environments are responsive to climate: Our goal is to create buildings, landscapes, and plans that are appropriate to their location, and that mitigate/adapt to climate change.


Singapore University of Technology and Design, Singapore

Canopy structures
filter sunlight and circulate air
creating a cooler microclimate

Pocket parks
provide respite
from the urban environment

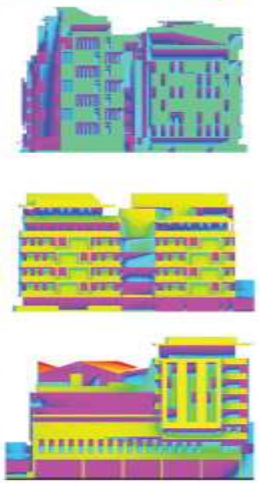
Street and building orientation
minimize the urban heat island effect and provide shade

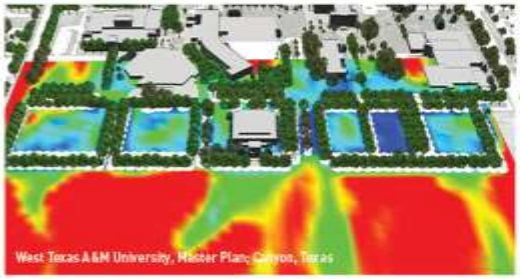

Abu Dhabi University Education Park; Abu Dhabi, United Arab Emirates

Facade studies assist in
reducing heating and cooling loads

Enhanced microclimates
create shaded outdoor spaces


St. Edward's University, Landscape Master Plan and Landscape Improvements, Austin, Texas

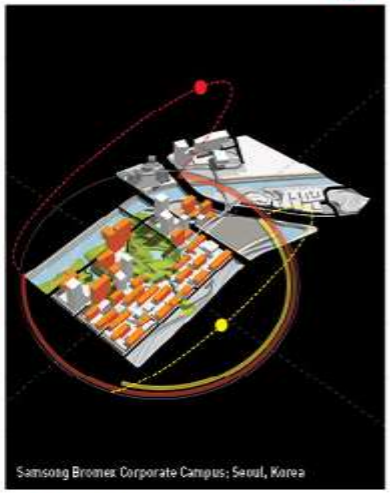

Lulu Neighborhood 3; Abu Dhabi, United Arab Emirates


West Texas A&M University, Master Plan; Canyon, Texas

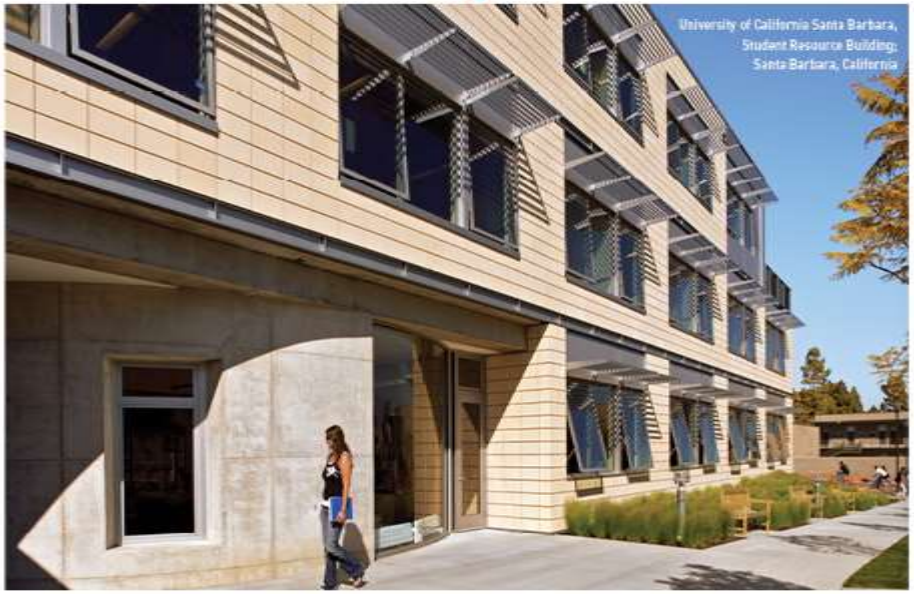
Windbreaks
mitigate strong winds

Optimal solar and wind orientation
minimizes heat gain and blocks northern winds


Greenacre Park; New York, New York


Samsung Bromex Corporate Campus; Seoul, Korea

Louvered shading
reduces heat gain and cooling loads


University of California Santa Barbara, Student Resource Building; Santa Barbara, California

ECOLOGY

Sustainable environments are respectful of the flora and fauna indigenous to the place: Our goal is to preserve and enhance biologically diverse habitats.

Dead Sea Development Zone; Amman, Jordan

Preservation of **ecological systems** in the Tamarisk Eco Reserve

ecological corridors provide for wildlife habitat and movement, increase rainwater infiltration, and promote outdoor recreation

Jiading Central Park; Shanghai, China

Five acre wild flower meadow reduces mowing costs and saves **$32,400 annually**

Minimizing human impact, establishing habitat corridors and creating riparian buffers **restores degraded coastal wetlands**

Wilkes-Barre River Common; Wilkes-Barre, Pennsylvania

Beidaihe New District Master Plan; Qinhuangdao, China

Jinan North District Urban Design; Jinan, China

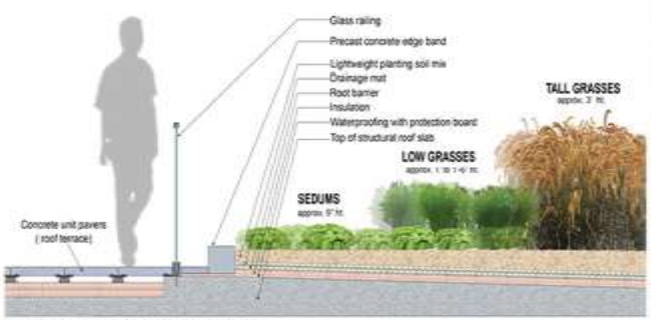
Restoring ecologicial function improves habitat conditions and creates a valuable amenity

The Walden Woods Project; Bristers Hill; Concord, Massachusetts

Interpretive signage and wayfinding **educates visitors**

Removing invasive plant species and reducing erosion **preserves salt marshes**

native sea grass **roof garden** minimizes stormwater runoff and reduces heat island effect



601 Congress Street, Landscape Architectural Services; Boston, Massachusetts

Dorchester Shores Beach Restoration, Savin Hill/Inner Malibu Beach; Dorchester, Massachusetts

WATER

Sustainable environments respect the hydrological cycle and watersheds: Our goal is to provide creative and innovative strategies for preserving watersheds, enhancing water quality, and decreasing the demand for potable water use.

2200 Pennsylvania Avenue; Washington D.C.

A green roof, cistern, and water feature collect and treat **28,500 gallons** of rainwater for irrigation

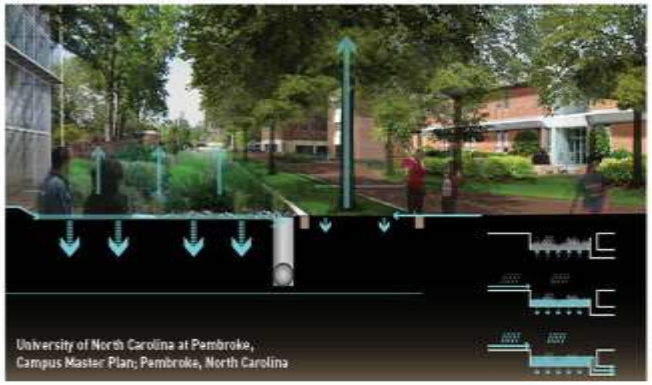
A network of **natural stormwater treatment facilities** mitigates peak loads and filters stormwater

A renovated reflecting pool that treats river water and reclaimed sump water saves **1.35 million gallons** of potable water annually

Lincoln Memorial, Landscape and Reflecting Pool; Washington D.C.

Interpreting the **H_2O footprint**

water-receiving landscapes mitigate existing flooding problems



University of North Carolina at Pembroke, Campus Master Plan; Pembroke, North Carolina

Wilmington Waterfront Development, Master Plan; Los Angeles, California

Dead Sea Development Zone; Amman, Jordan

The design protects three natural systems mountainous wadis, alluvial wadis and rivers, and an existing Tamarisk grove

Lakeside-Southworks, Master Development Plan; Chicago, Illinois

Rainwater provides 30% of domestic water supply

Drexel University, Wellness Center; Philadelphia, Pennsylvania

Raingardens integrate with the building and landscape

College of William and Mary, School of Education; Williamsburg, Virginia

MOBILITY

Sustainable environments address mobility in all of its forms: Our goal is to plan for a comprehensive system of pedestrian, bicycle, transit, and vehicular movement—a system that coordinates with the land use patterns and the transportation policies of a campus, community, or region.

Cedar Rapids Riverfront; Cedar Rapids, Iowa

Environmental education trails link regional systems and neighborhoods to the riverfront

The Charlotte LRT corridor **bridges** uptown and downtown **districts**

Charlotte CTC Arena Station; Charlotte, North Carolina

Euclid Avenue Bus Rapid Transit; Cleveland, Ohio

University of California Santa Barbara, Student Resource Building; Santa Barbara, California

29% reduction in single-occupant commuting through alternative transportation plans

Sasaki Associates, Inc.; Watertown Massachusetts

Investments in **pedestrian networks** encourage walking

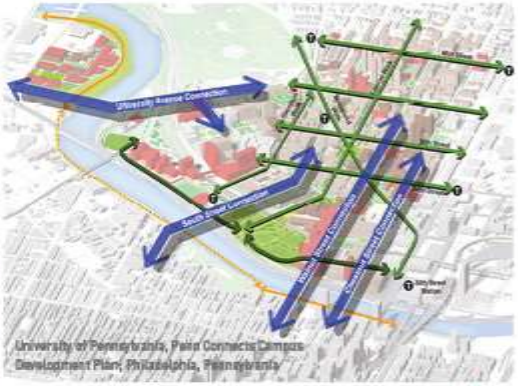
2 million transit trips decrease carbon emissions by **8,816 metric tons**

A comprehensive bicycle network provides mobility options

Auburn University, Campus Sign Standards; Auburn, Alabama

Pardall Corridor serves over **10,000 bike riders each day**

Fordham University, Campbell, Sattler & Conley Residence Halls; Bronx, New York



University of Pennsylvania, Penn Connects Campus Development Plan; Philadelphia, Pennsylvania

Circulation improvements connect urban districts

MATERIALS

Sustainable design demands non-toxic, low carbon materials: Our goal is to specify sustainable materials procured in close proximity to the site and that do not contribute to environmental degradation during extraction, manufacture, or delivery.

Adaptive reuse to create a new law school maintains

95%

of the building

A **new park** incorporates

existing ore wall

Integrated design strategies

encourage recycling

Adaptive reuse of buildings makes use of

embodied energy

Recycling and salvaging materials diverted

95%

of construction waste from landfills

Salvaged wood

from an old Thomas Edison manufacturing facility became the

ceiling of a new dining hall

Crushed stonedust, preserved pier piles, local brick, marine wood, and recyled granite

are utilized in the waterfront park.

Bowling alleys

transform into

conference tables

COMMUNITY

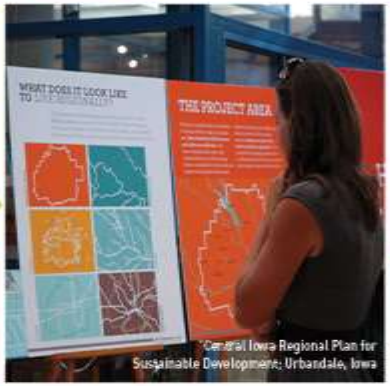
Sustainable environments foster a sense of community: Our goal is to create environments that encourage community engagement and interaction.


St. Edward's University, Landscape Master Plan and Landscape Improvements; Austin, Texas

Climate responsive design creates spaces for community engagement

A park serves as a natural buffer between port operations and adjacent residences

An integrated communication process builds community support



Central Iowa Regional Plan for Sustainable Development; Urbandale, Iowa

Multipurpose spaces foster **a sense of community**

Open space connects the downtown to the natural resources of the river corridor


Central Indianapolis Riverfront, Master Plan; Indianapolis, Indiana


University of Massachusetts, Recreation Center; Amherst, Massachusetts


Lulu Neighborhood 3; Abu Dhabi, United Arab Emirates

Shaded pedestrian routes **bring people together**

Thoughtful urban design provides **places for people**


Wilmington Waterfront Park Master Plan; Los Angeles, California


National Harbor; National Harbor, Maryland

A landmark plaza becomes the heart of an emerging urban core of **mixed-use development**


Waterway Square; The Woodlands, Texas

Mission

PEOPLE

Meet growth targets for 5,000 additional students, 160 additional tenured faculty, and related personnel growth.

MISSION

Develop strategies for supporting the mission to "Go Big" and teach, research, and serve.

A Strategic Plan for UNL: Setting Our Compass

General Strategies for Success

1. Resource-Maximizing Strategies
2. Resource-Investment Strategies
3. Operational Strategies

ATHLETICS

Support the athletic mission of the Nebraska Huskers and role in the Big 10 conference

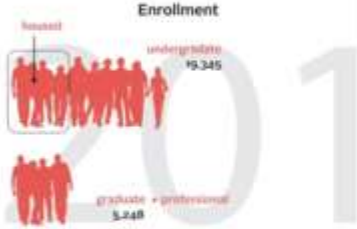
PLACE

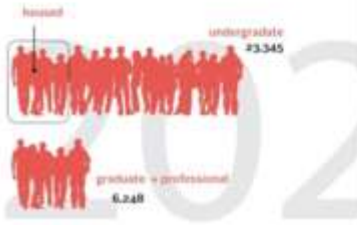
Establish a sense of place that is reflective of a Big Ten Institution while preserving the character and image of UNL

COMMUNITY

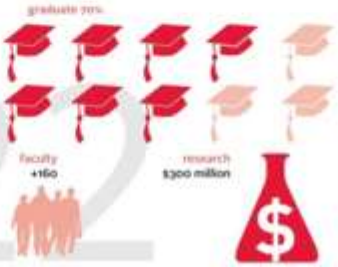
Foster collaboration among UNL and the surrounding community

Enrollment





Graduation, Tenure Faculty, Research $$$

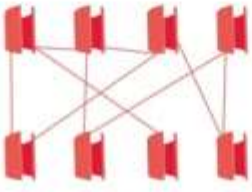


Teams

MEN	WOMEN
Baseball	Basketball
Basketball	Bowling
Cross Country	Cross Country
Football	Golf
Golf	Gymnastics
Gymnastics	Rifle
Tennis	Soccer
Track and Field	Softball
Wrestling	Swimming and Diving
	Tennis
	Track and Field
	Volleyball

Campus Art

Campus Art Strategy



On-campus Housing

Environment

LAND

Reserve the land for the land grant mission

HYDROLOGY

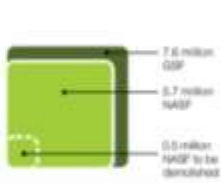
Incorporate green strategies for stormwater management

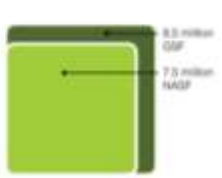
LANDSCAPE

Create a "working landscape." Utilize native plants, minimize potable water, herbicide and pesticide use

SPACE

Provide the facilities needed to support the mission



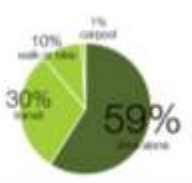


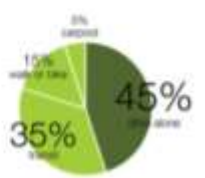
INFRASTRUCTURE

Review the capacity, condition and location of existing infrastructure

MOBILITY

Reduce emissions by decreasing solo-occupant vehicle use





2017

2022

Resources

WATER

Reduce potable water consumption per square foot

Annual Water Consumption (2006)

ENERGY

Aim for greater energy efficiency than required by building codes. Establish EUI targets for new construction and renovation

Annual Electricity and Energy Consumption

EMISSIONS

Aim to become climate neutral by 2050. 10% reduction in purchased electricity, heating, commuting, travel and fleet emissions by 2015

Annual Greenhouse Gas Emissions ($MTCO_2e$)

MATERIALS

Increase the percentage of materials purchased that meet environmentally preferable purchasing guidelines

Local Procurement

Source of procured goods

Source of procured goods

WASTE

Lower landfill impact by reducing solid waste. Encourage recycling

Solid Waste Management

annual per capita waste generation (lbs)

diversion rate

annual per capita waste generation (lbs)

diversion rate

Finances

COST

Coordinate emerging capital projects with projected operational costs

Operational Cost per Square Foot

2012

2022

RESEARCH

Respond to the research mission and potential funding

Research Funding

2012

2022

ENDOWMENT

Coordinate with fundraising efforts of the university. Support the capital campaign.

Endowment

2012

2022

PARTNERSHIPS

Respond to partnership objectives and opportunities

Partnerships with Private Sector

2012

2022

social

people

mission

place

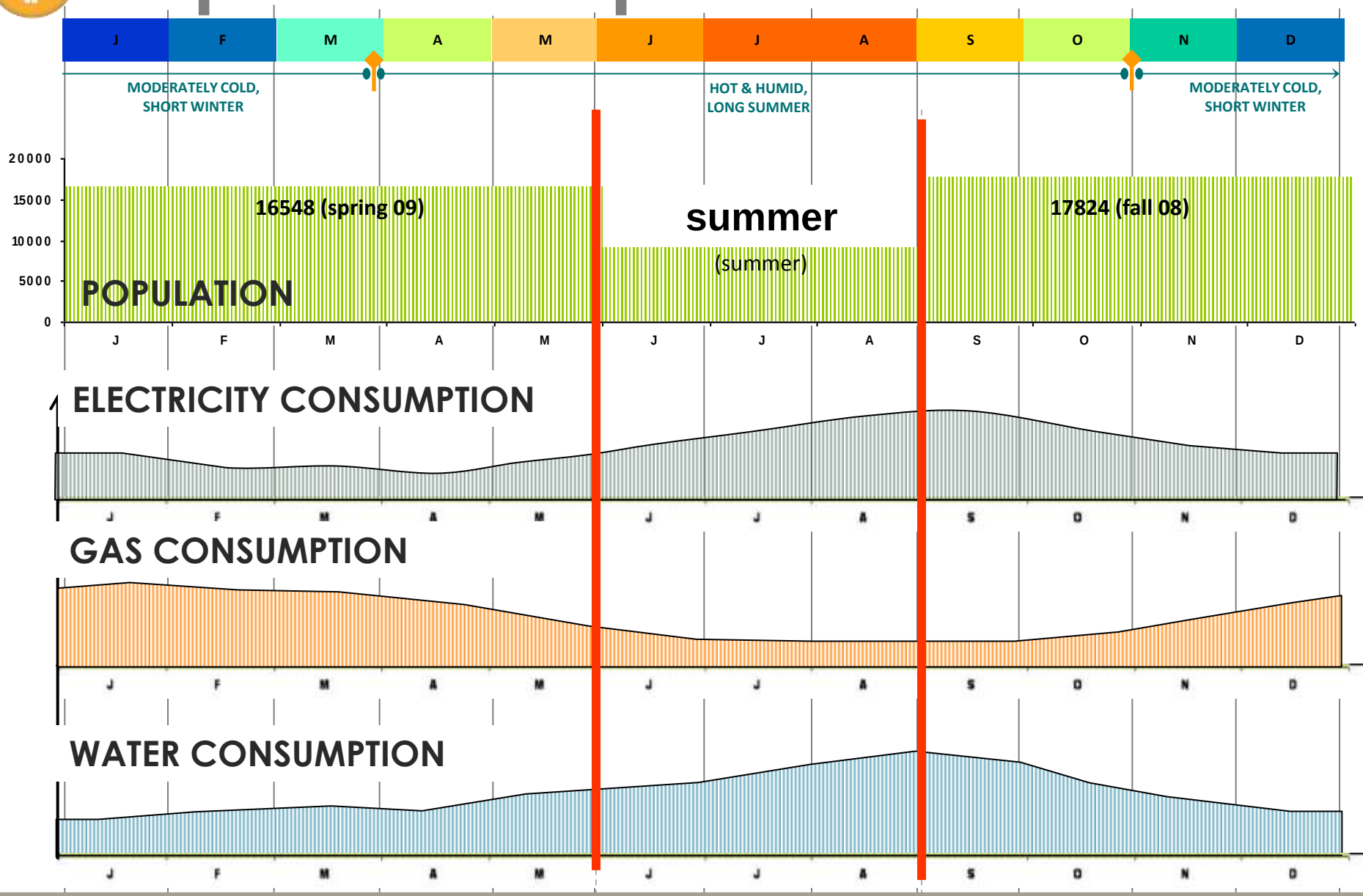
community

Population Impact

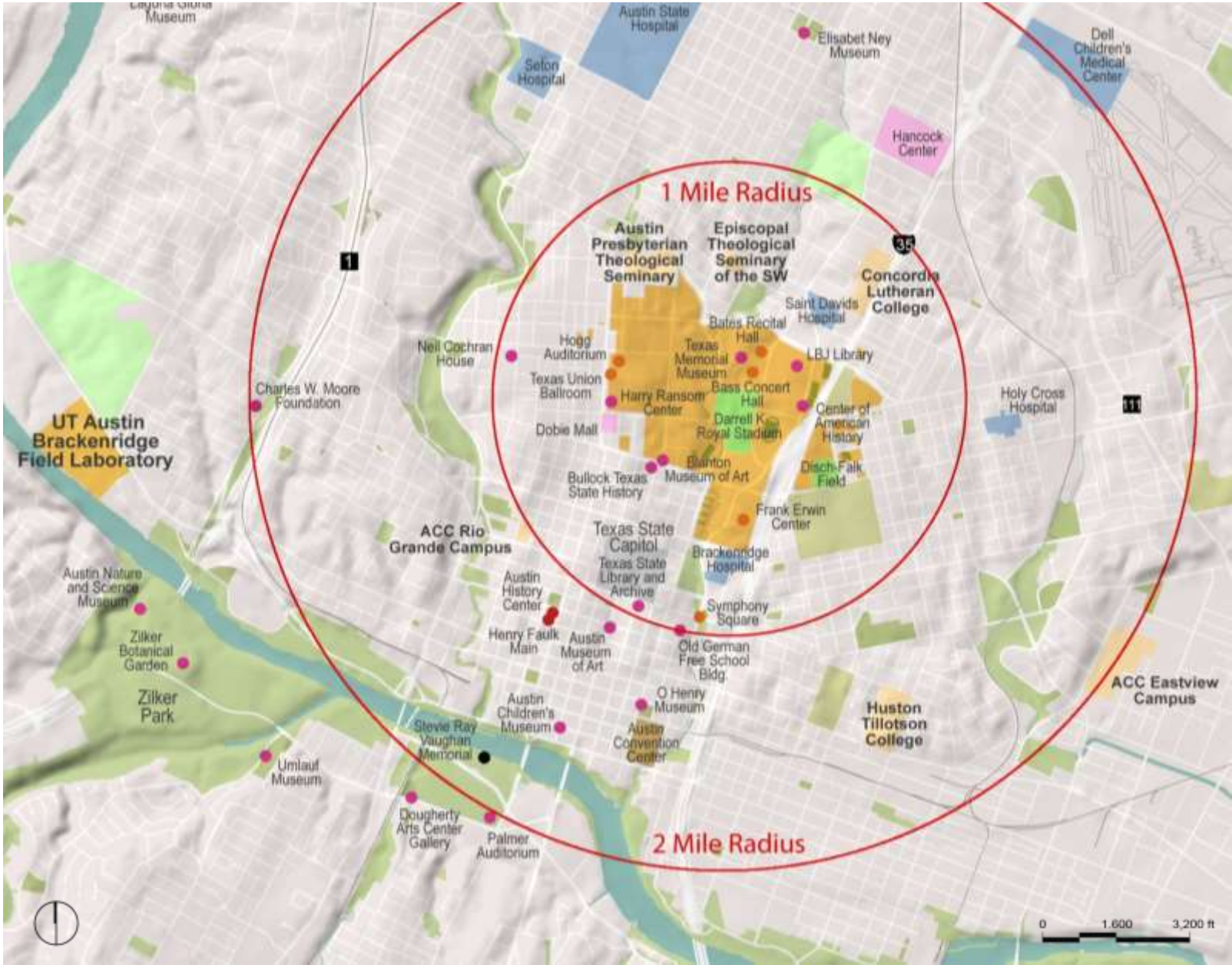
2011

2022

Population Impact



Community



Attraction Types

- Community Property
- Other Institution
- Hospital
- Mall
- Museum
- Concert Hall / Entertainment
- Library

SASAKI

environmental

NATURAL SYSTEMS

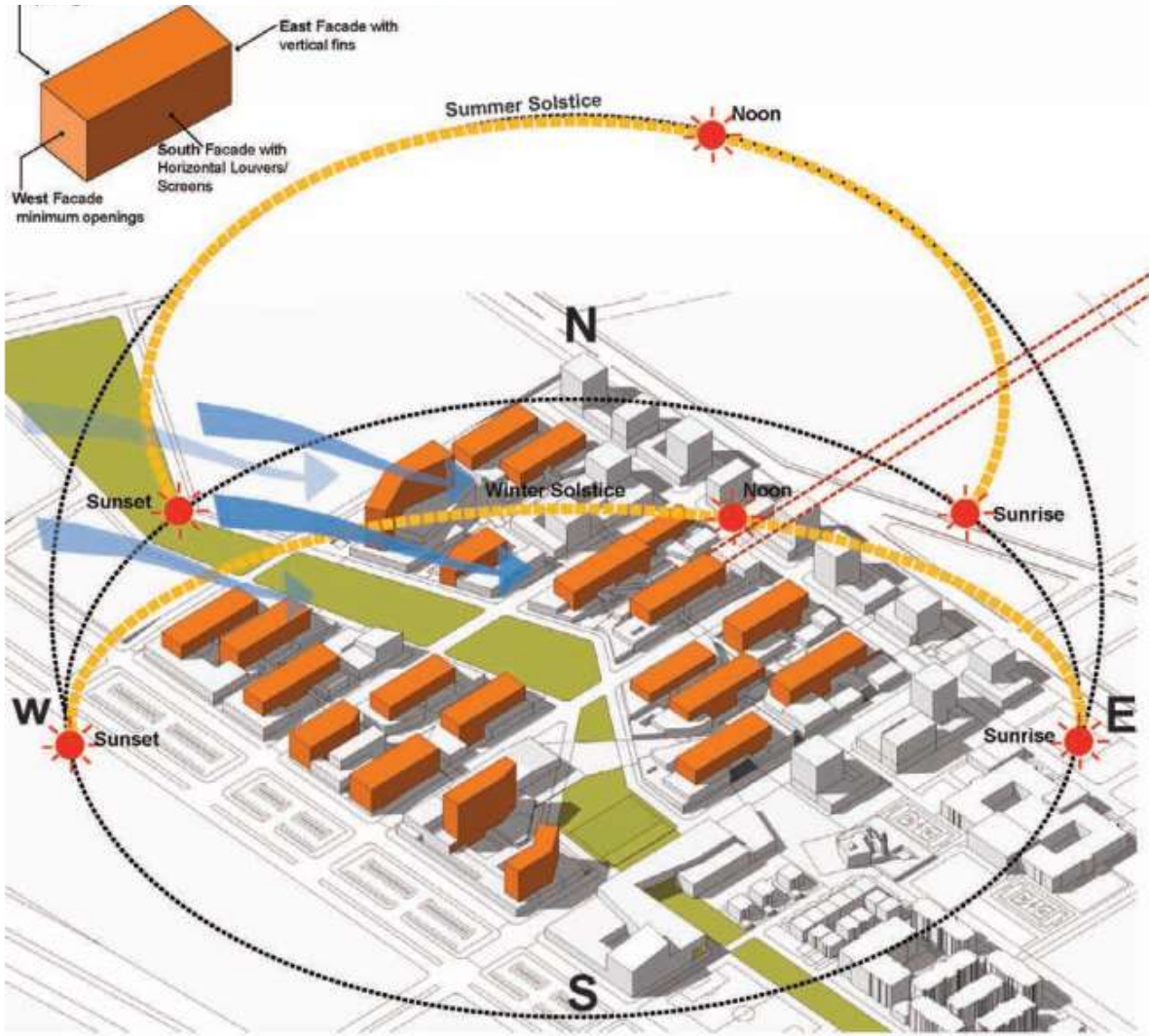
climate

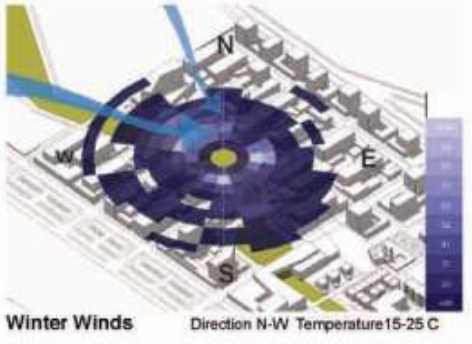
land

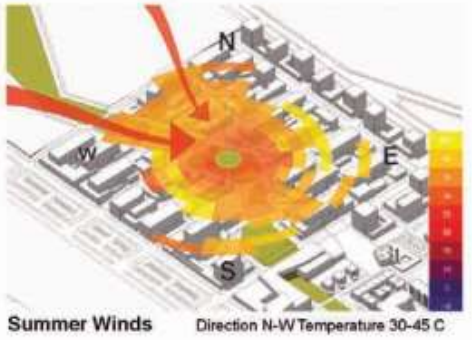
hydrology

climate

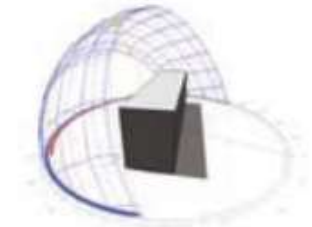
Orientation + Wind Analysis



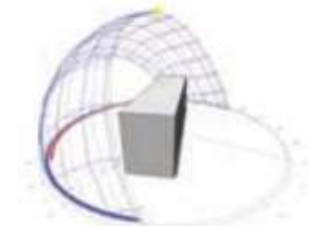




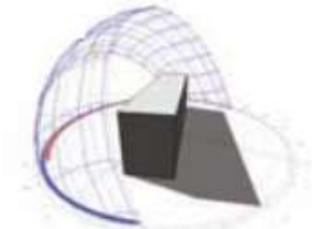
Building Spacing



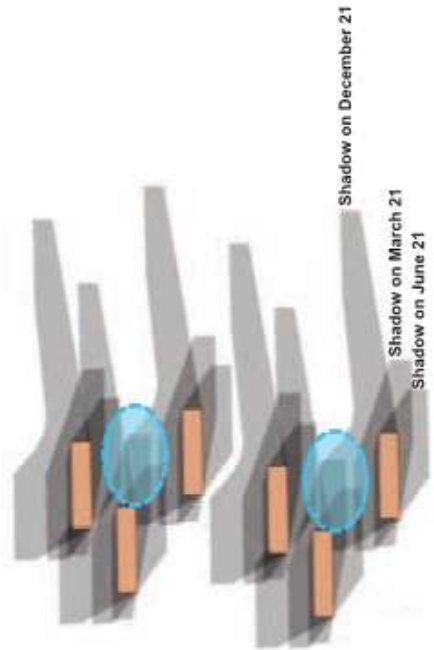
Shadow on March 21
12:00 pm



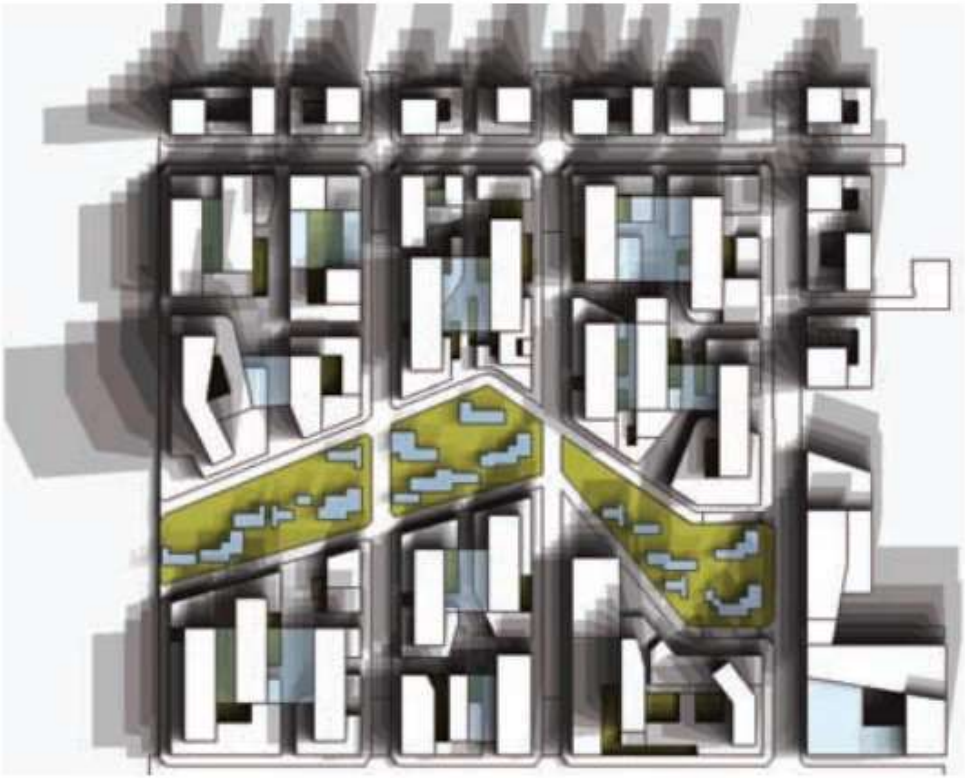
Shadow on June 21
12:00 pm



Shadow on December 21
12:00 pm

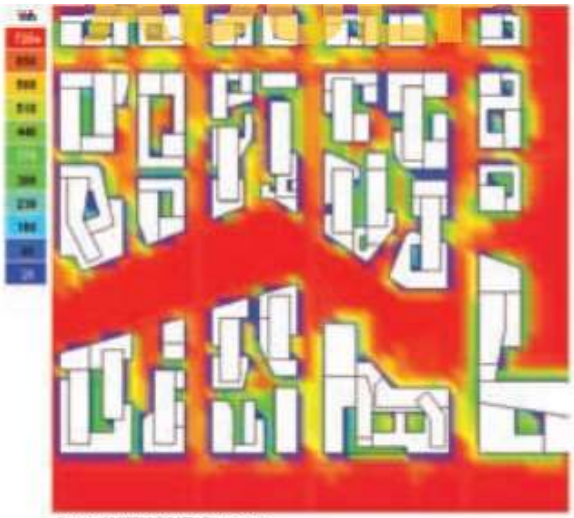


Cooler Micro-climate created between buildings

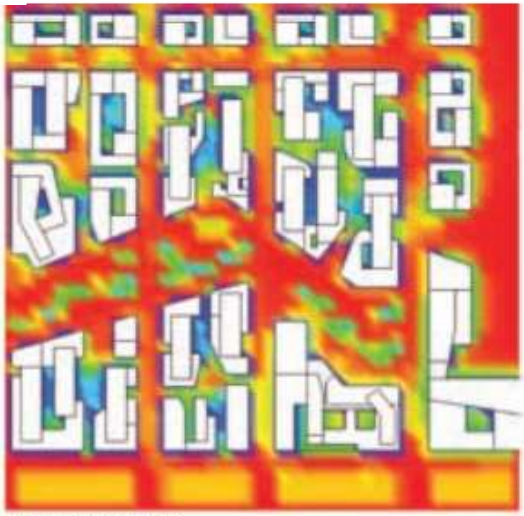


Average Annual Shadow Range (9 am- 4 pm)

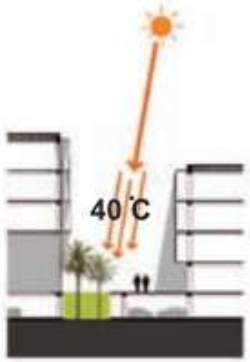
Urban Heat Island Analysis



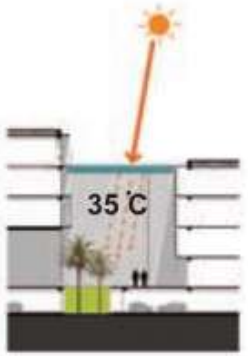
June WITHOUT Canopy



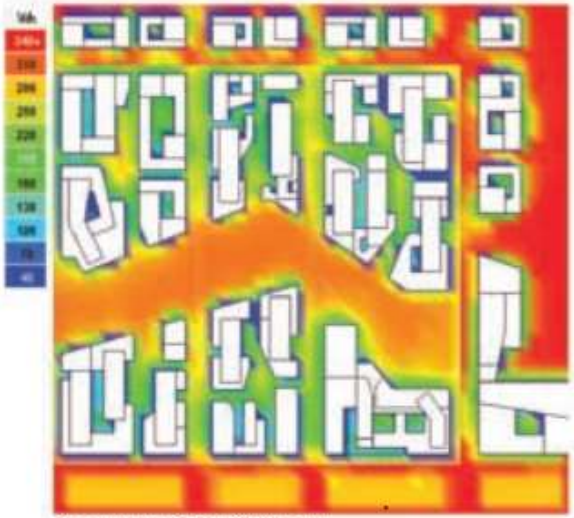
June WITH Canopy



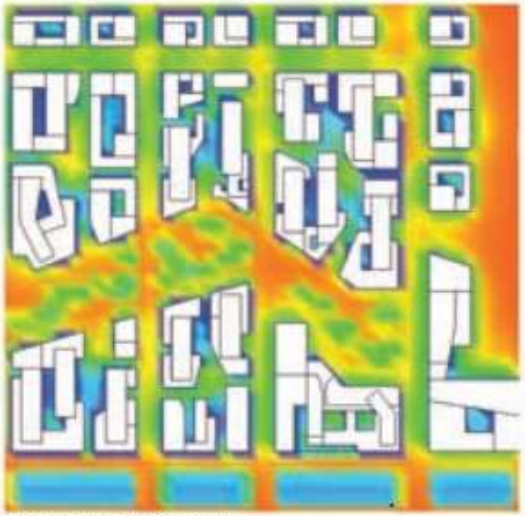
Section WITHOUT Canopy



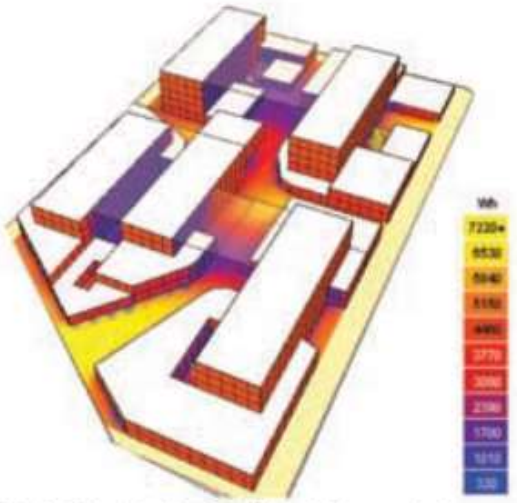
Section WITH Canopy



December WITHOUT Canopy

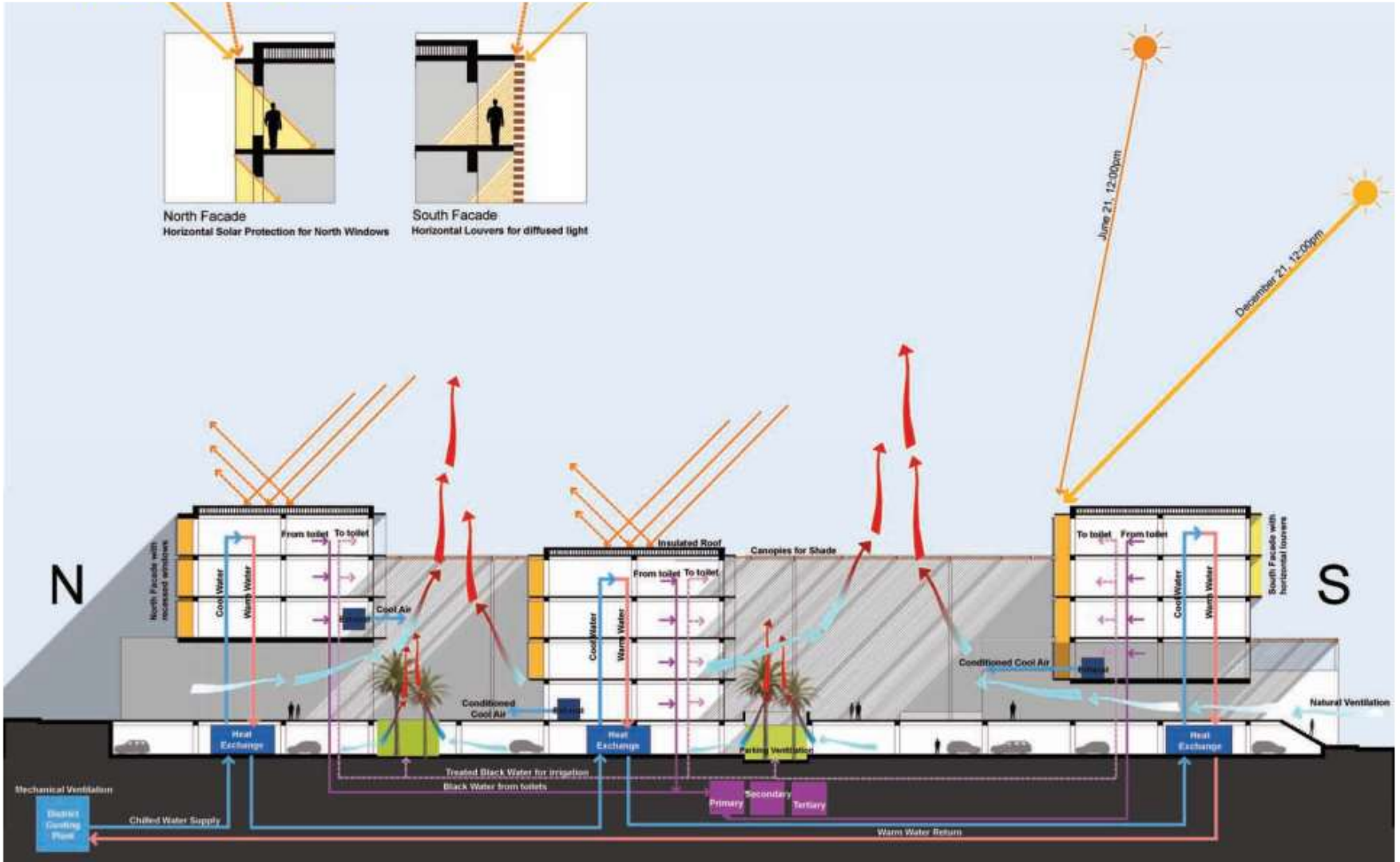


December WITH Canopy



Typical Block Surface Radiation (with canopies)

Sustainable Cooling Strategies

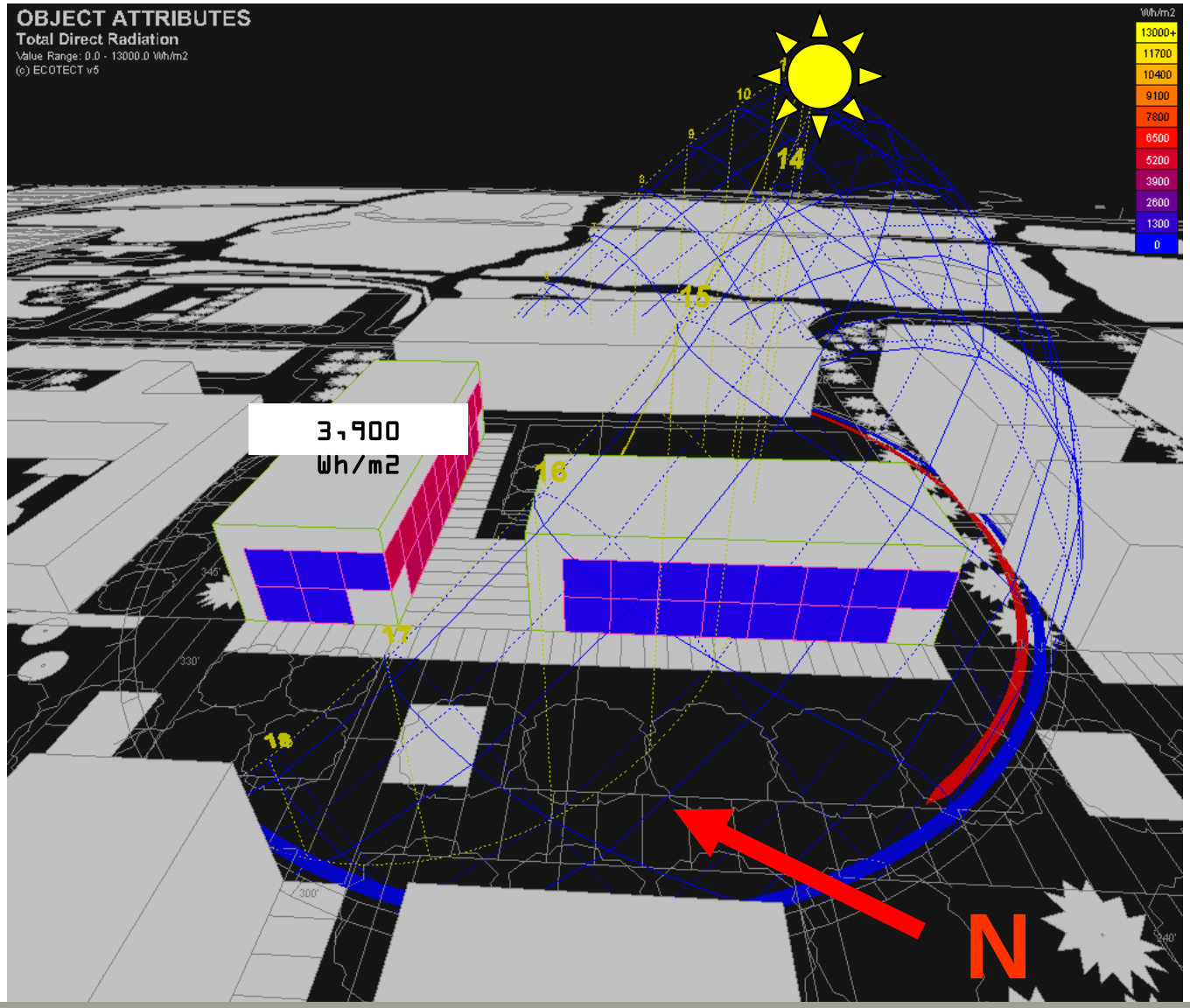


Climate Responsive Design

Solar Gain: summer south facing

Summer

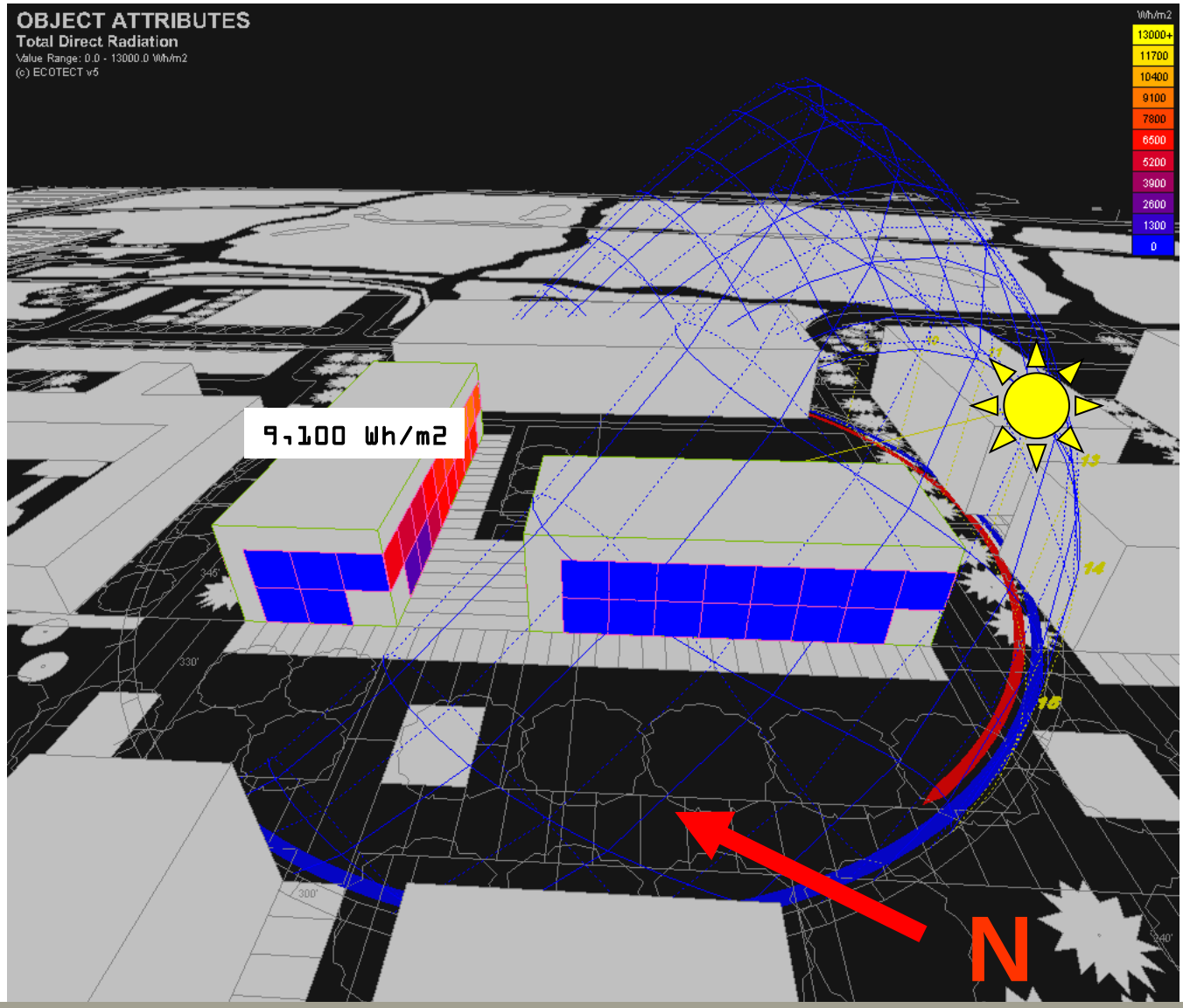
3,900 Wh/m2



Solar Gain: winter south facing

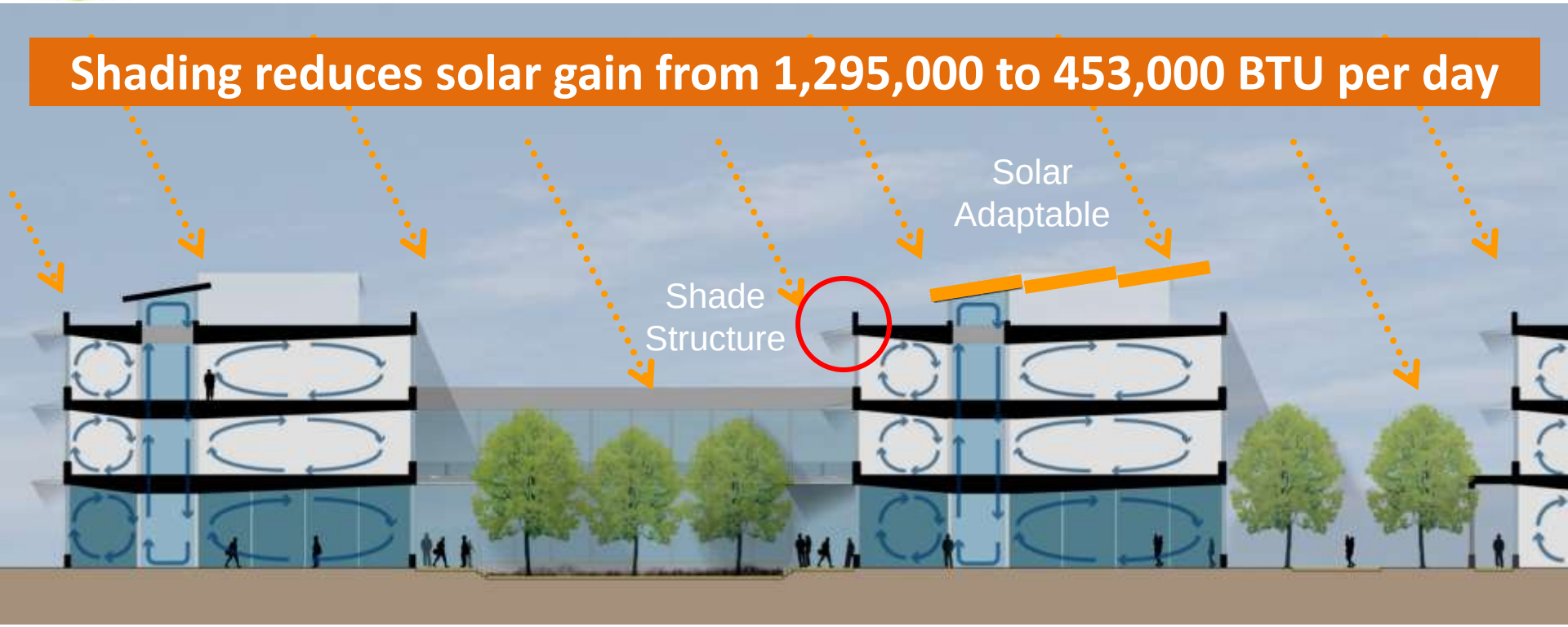
Winter

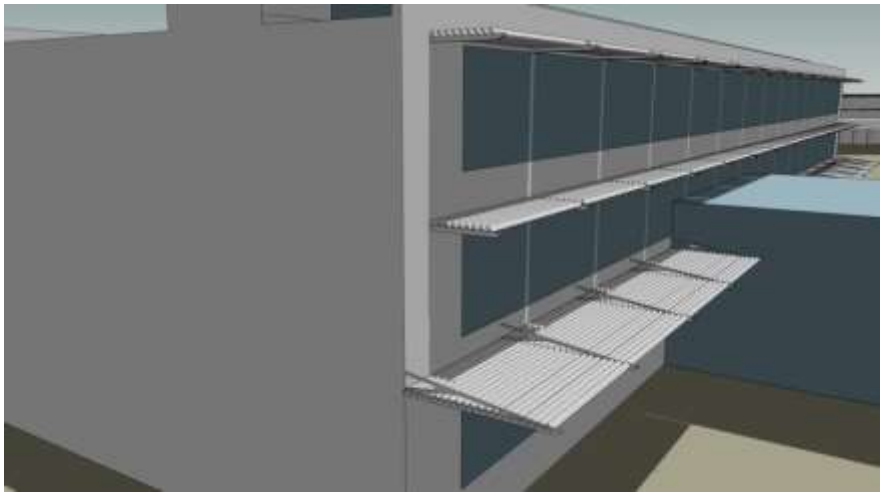
9,100 Wh/m2



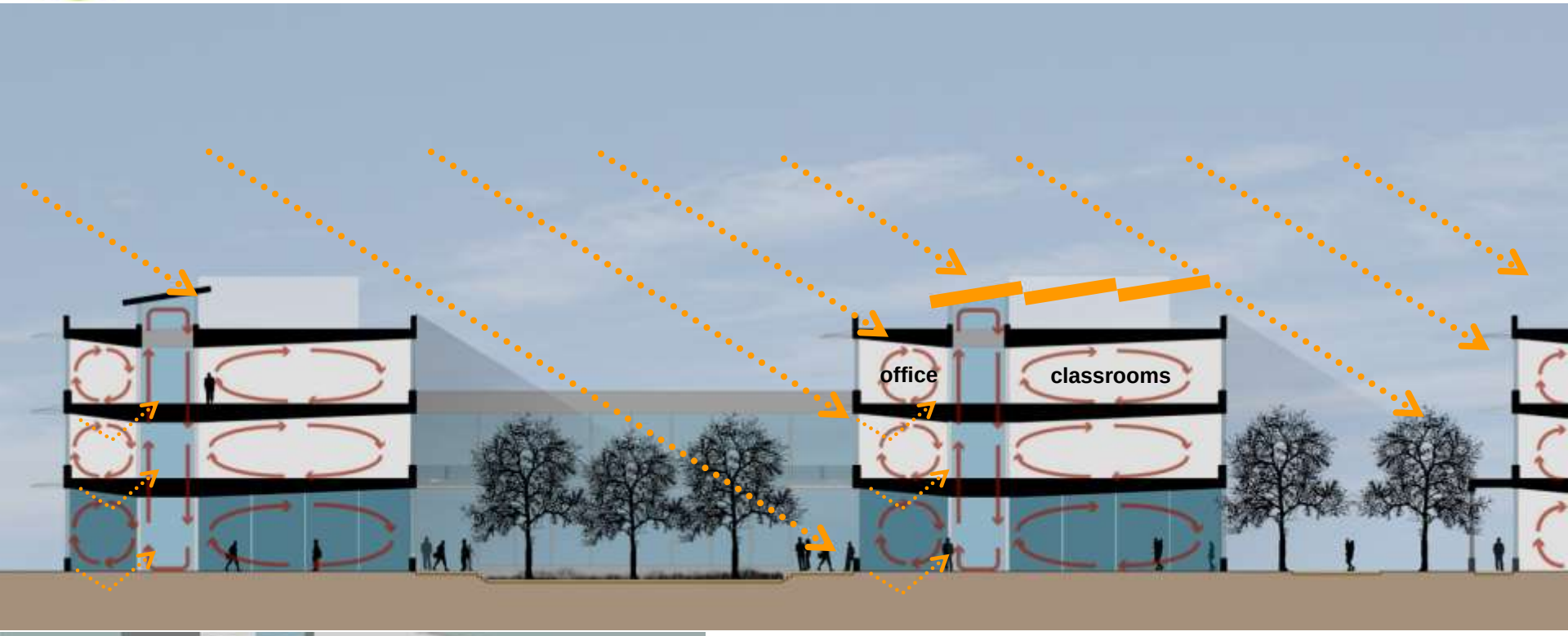
Summer Conditioning Strategy

Shading reduces solar gain from 1,295,000 to 453,000 BTU per day





Winter Conditioning Strategy

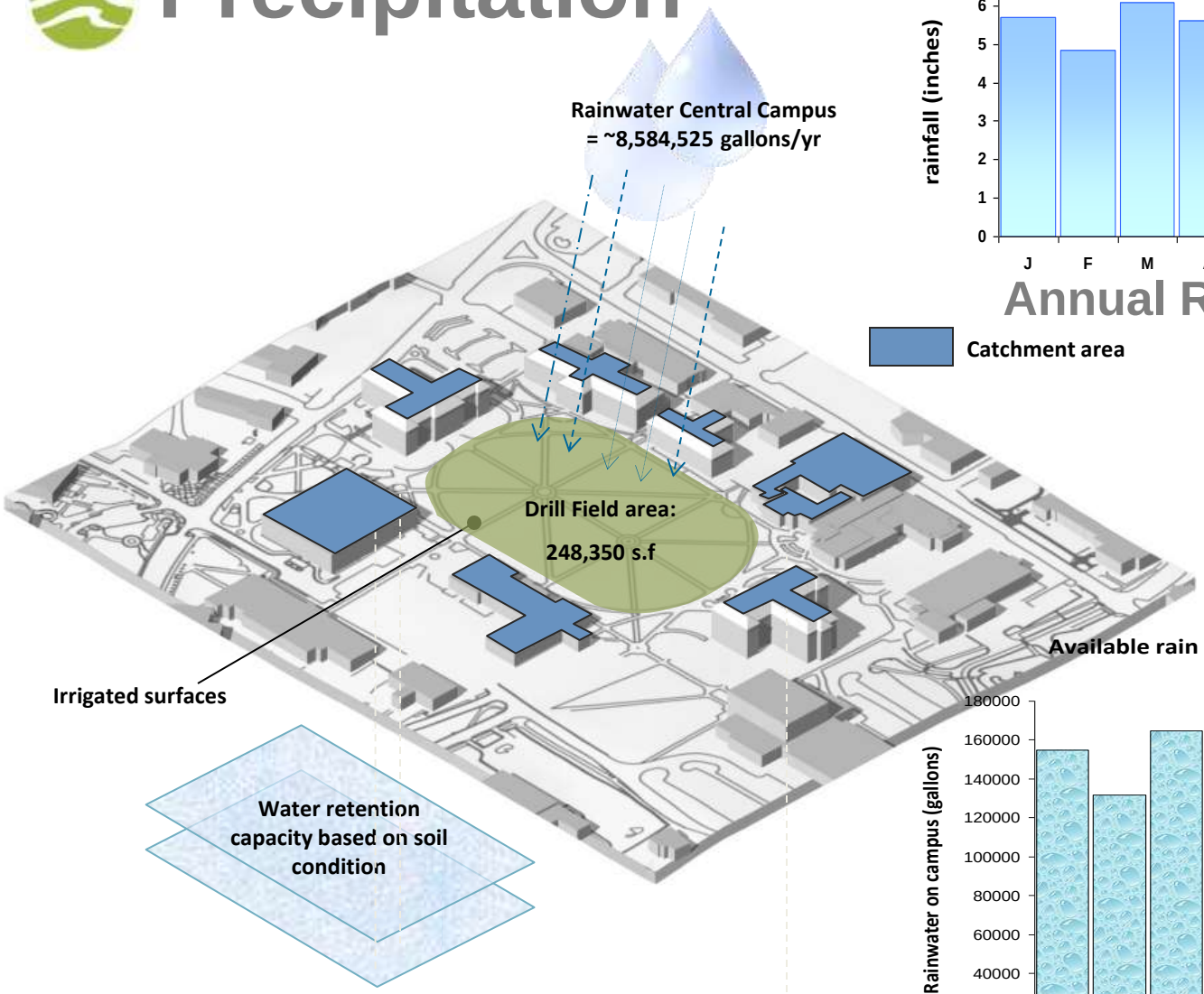


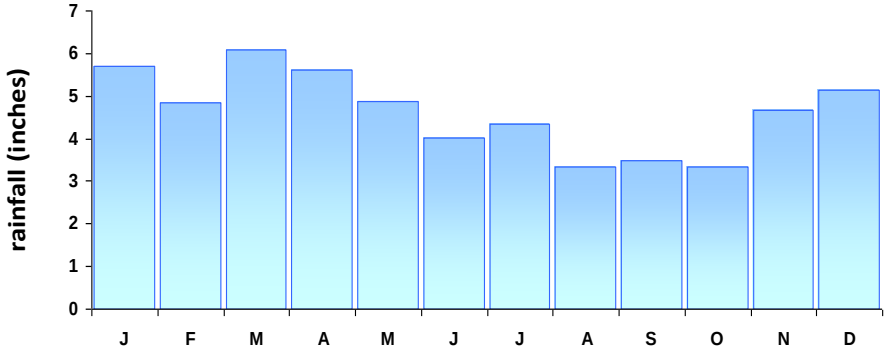
Building Energy Strategies

- orientation
- high performance envelope design
- cool roofs (Energy Star, shaded or green roofs)
- reduce electrical load (lower Energy Use Intensity – EUI)
- design for day lighting
- shading devices and new glazing technology
- ensure sub-metering is in place for each building
- design for solar adaptation
- low occupancy space – south side; high occup.- north side

hydrology

Precipitation

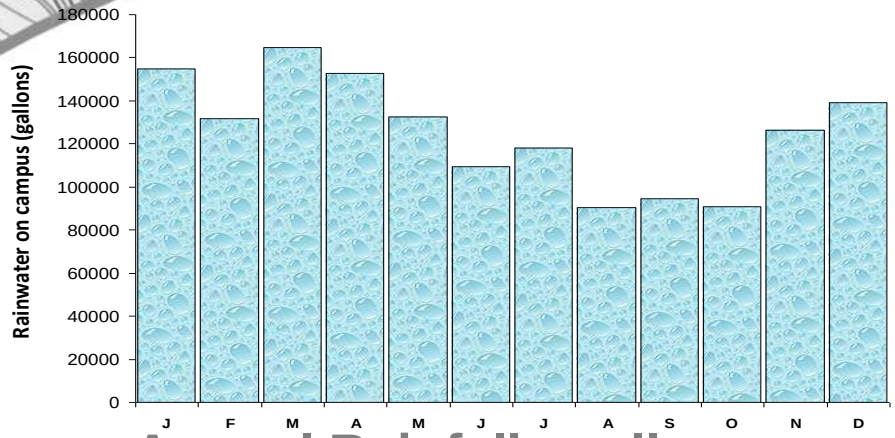




Annual Rainfall - inches

Catchment area

Available rain water falling on the 4400 acres campus



Annual Rainfall - gallons

Topography + Streams

Elevation in Feet

- 720 - 760
- 680 - 720
- 640 - 680
- 600 - 640
- 560 - 600
- 520 - 560
- 480 - 520
- 440 - 480
- 400 - 440

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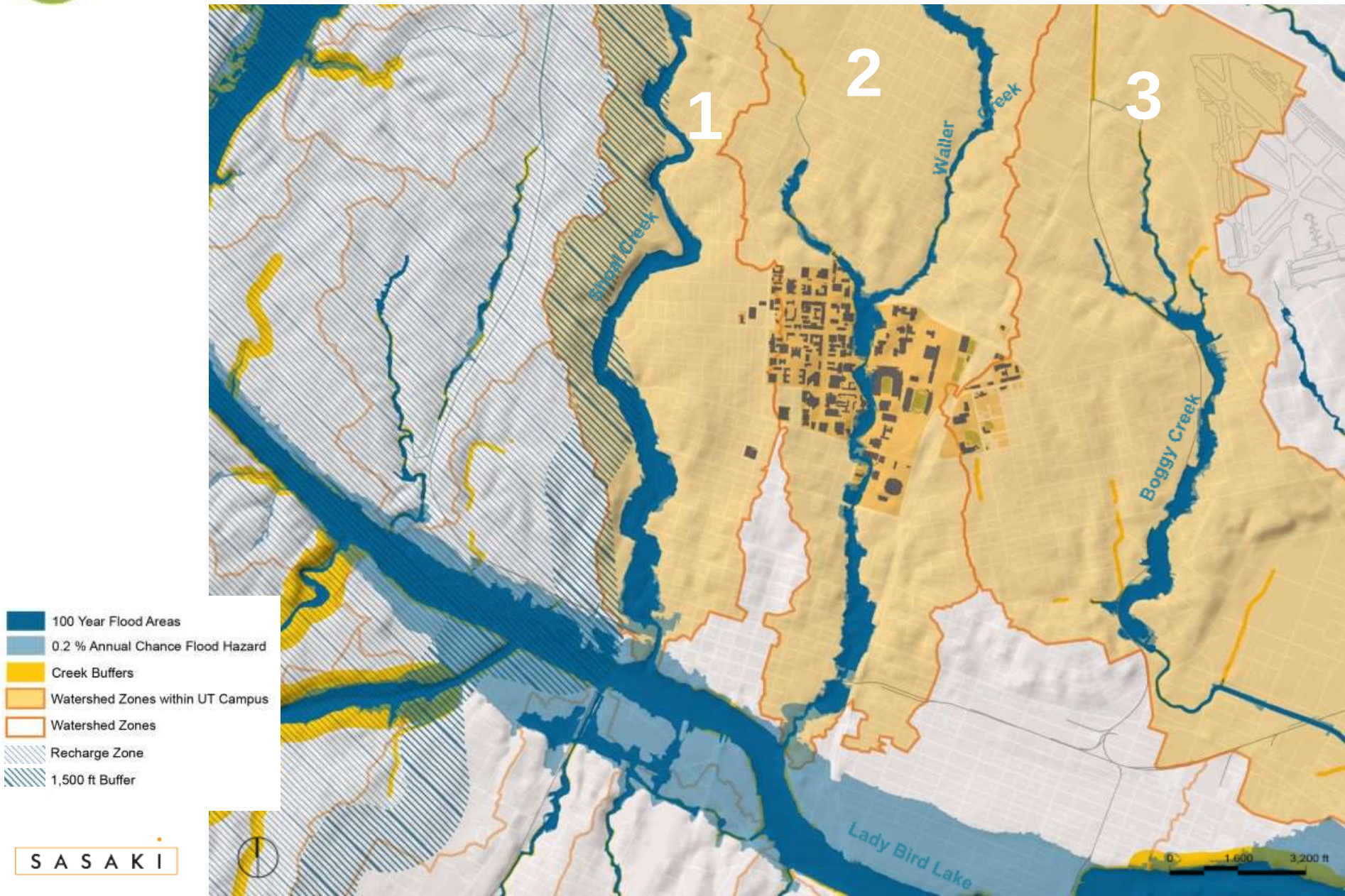
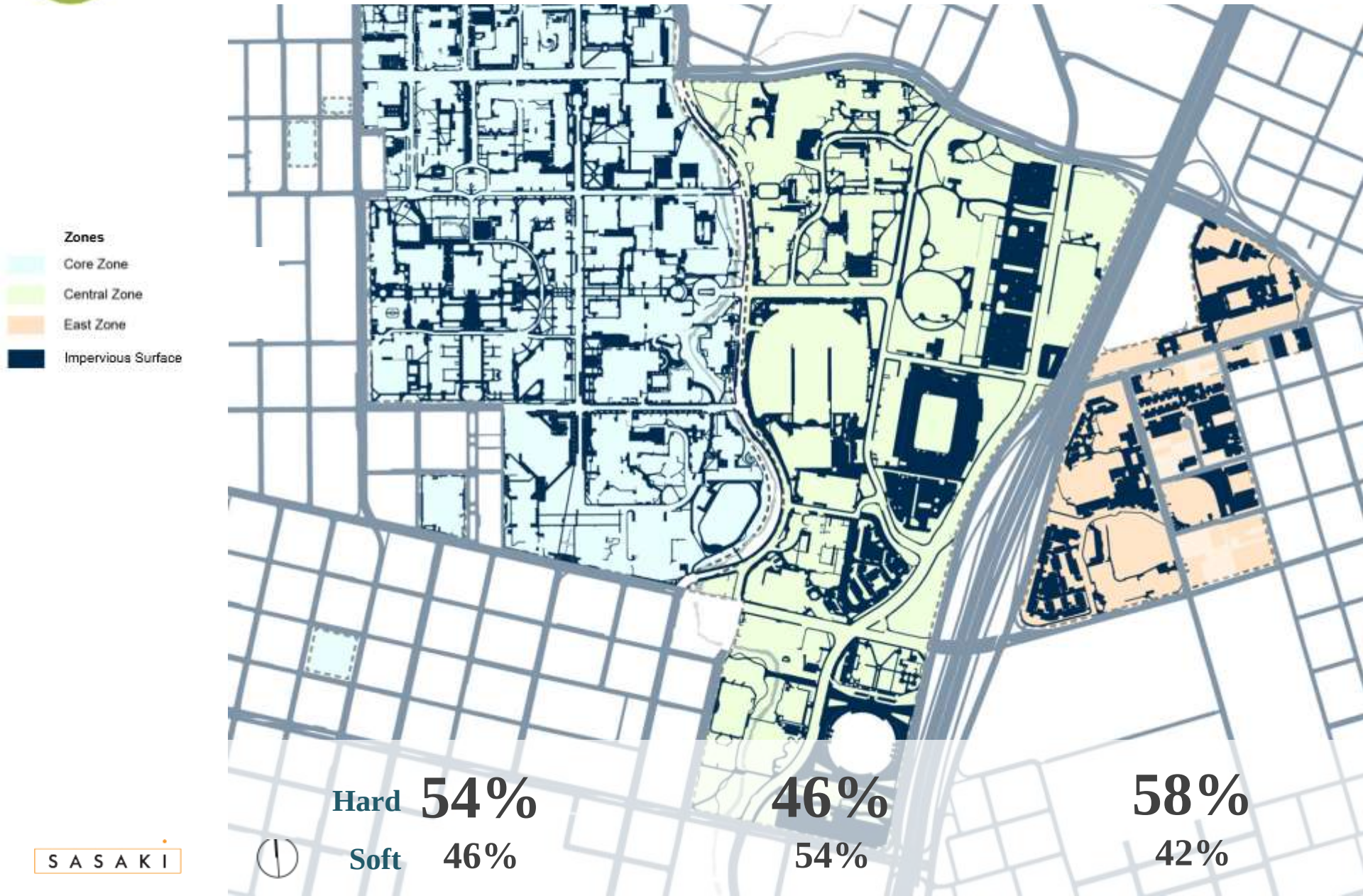
Open Space Structure

SASAKI

Flood Zones & Soil Conditions



Impervious Area



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environmental

BUILT ENVIRONMENT

land use | landscape | space | infrastructure | mobility

landscape

Develop a “working landscape”

Landscape Typology + Maintenance

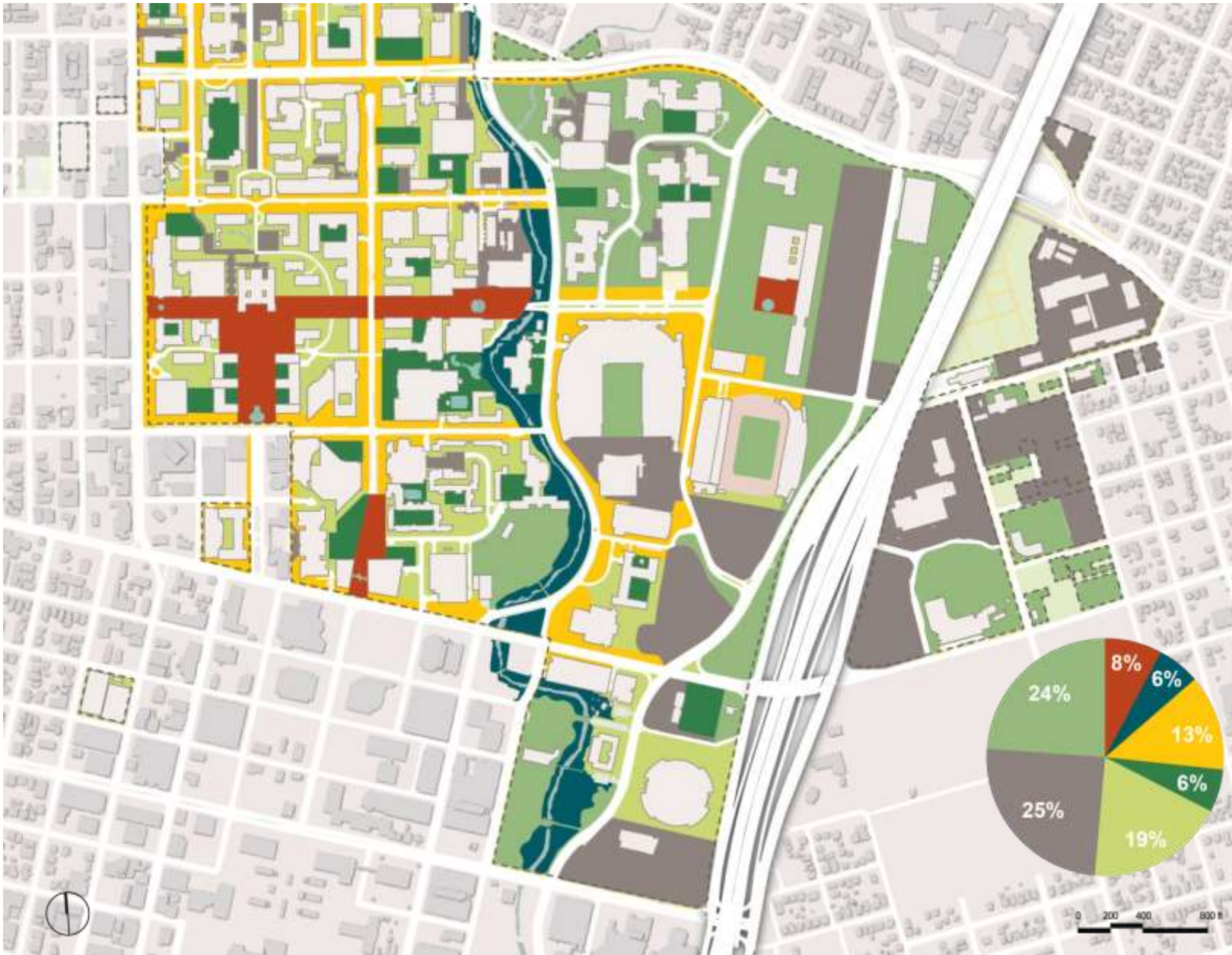
Surfaces

Buildings = 28%

Streets = 8%

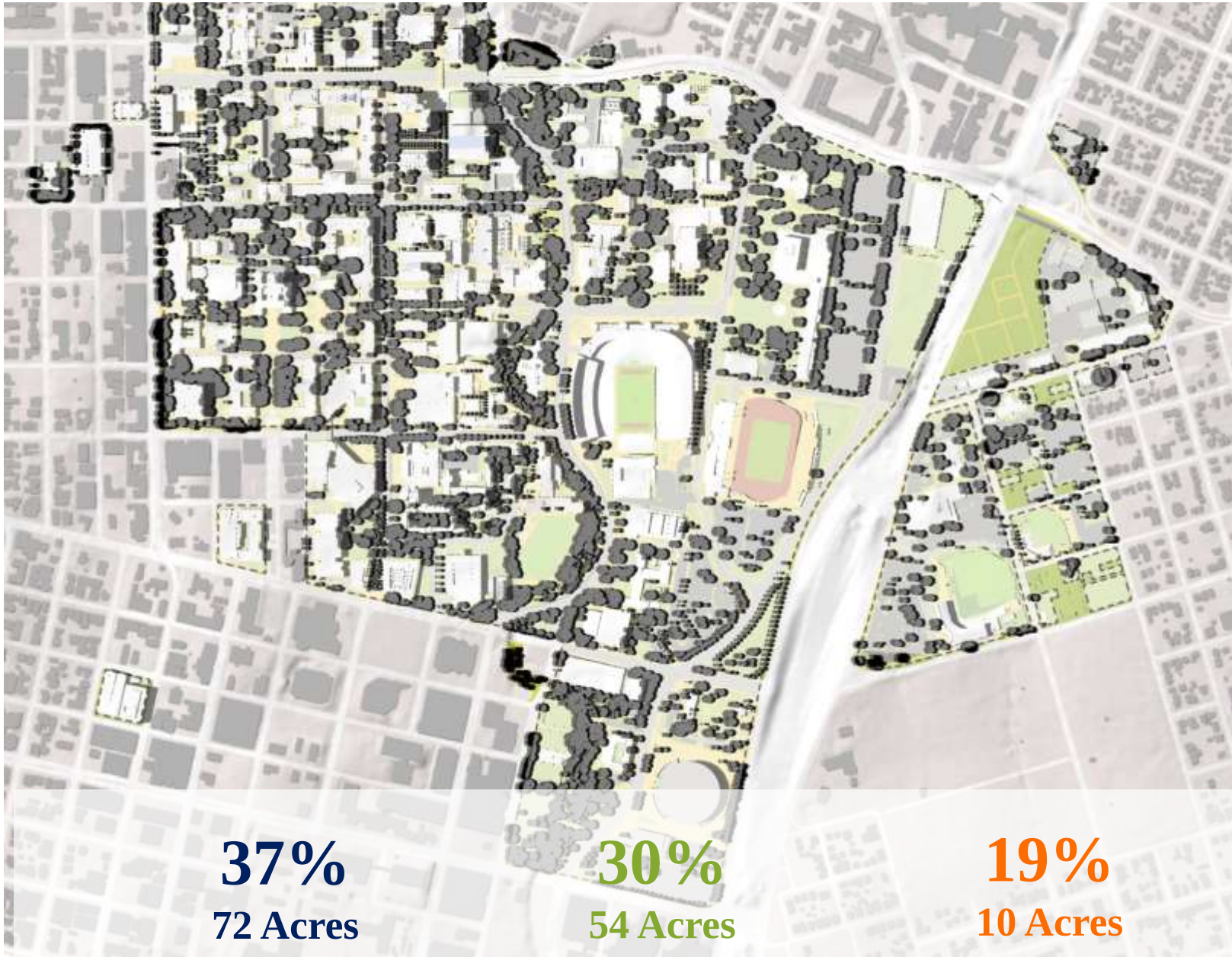
Landscape= 65%

- Civic Space
- Waller Creek
- Streetscape
- Courtyards and Quads
- Connective Space
- Parking and Service
- Open Lawns
- Water



SASAKI

Shade Studies



37%
72 Acres

30%
54 Acres

19%
10 Acres

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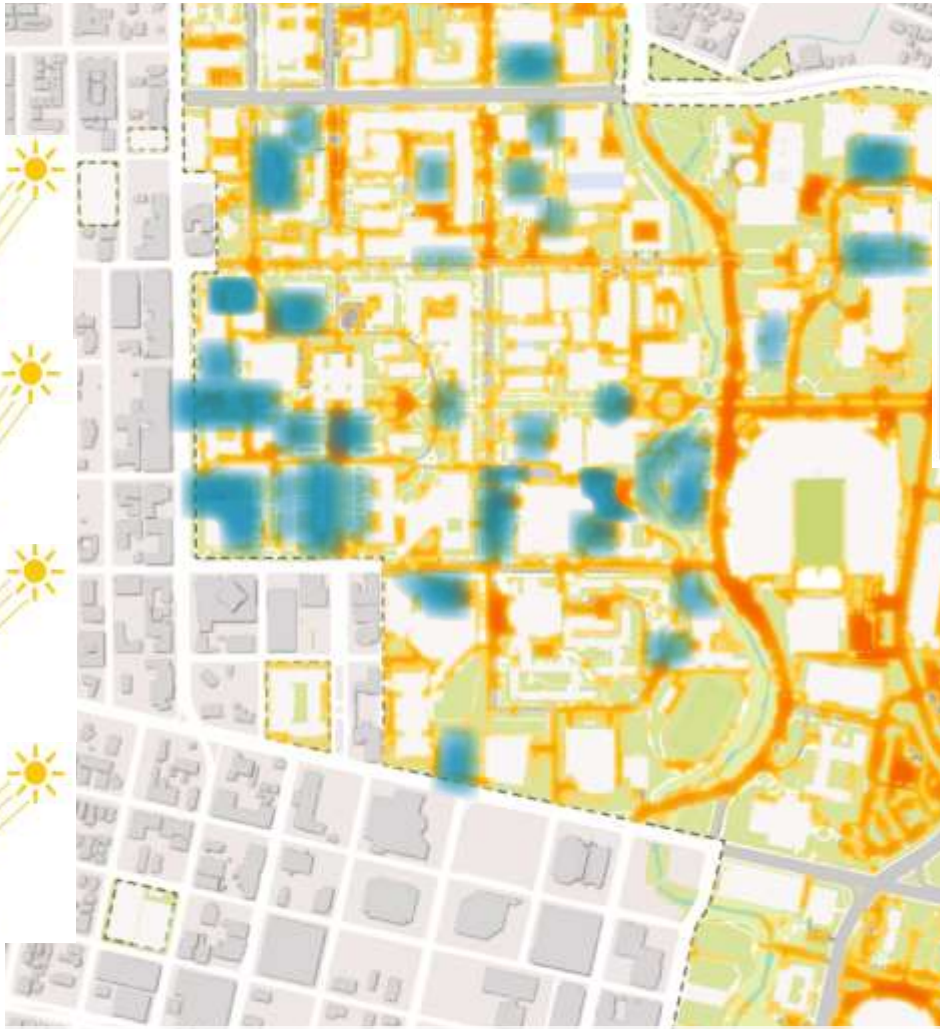
Heat Islands + Human Comfort Zones



	SURFACE TEMPS		AIR TEMPS	
	☀	☀ 🌳	☀ ≈	☀ 🌳 ≈
Asphalt	119.4	97.8	98.8	93.3
Red Brick	104.1	96.6	93.7	91.8
Concrete	102.0	93.1	96.9	91.3
Landscape	n/a	n/a	n/a	90.1
Covered Walk	n/a	n/a	n/a	87.6

24%
196 Acres

29%
182 Acres

38%
52 Acres

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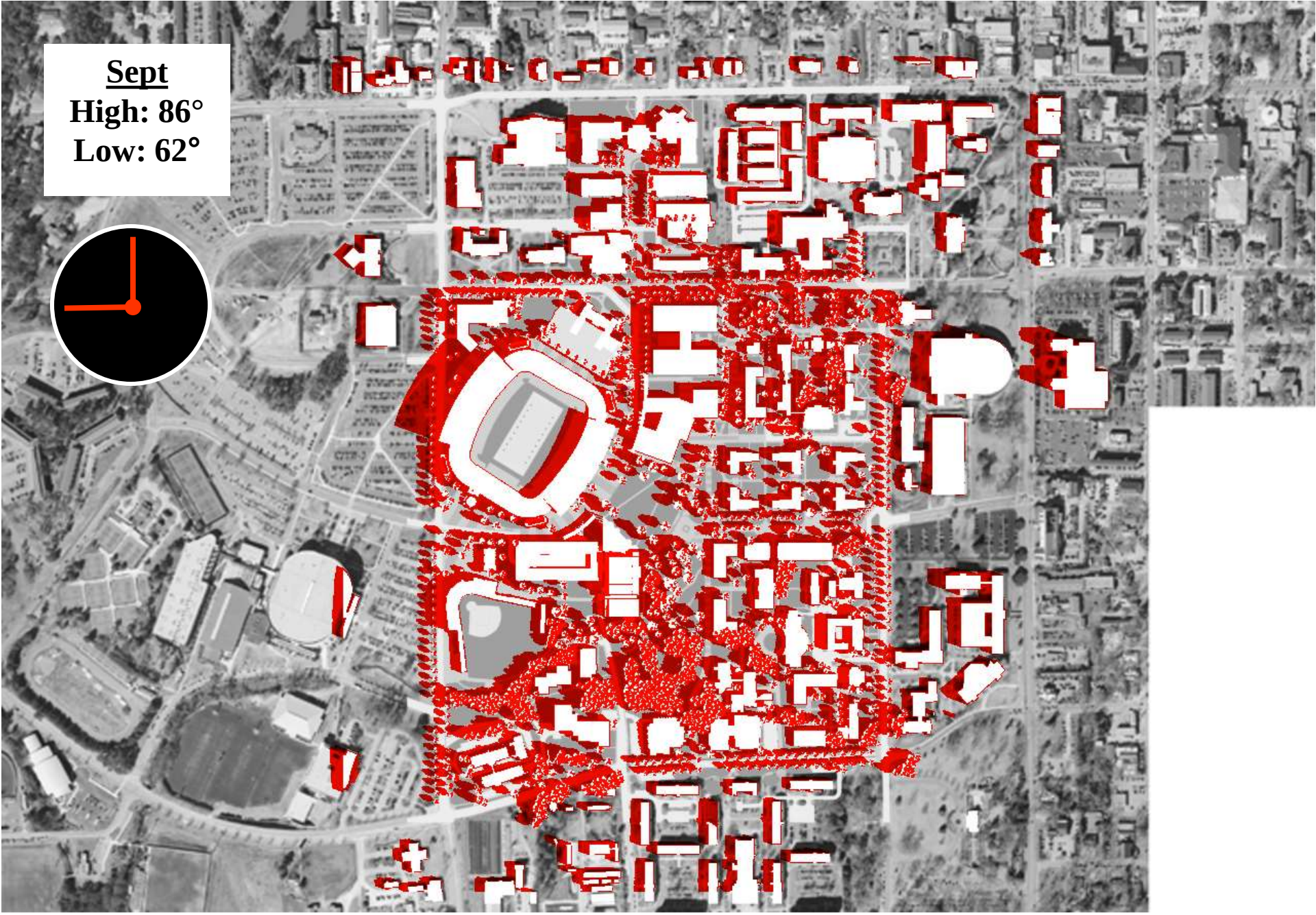
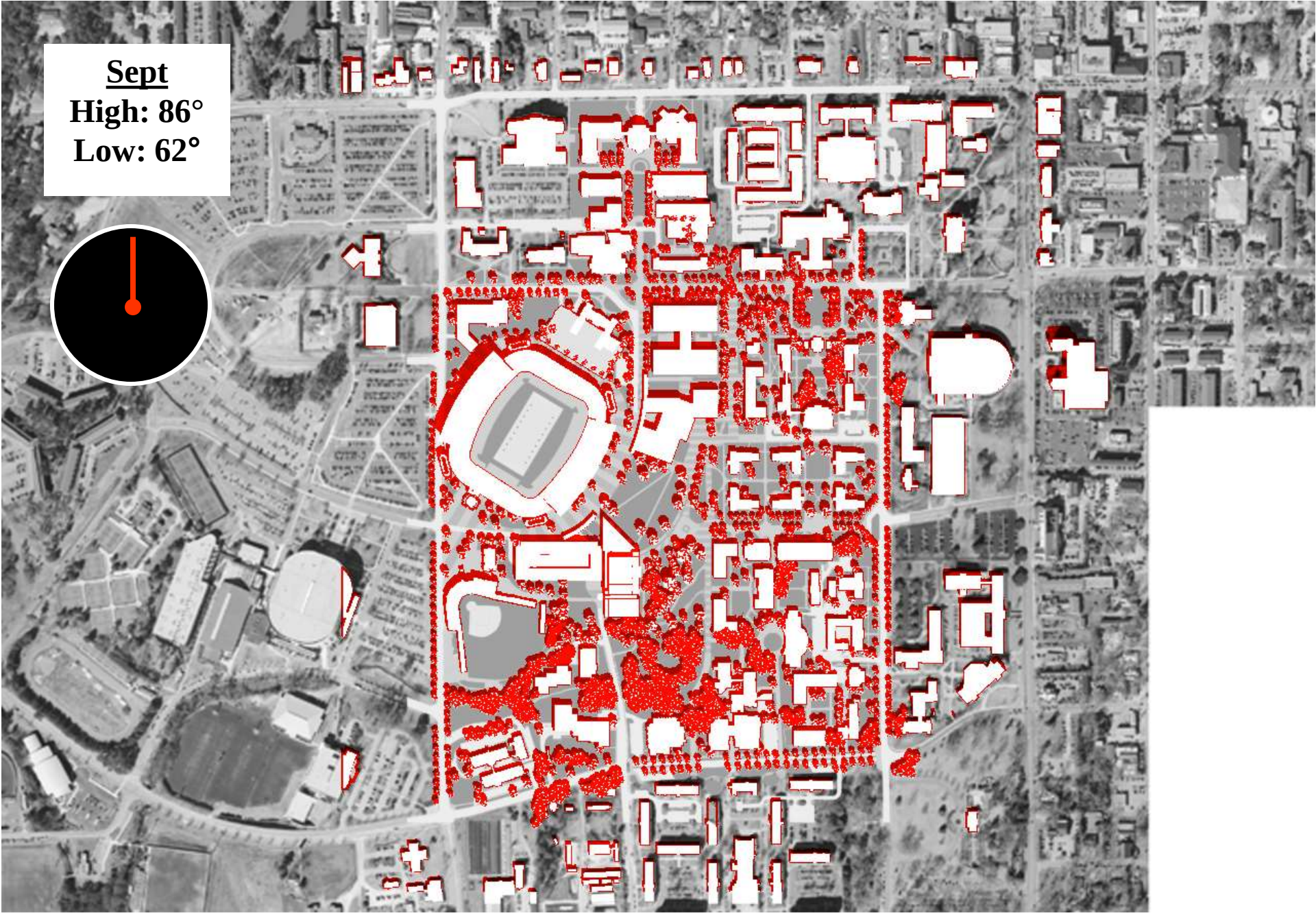
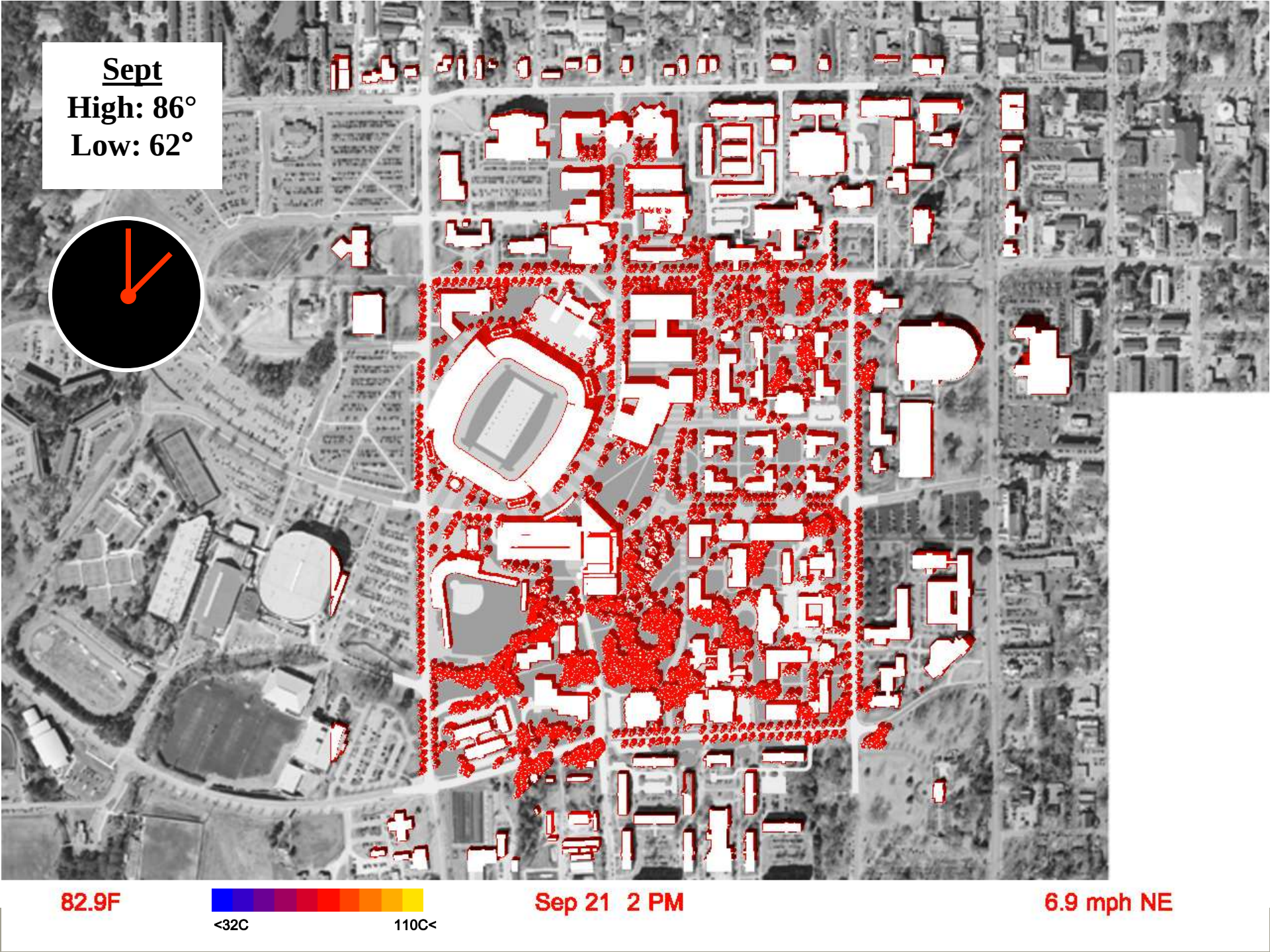
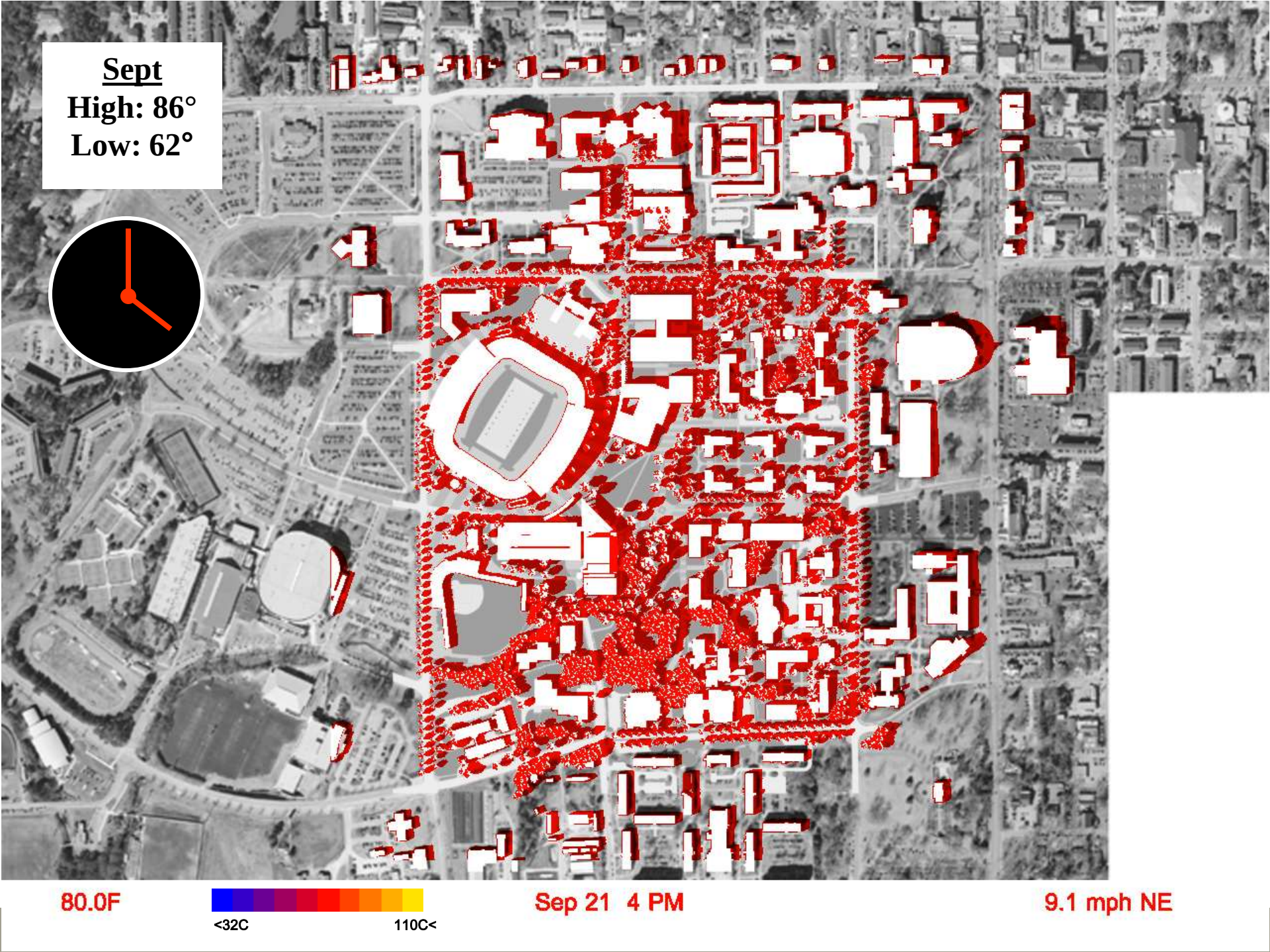
shade strategy


Sept
High: 86°
Low: 62°
78.9F
<32C
110C<
Sep 21 9 AM
10.2 mph NE


Sept
High: 86°
Low: 62°
82.0F
<32C
110C<
Sep 21 12 PM
12.7 mph E


Sept
High: 86°
Low: 62°
82.9F
<32C
110C<
Sep 21 2 PM
6.9 mph NE

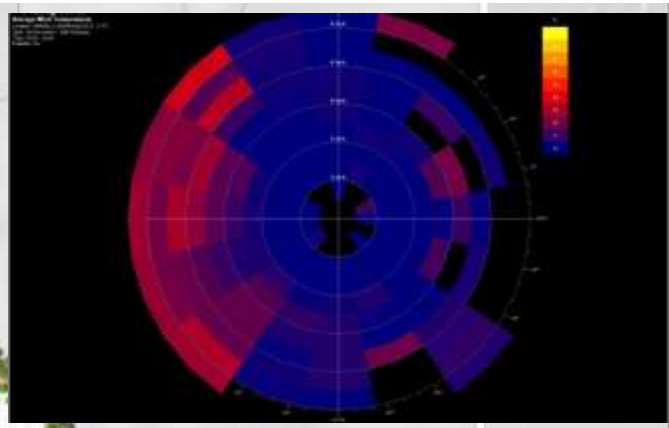

Sept
High: 86°
Low: 62°
80.0F
<32C
110C<
Sep 21 4 PM
9.1 mph NE

Shade Strategy

Shade Strategy

windbreaks

Windbreaks



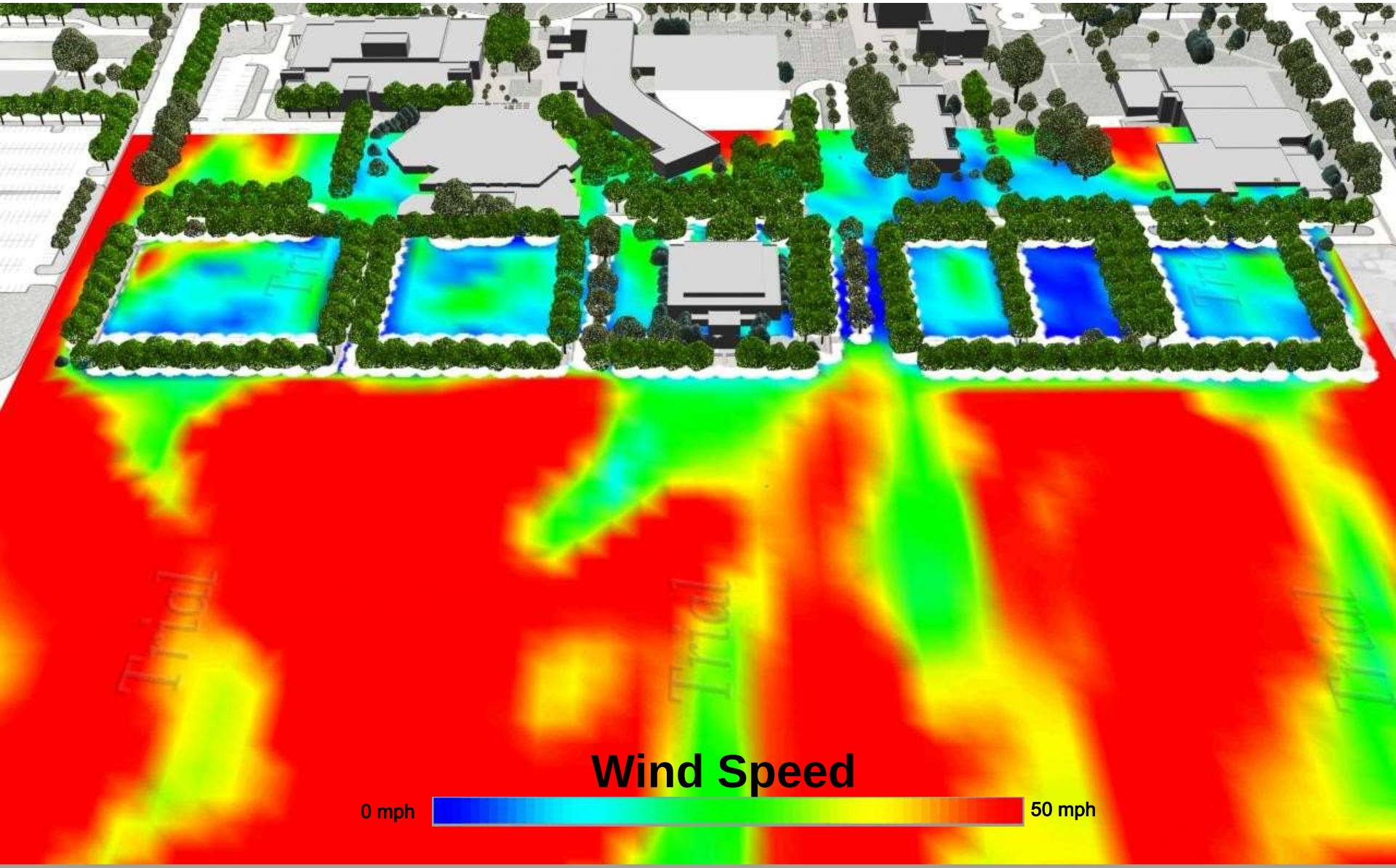
WINTER WINDS

- **EXISTING WINDBREAKS PROVIDE MINIMAL PROTECTION FROM NORTH / NORTHWEST WINTER WINDS**

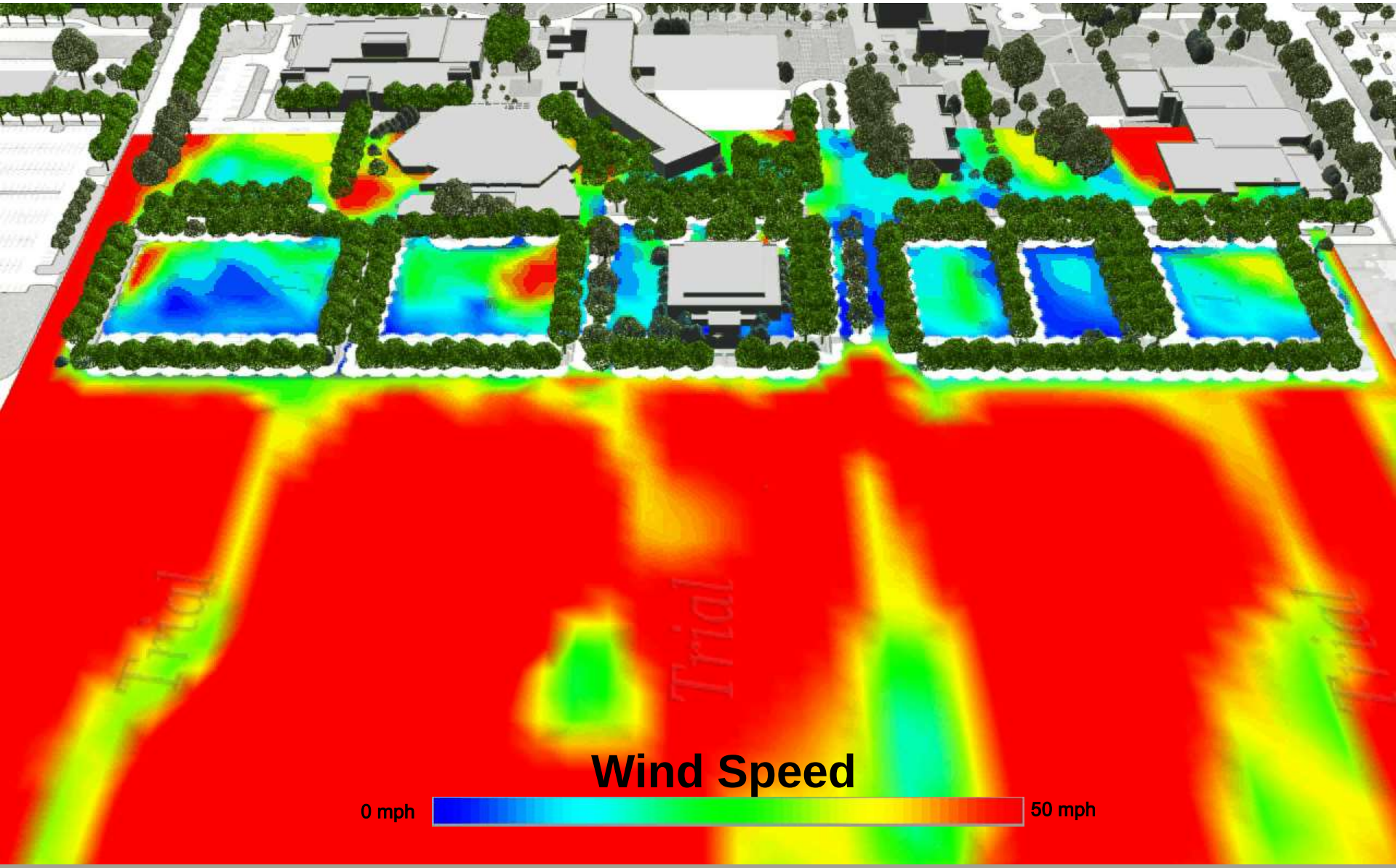
Windbreaks

- Virtual Wind Analysis programs are utilized to determined the effectiveness of a wind break

Windbreaks: computational analysis



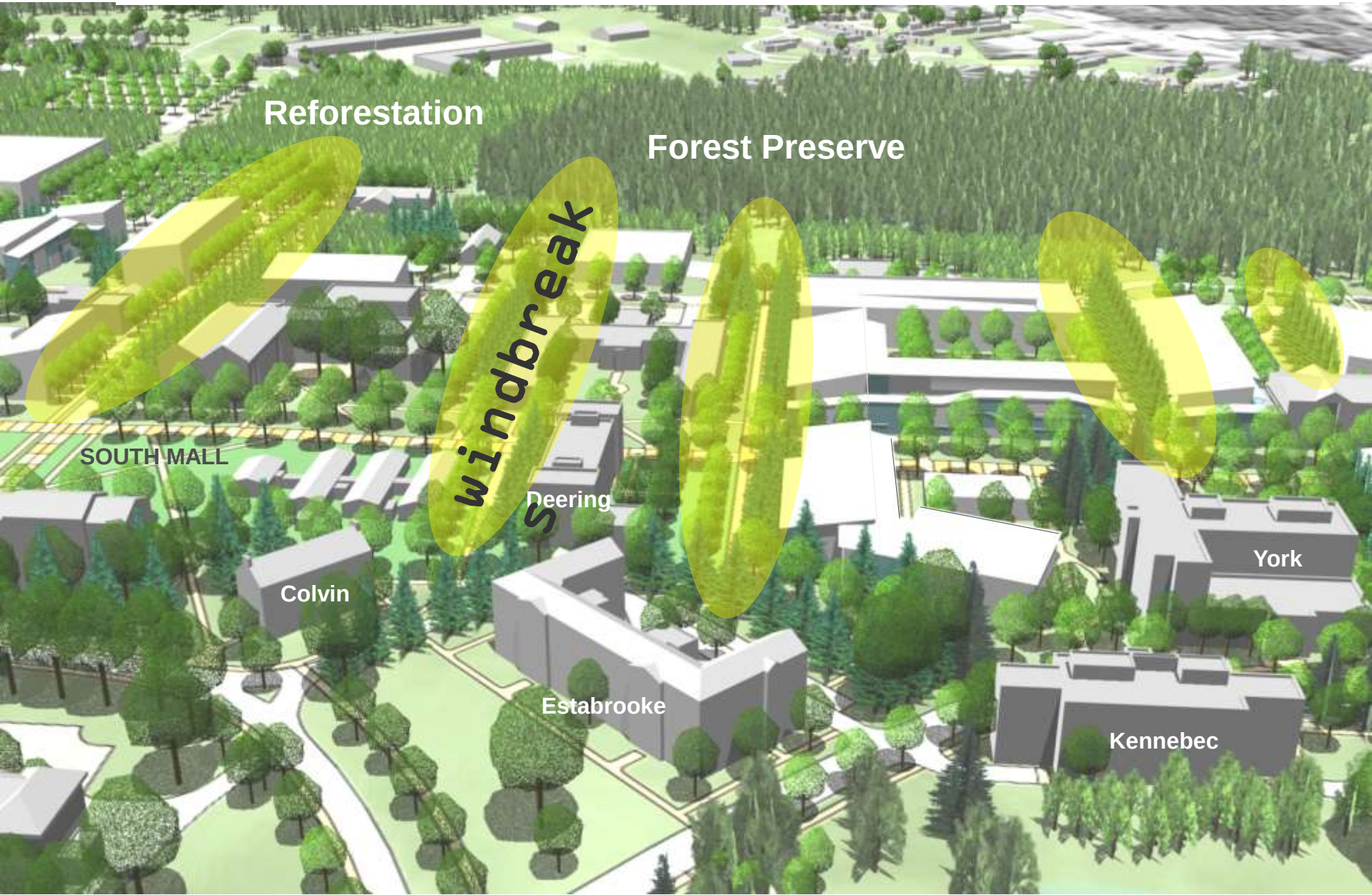
Windbreaks: computational analysis



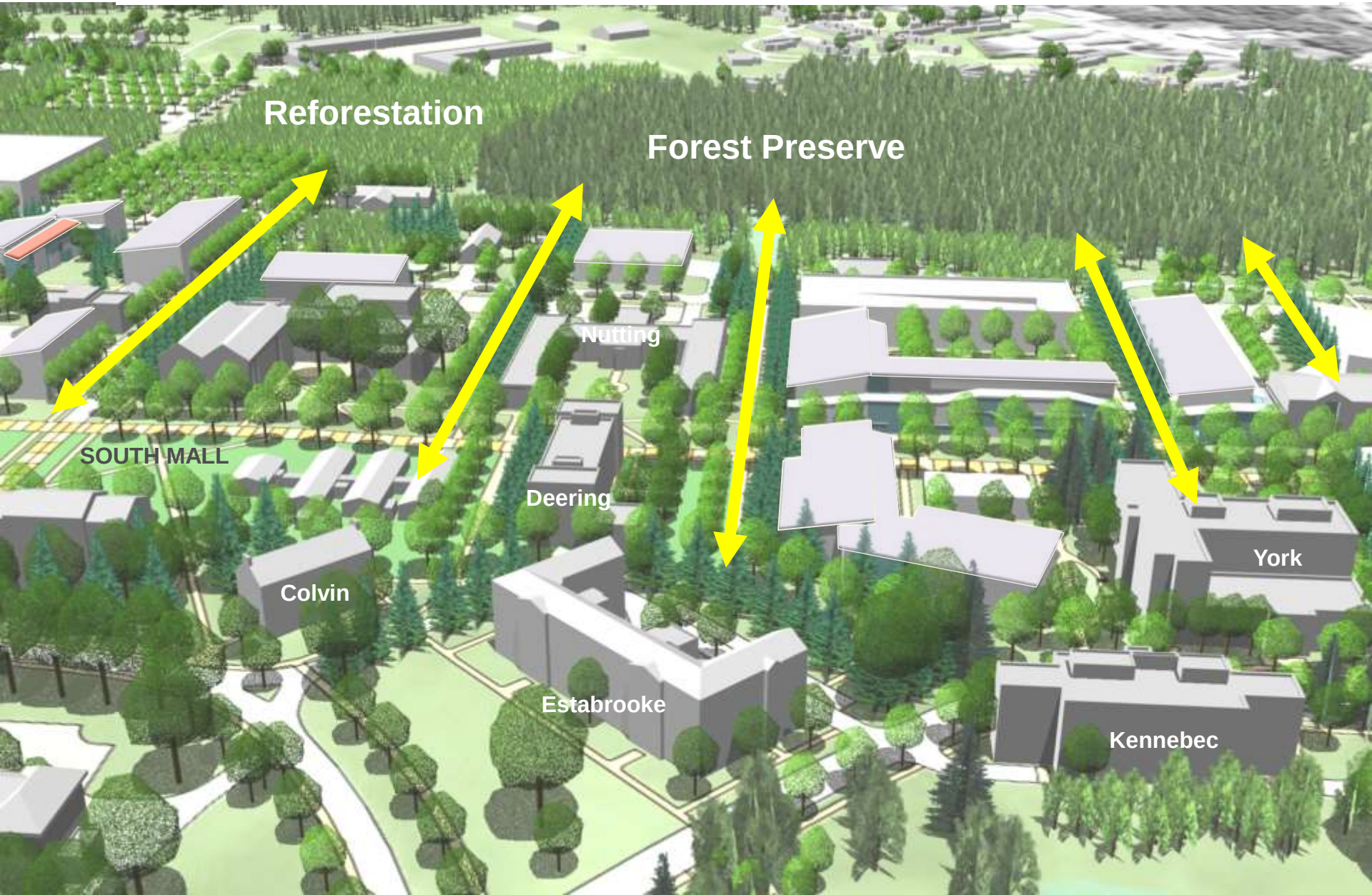
Integrated Landscape Solutions

Integrated Landscape Solutions

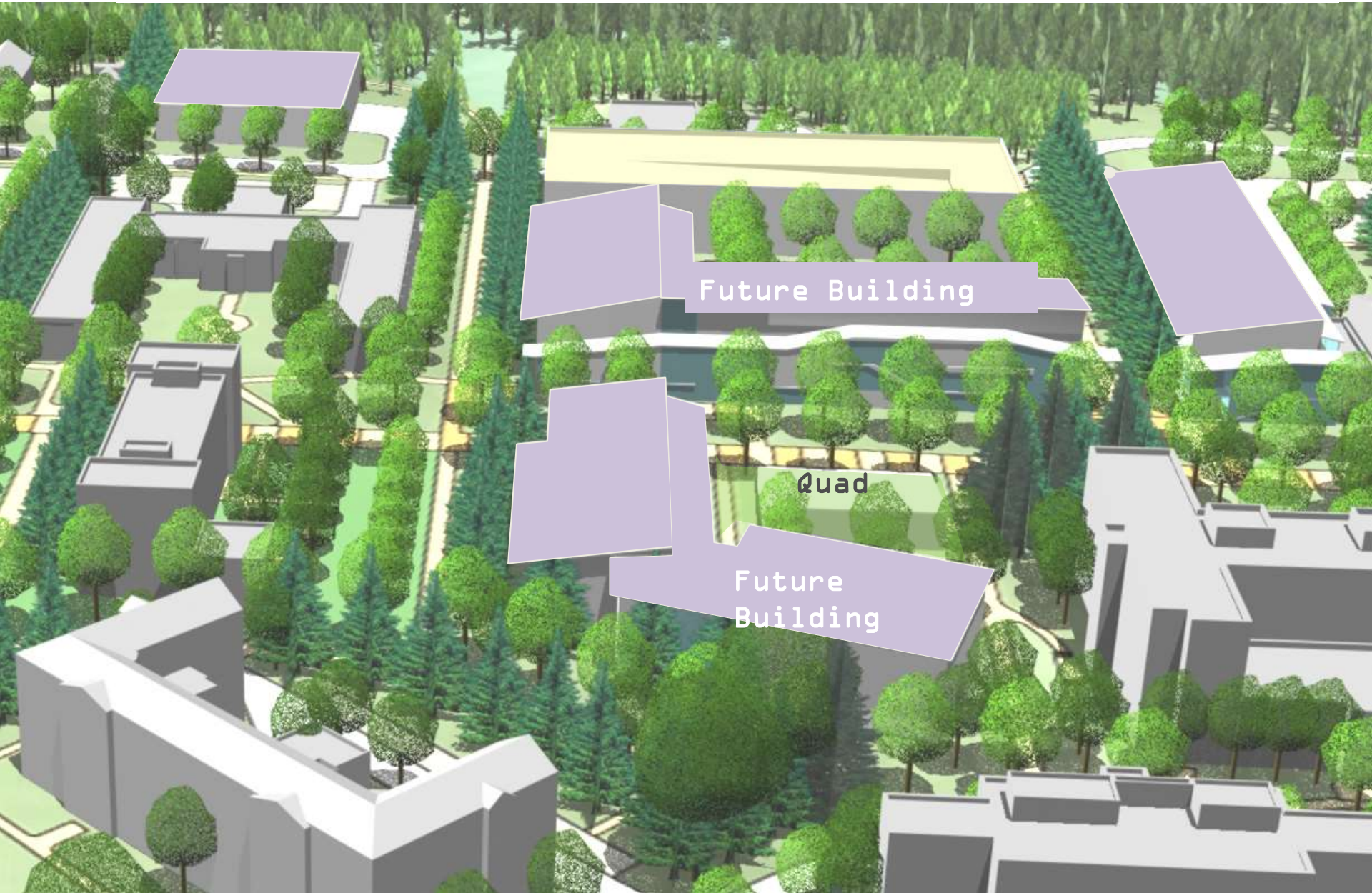
Integrated Landscape Solutions



Integrated Landscape Solutions

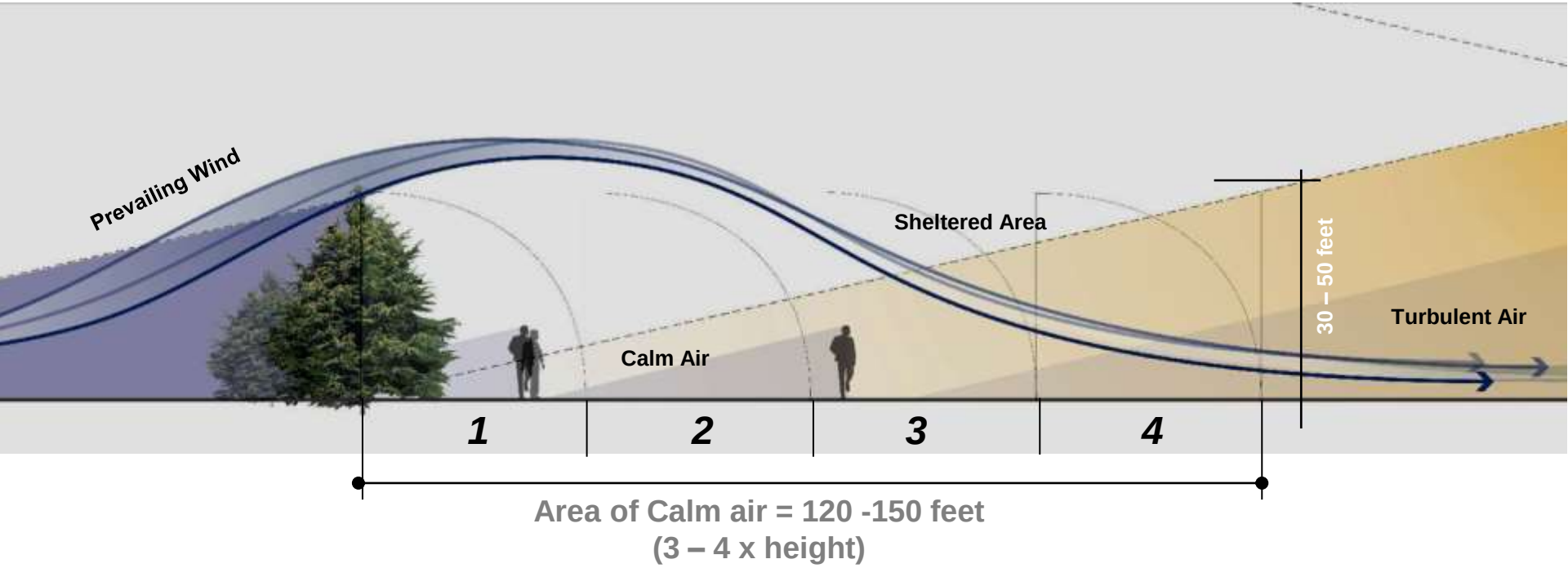


Integrated Landscape Solutions



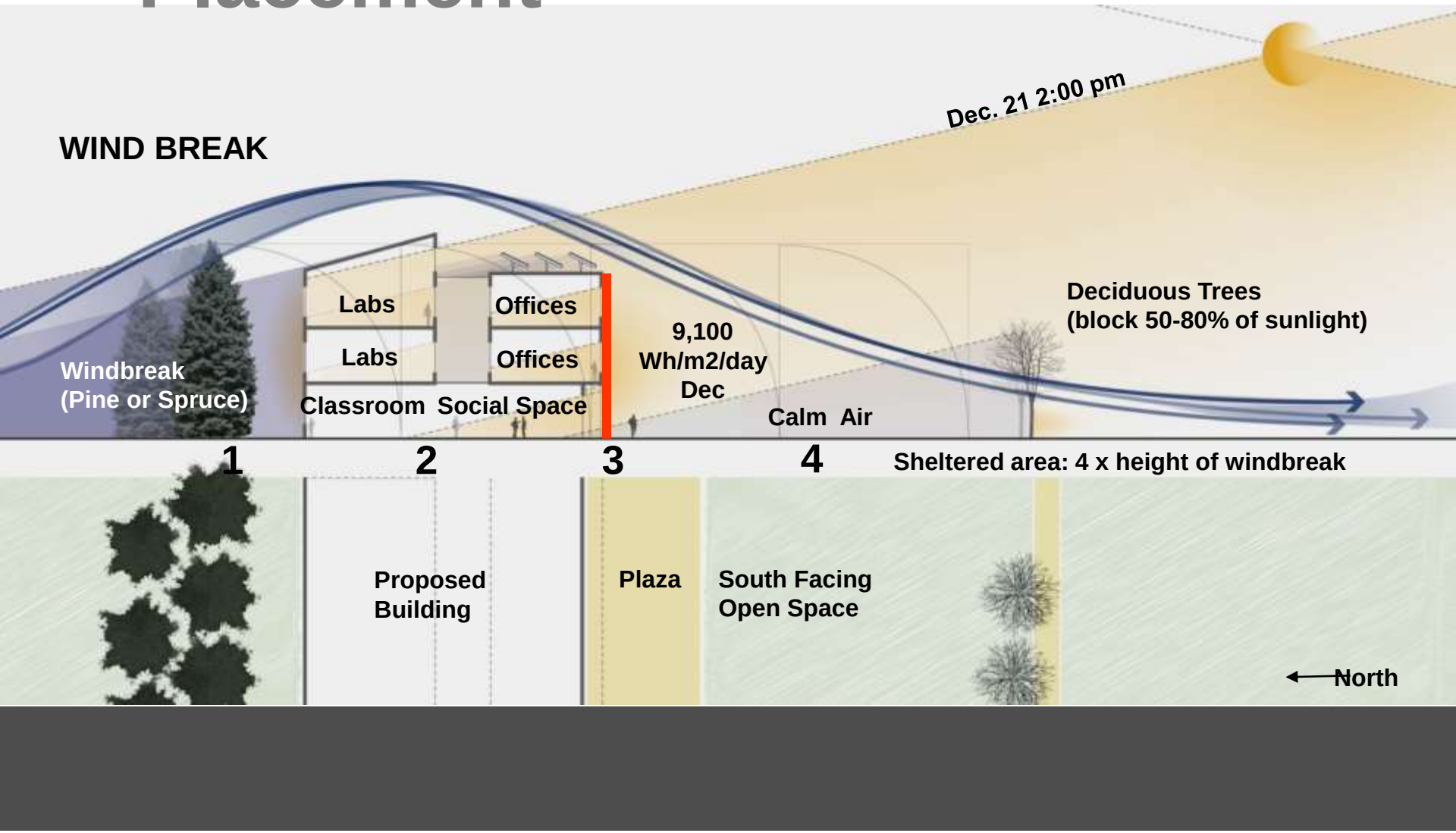
Integrated Landscape Solutions

Windbreaks



- Windbreaks and shelterbelts have been utilized to protect land from wind erosion and conserve soil moisture by reducing evaporation
- Windbreaks can assist in reducing wind speed, heating and cooling loads, and contribute to the visual quality of the environment.

Windbreaks and Building Placement



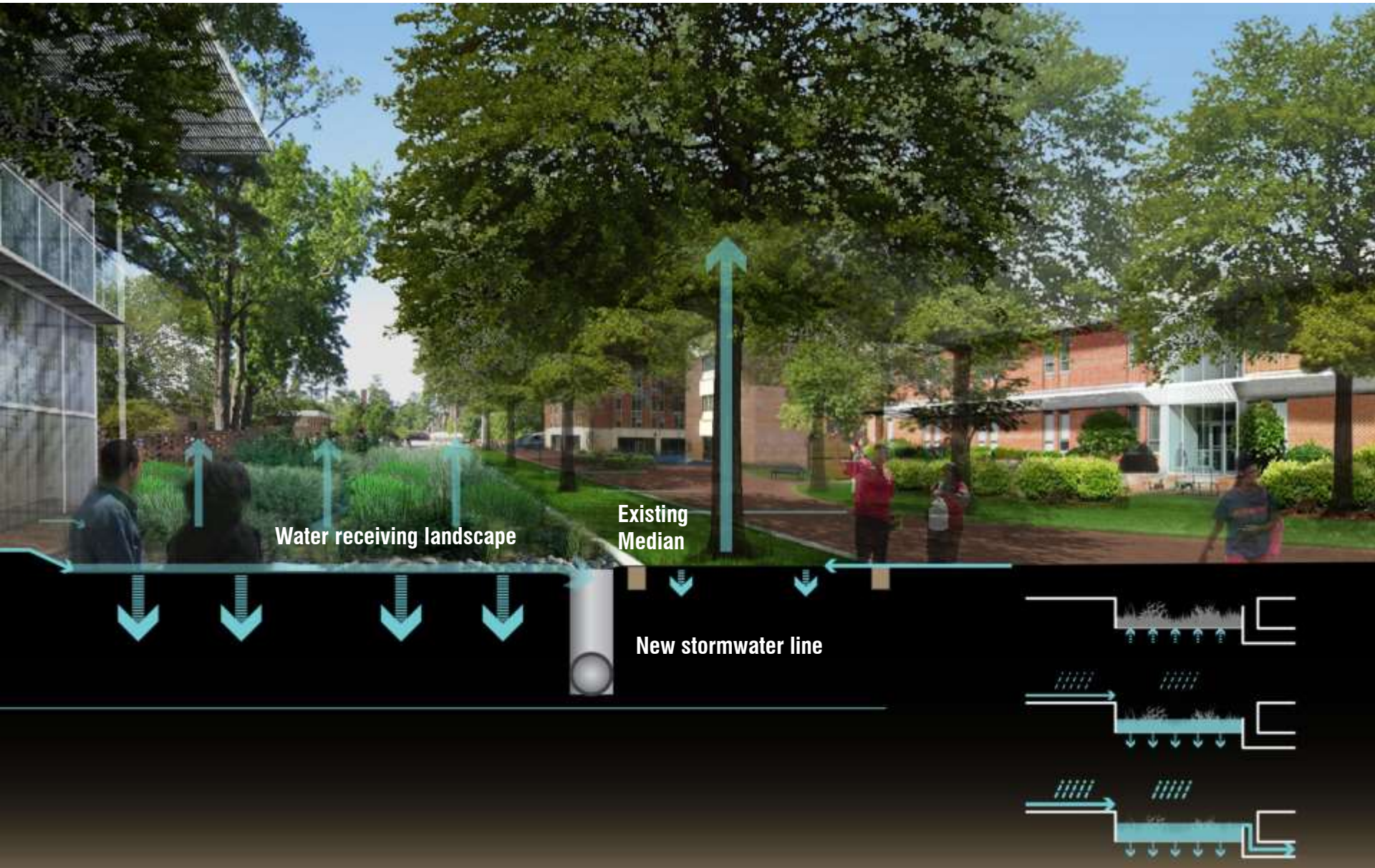
water management

Integrated Landscape Solutions

Integrated Landscape Solutions

Integrated Landscape Solutions

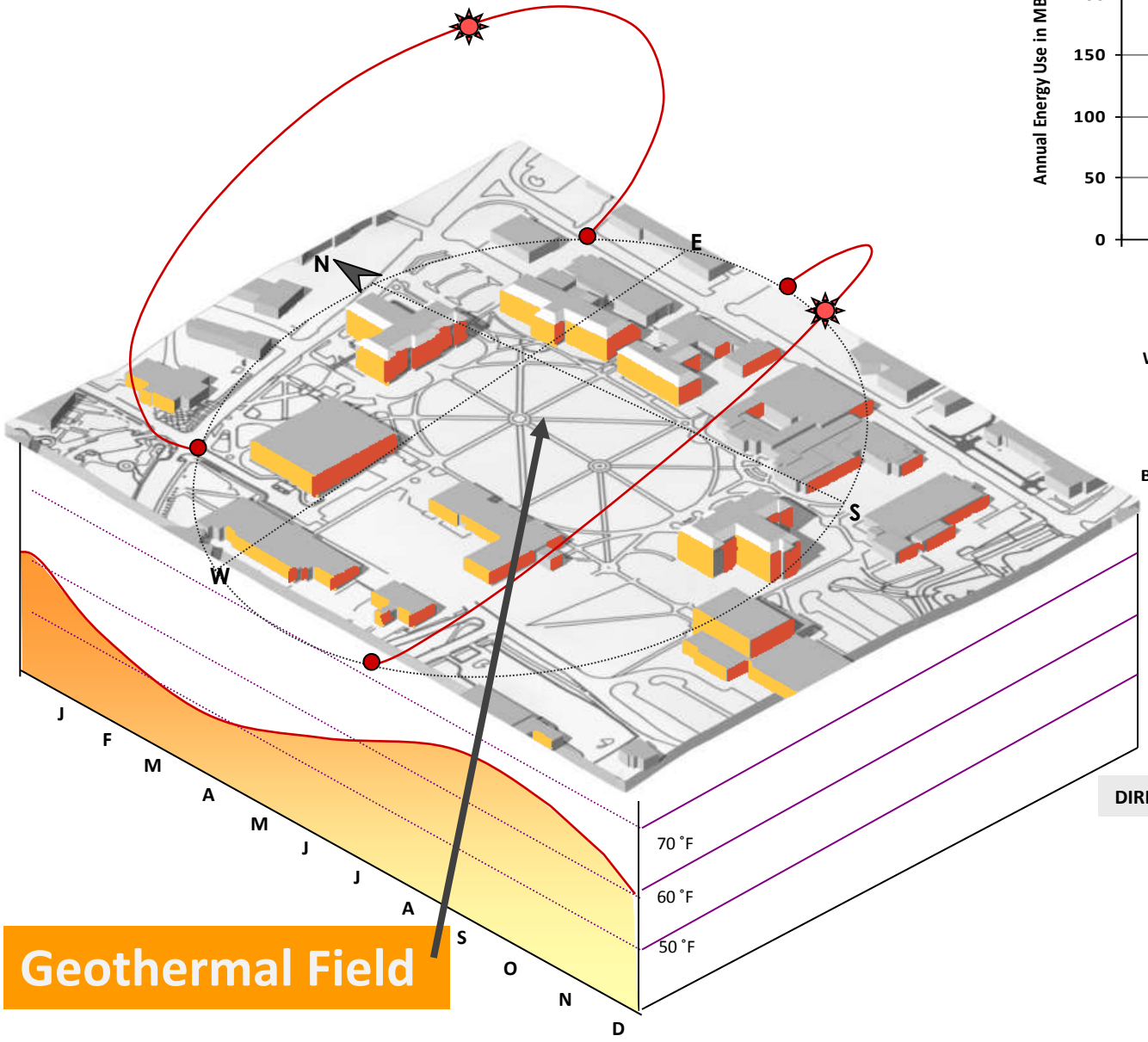
Integrated Landscape Solutions

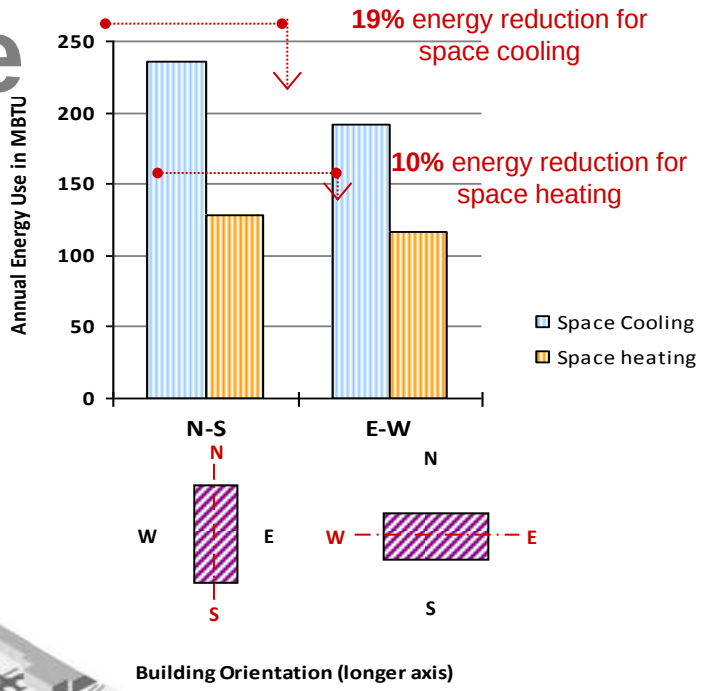


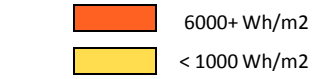
Integrated Landscape Solutions

energy production

Energy + Landscape







carbon sequestration

Carbon Sequestration

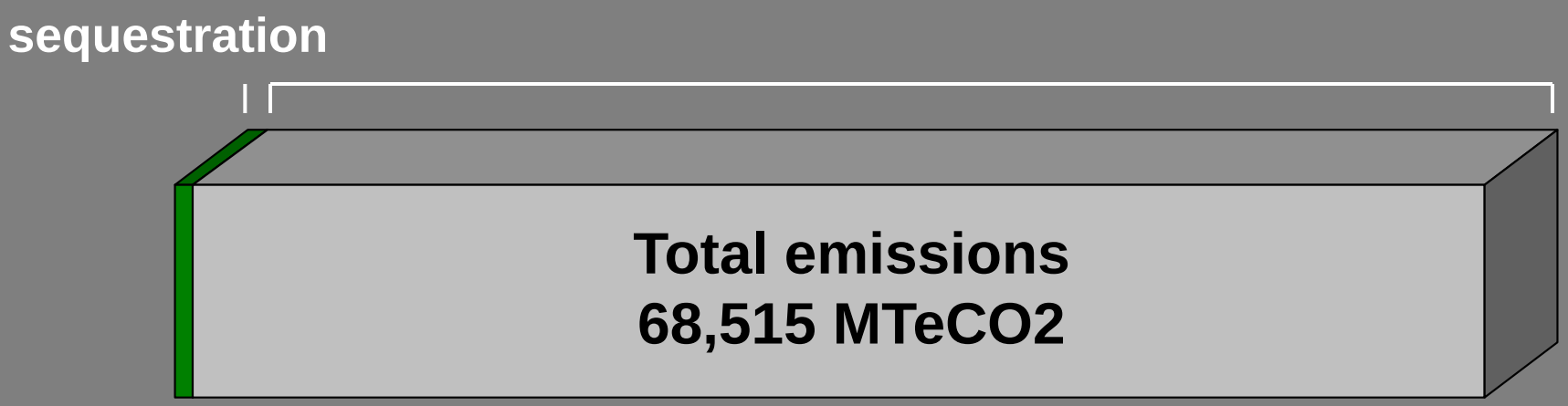
CO_2 stored
868.16
MTeCO2

CO_2 annually sequestered
10.78 MTeCO2

Carbon Sequestration

CAMPUS EMISSIONS	SEQUESTRATION THROUGH TREES ANNUALLY
CO_2 emitted	CO_2 sequestered (annually)
68,515 MTeCO2	1,017 tonnes

Tree cover sequestration: 1.5% of CO2 emissions



space

Space and Energy

Space

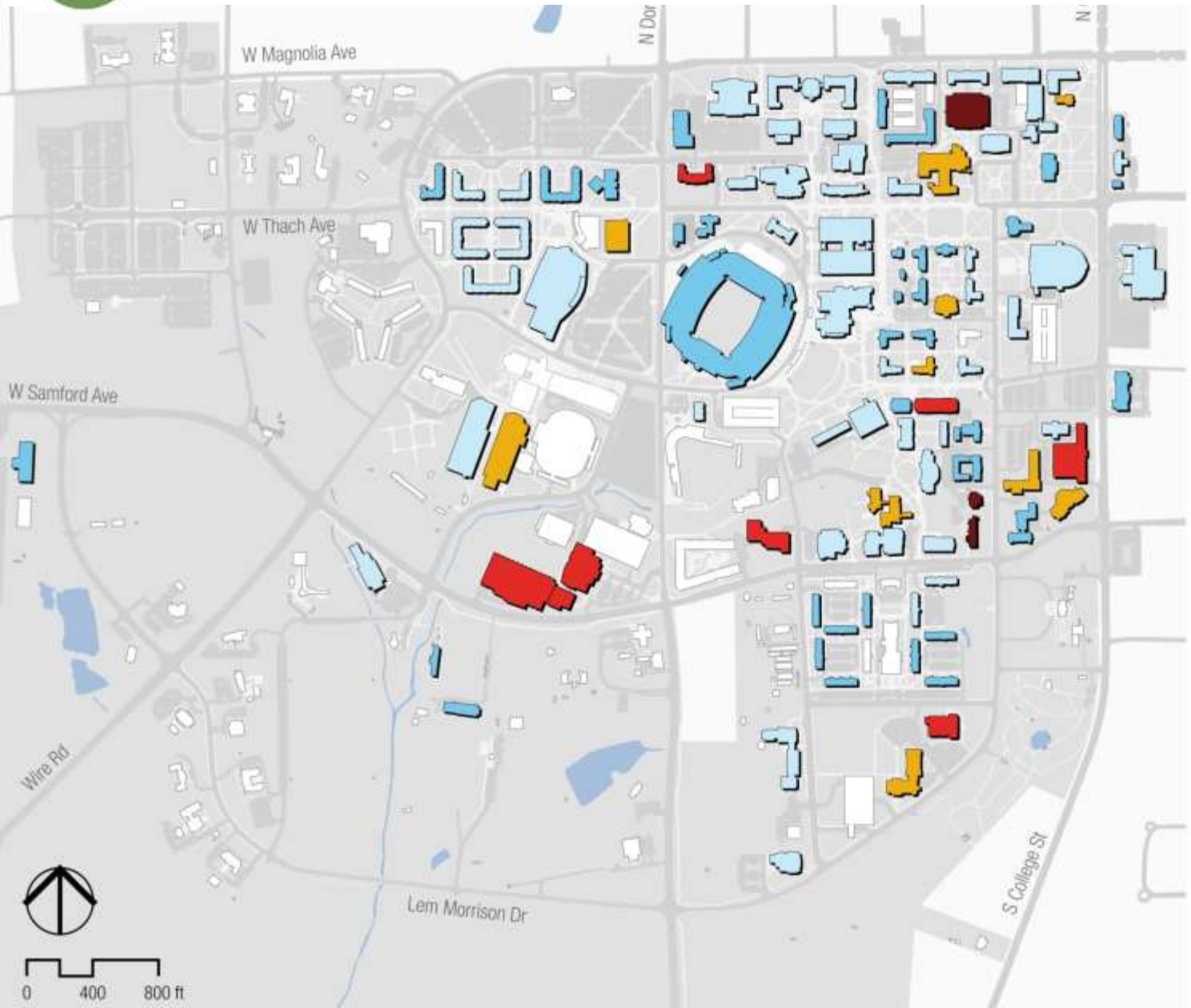
People

Energy

Emissions

Cost

Energy Usage Intensity (EUI)

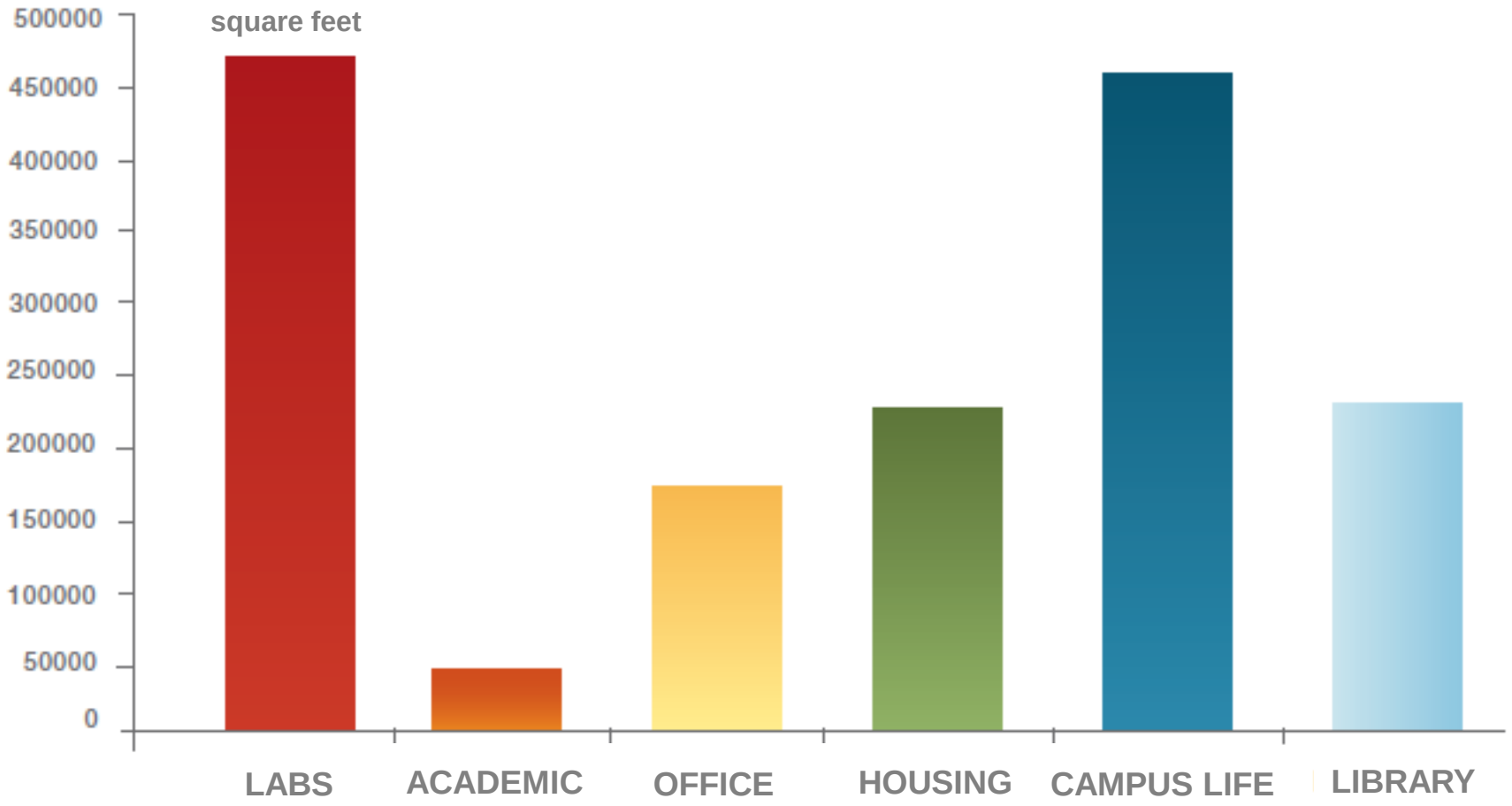


EUI, or *energy use intensity*, is a unit of measurement that describes a building's energy use. EUI represents the energy consumed by a building relative to its size. EUI is calculated by taking the total energy consumed in one year and dividing by the total floor space of the building.

kBtu/SF

- 400+
- 300 to 399
- 200 to 299
- 100 to 199
- < 100

Space and Energy Use Intensity



	LABS	ACADEMIC	OFFICE	HOUSING	CAMPUS LIFE	LIBRARY
Avg EUI	300 kBTU/sf/yr	100 kBTU/sf/yr	100 kBTU/sf/yr	125 kBTU/sf/yr	200 kBTU/sf/yr	200 kBTU/sf/yr
Target	250 kBTU/sf/yr	75 kBTU/sf/yr	75 kBTU/sf/yr	80 kBTU/sf/yr	200 kBTU/sf/yr	150 kBTU/sf/yr

mobility

Mobility Strategy

SASAKI

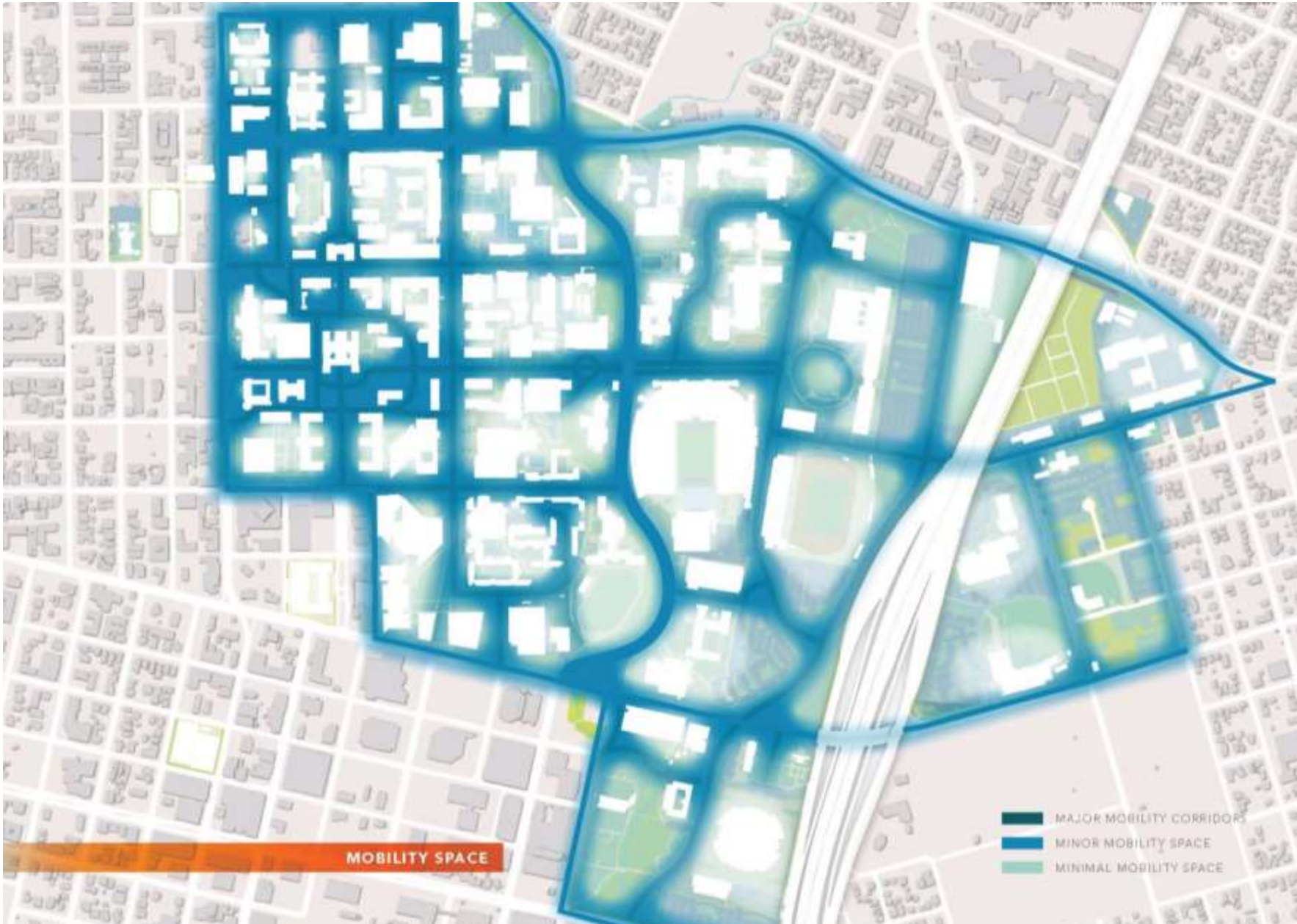
Mobility Strategy – bicycle network

SASAKI

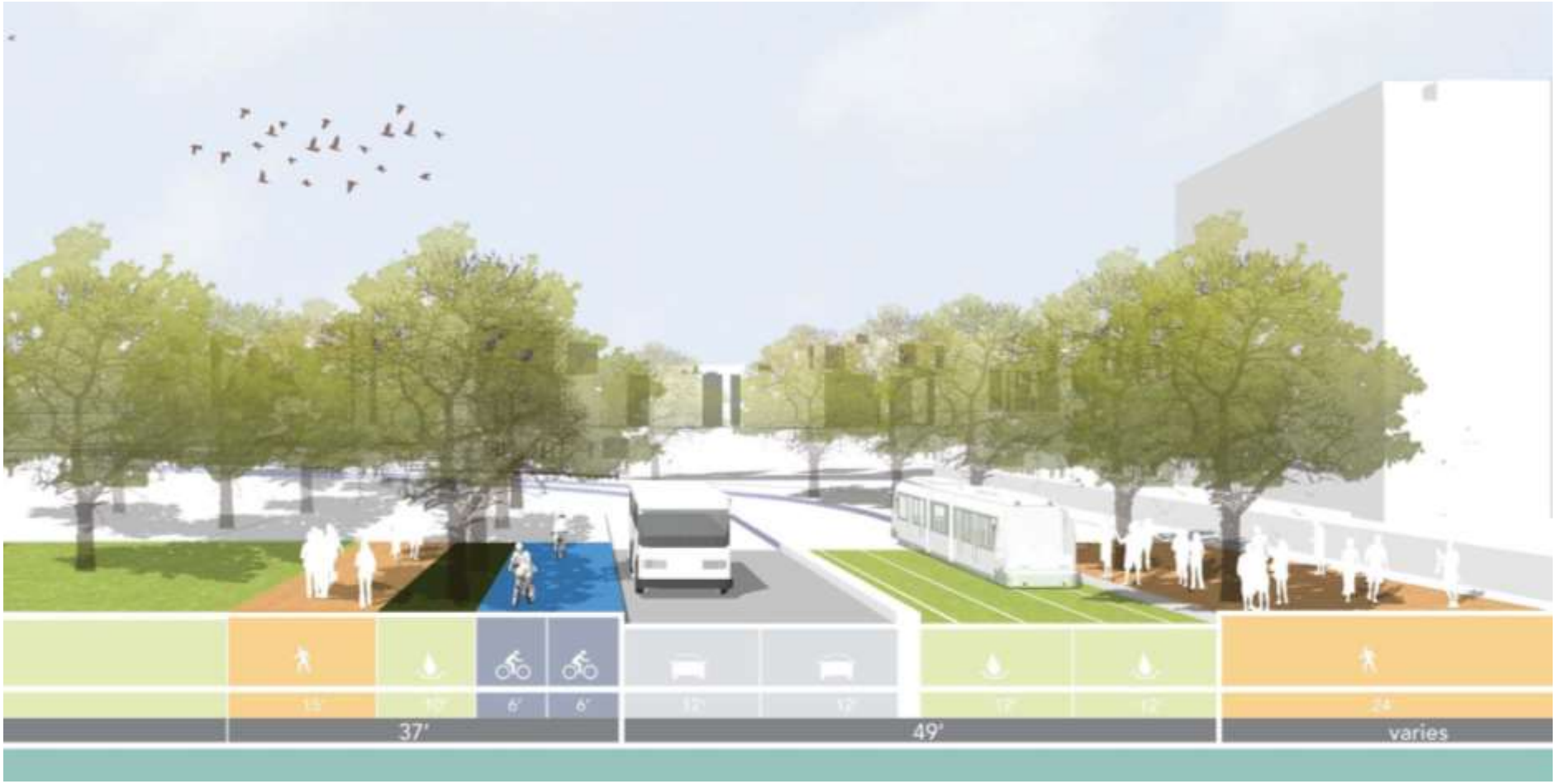
Mobility Strategy – transit network

SASAKI

Mobility Space



Mobility Space + Complete Streets



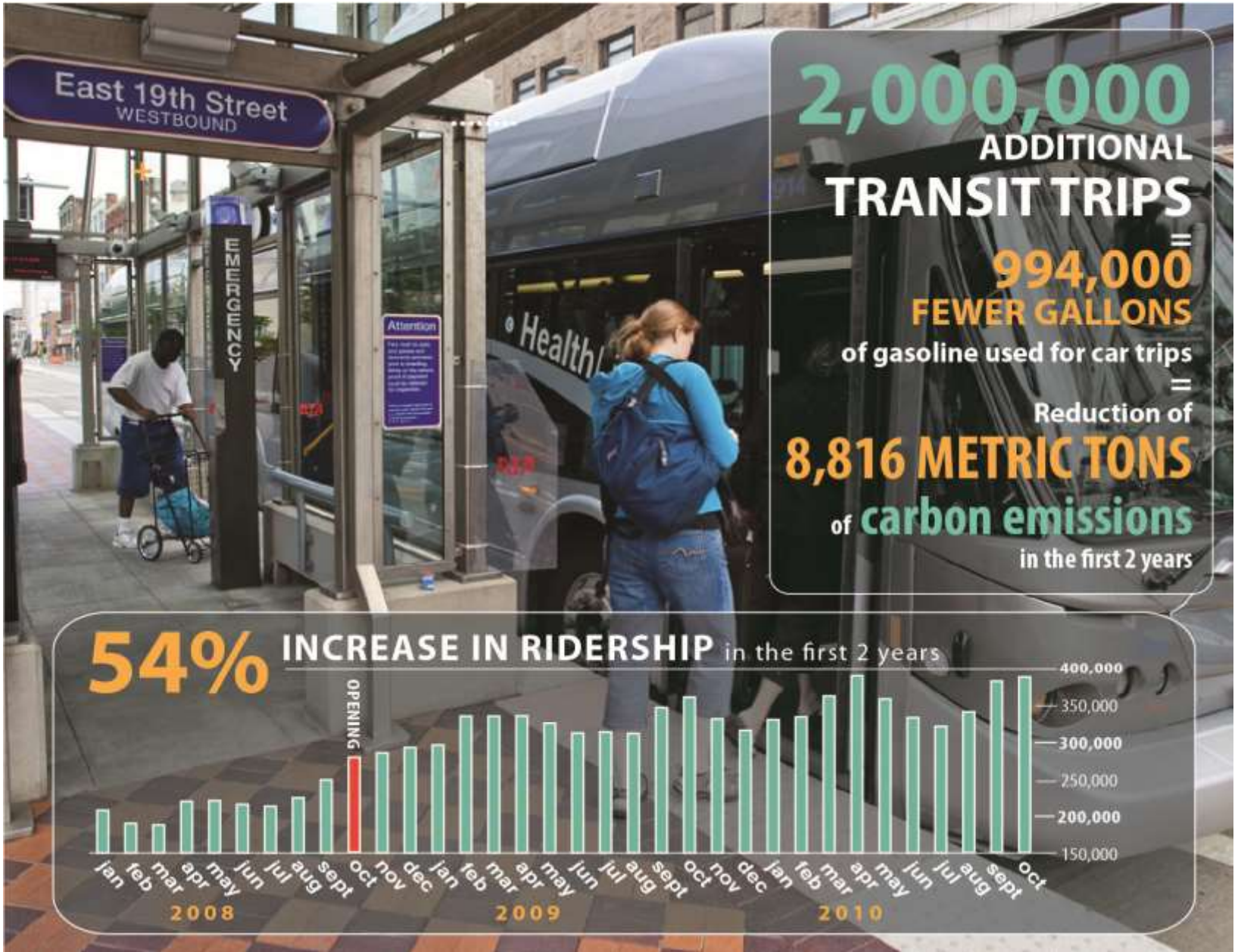
Mobility Space + Complete Streets

Modal Split Targets

2010

2020

Mobility Space + Complete Streets



resources

RESOURCE FLOWS

potable water

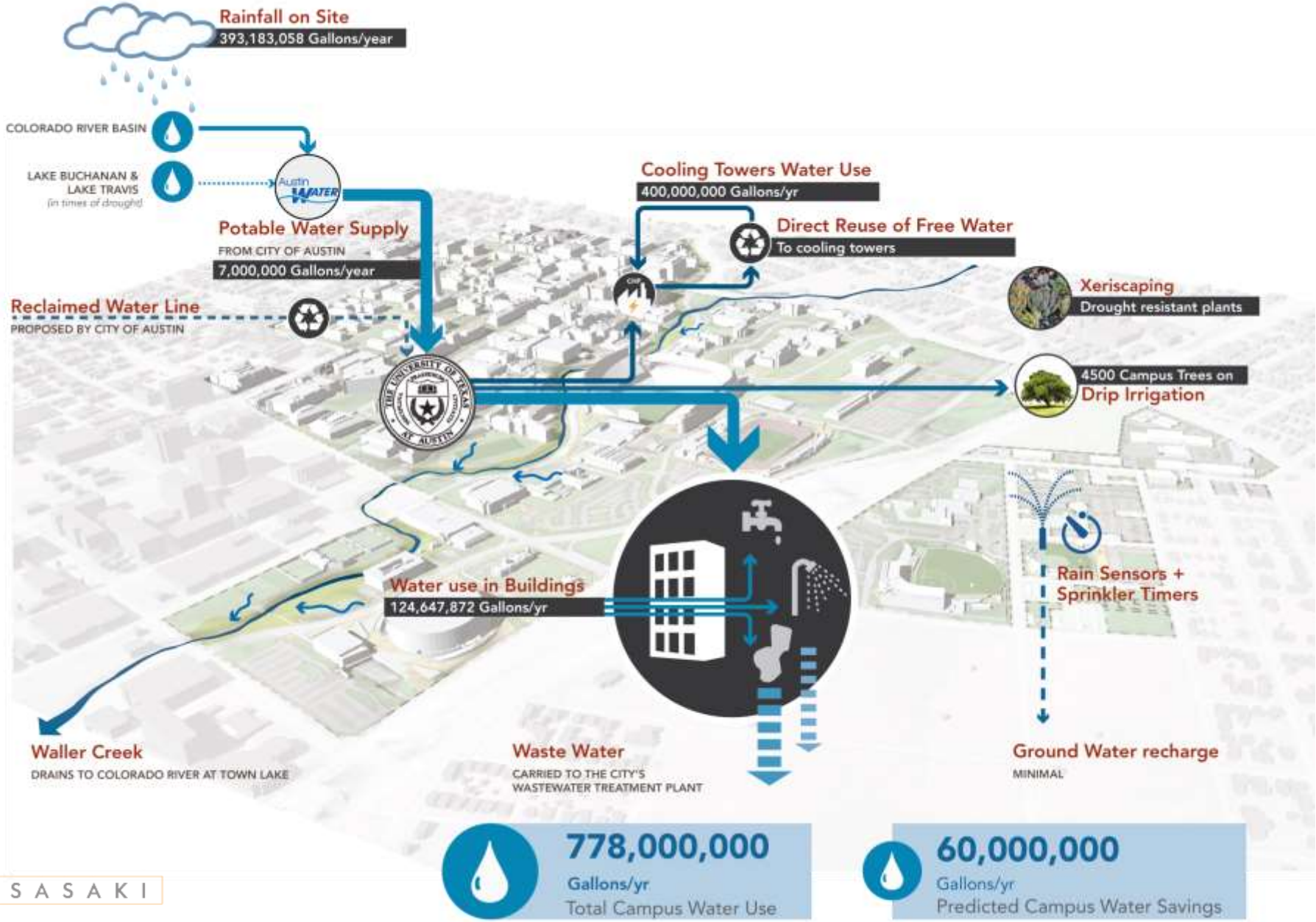
energy

emissions

materials /waste

potable water

Water Resource Flows



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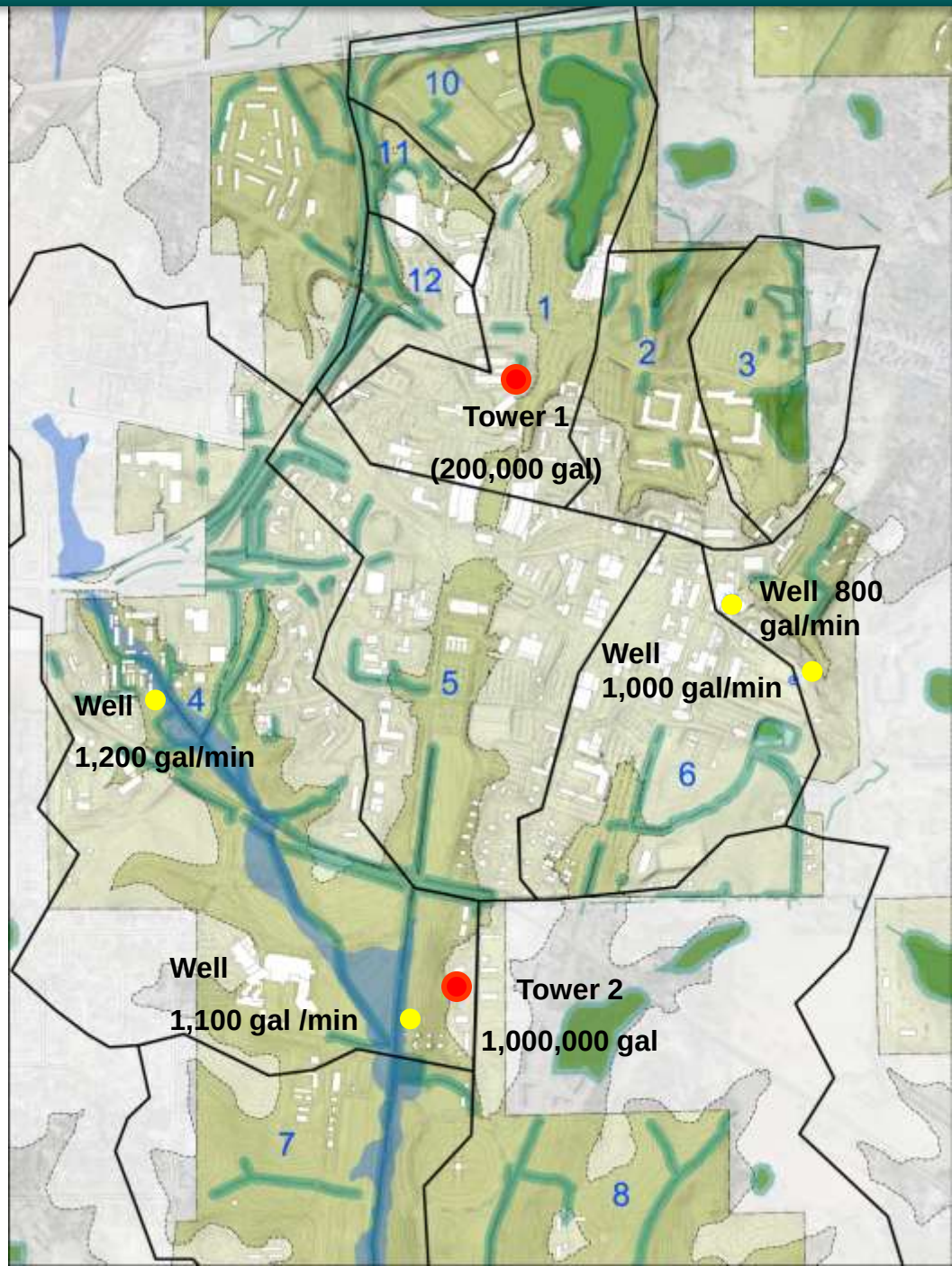
Supply

Average Daily Water Consumption: 1,000,000 gallons

Approximately 2 Olympic Pools per Day



Potable Water Consumption

2010

Average Daily Water Consumption: 1,000,000 gallons

Summer 2010 Average Daily Consumption: 1,750,000 gallons

= 100,000 gallons

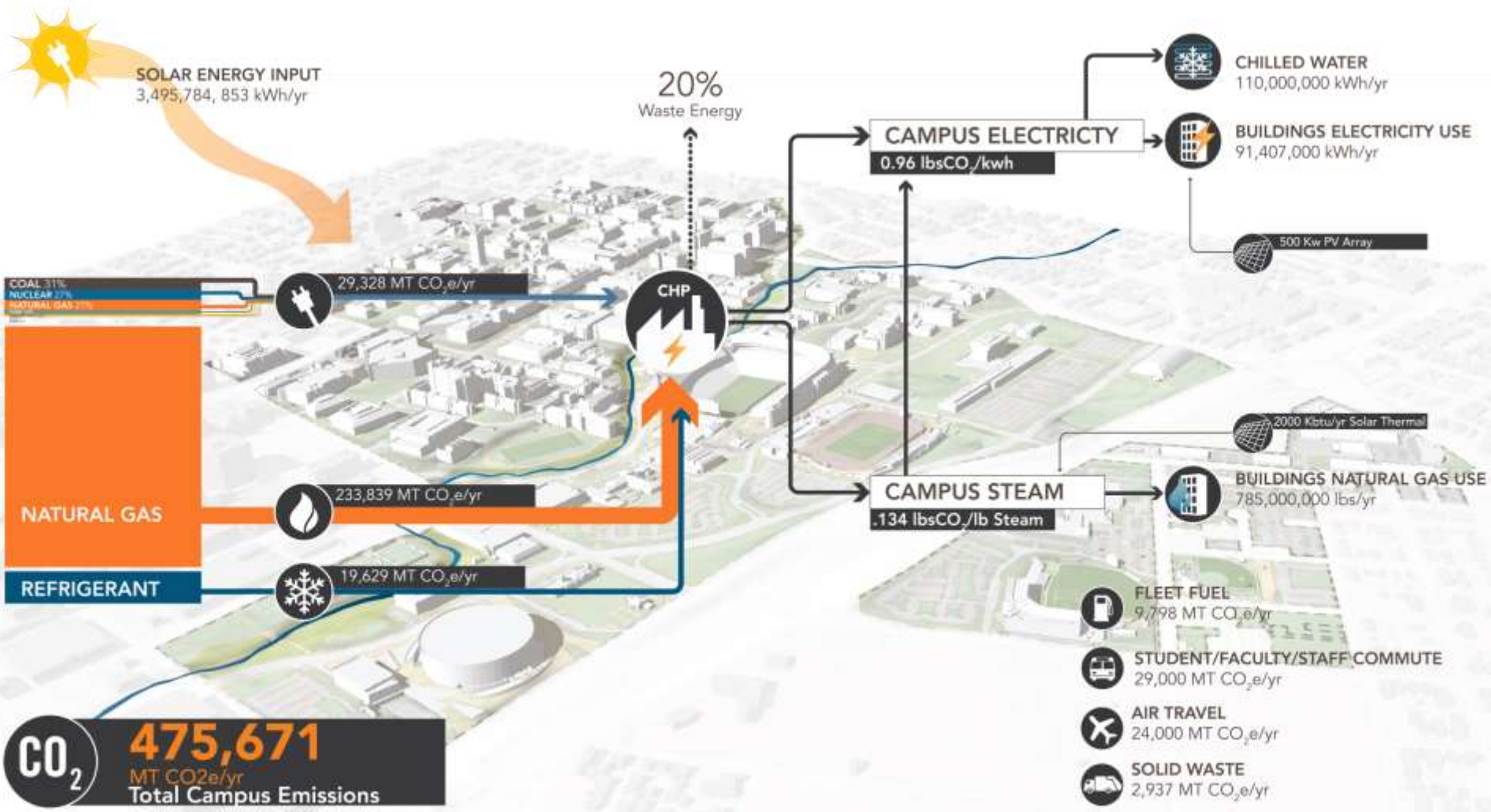
2020 Goal: 20% reduction in water use

Targeted Daily Water Consumption: 800,000 gallons

20% reduction

energy

Energy Flows



Energy Consumption

2010

Annual Electricity Consumption (2009): 224,000 MBTU (65,684,000 kWh)

Annual Natural Gas Consumption (2009): 142,470 MBTU (1,424,708 Therms)

= 20,000 MBTU

TOTAL MBTU: 366,587

2020

Energy Consumption

2010

Annual Electricity Consumption (2009): 224,000 MBTU (65,684,000 kWh)

Annual Natural Gas Consumption (2009): 142,470 MBTU (1,424,708 Therms)

= 20,000 MBTU

TOTAL MBTU: 366,587

2020

Targeted Electricity Consumption: 180,000 MBTU

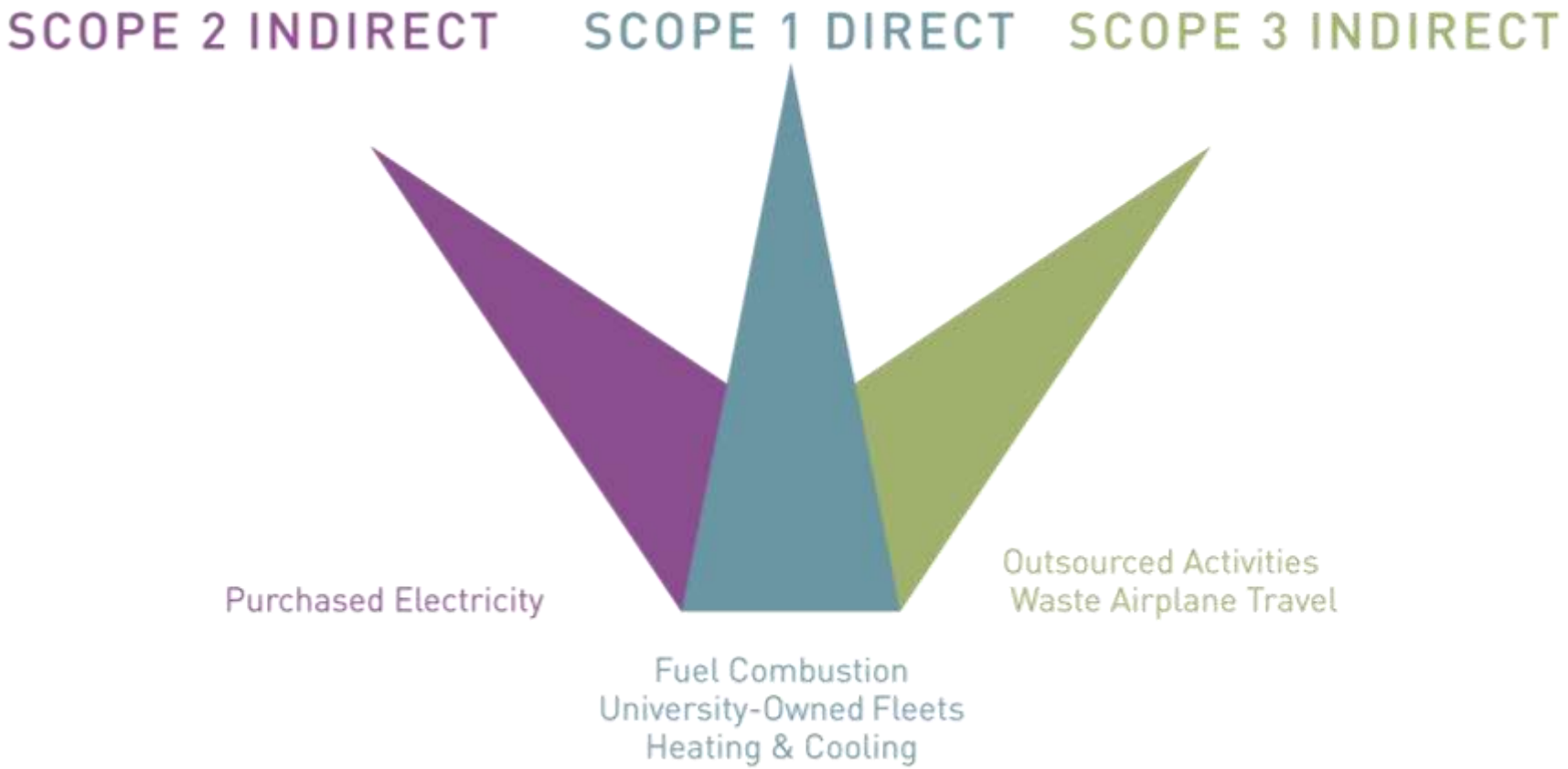
Renewable ??

Targeted Natural Gas Consumption: 128,000 MBTU

30% reduction

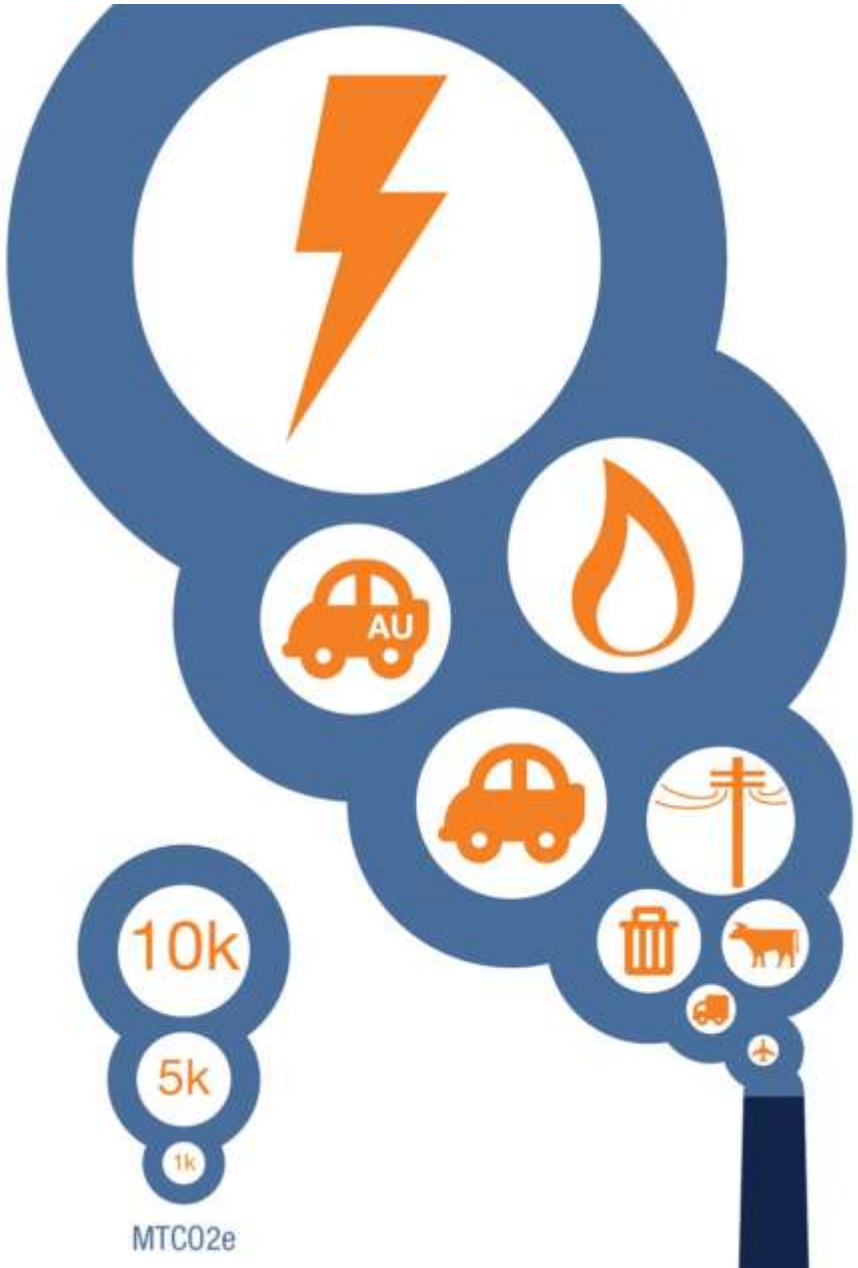
emissions

Emissions Scopes



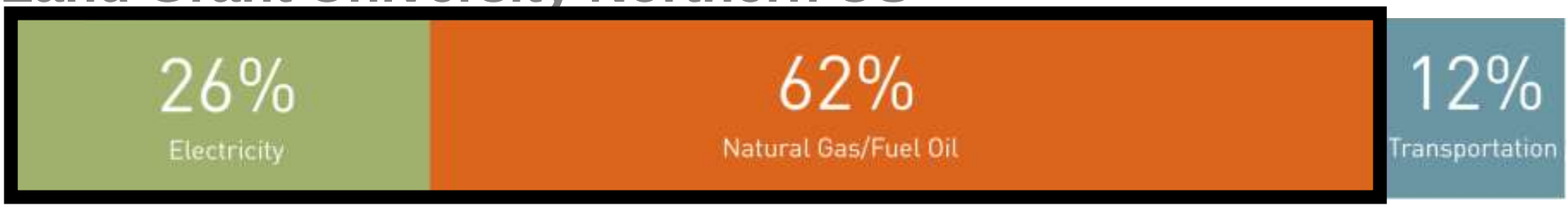
Emissions

% of Net Emissions	Emissions Source
54.7%	Purchased Electricity
13.7%	Stationary Combustion
11.7%	Financed Ground Transportation
9.1%	Commuting
5.4%	Transmission Losses
2.6%	Solid Waste
1.9%	Fugitive Emissions
0.6%	University-Owned Transportation
0.2%	Air Travel
Net Emissions:	**160,986 MTCO2e**



Emissions Comparisons

Land Grant University Northern US

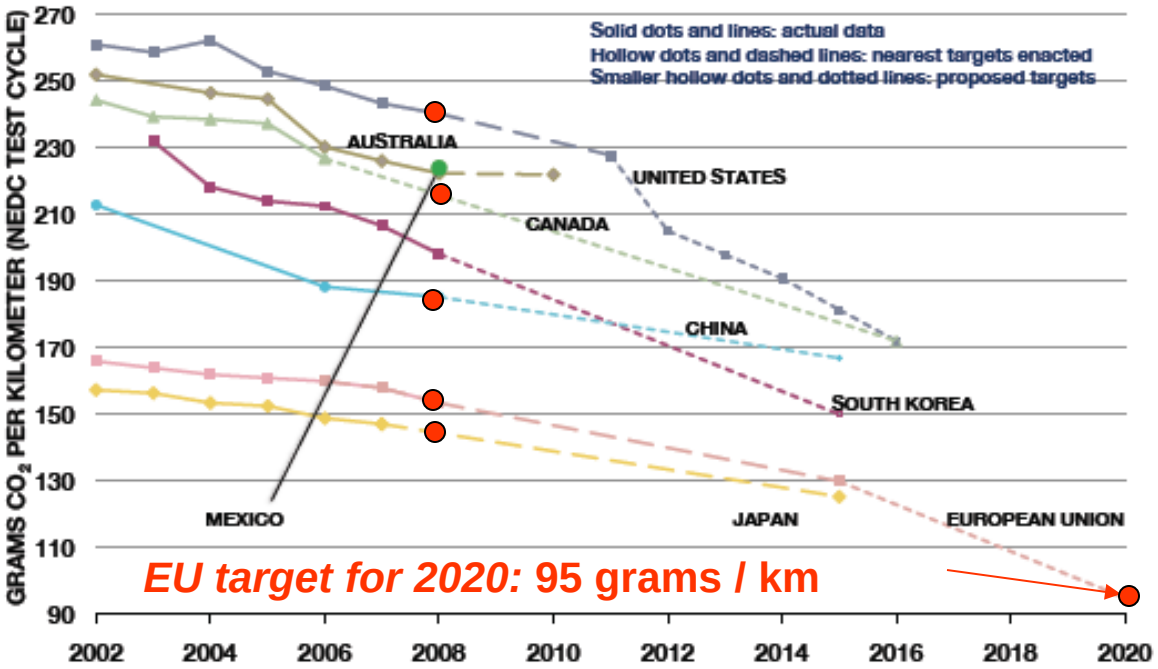


Land Grant University Southern US

Commuter College Southern US

US Fleet Emissions

The US Fleet average: 240g CO_2 / km



Fleet Average (2008)	Grams CO_2 / km
United States	240 grams
Canada	215 grams
China	185 grams
European Union	152 grams
Japan (2007)	~145 grams

http://www.theicct.org/documents/0000/1400/ICCT_efficiency_fundamentals_March_2010.pdf

Emissions

2010

Scope 1 (2009): 19,343 MTeCO2 (Natural Gas Consumption)

Scope 2 (2009): 75,595 MTeCO2 (Purchased Electricity)

= 10,000 MTCO2

5.5 MTeCO2

1 FTE

15.3 MTeCO2

1000 FT^2

2020

Emissions Targets

2010

Scope 1 (2009): 19,343 MTeCO2 (Natural Gas Consumption)

Scope 2 (2009): 75,595 MTeCO2 (Purchased Electricity)

= 10,000 MTCO2

5.5 MTeCO2

Per Capita

15.3 MTeCO2

1000 FT²

2020

Scope 1 Target: 15,000 MTeCO2 (Natural Gas Consumption)

Scope 2 Target: 60,000 MTeCO2 (Purchased Electricity)

materials / waste

Material Procurement

500 mile radius

Waste Management Targets

2010

3,922,708 lbs of solid waste

124,000 lbs recycled

2020

30% reduction

= 500,000 lbs

economic

operation
al costs

economic
development

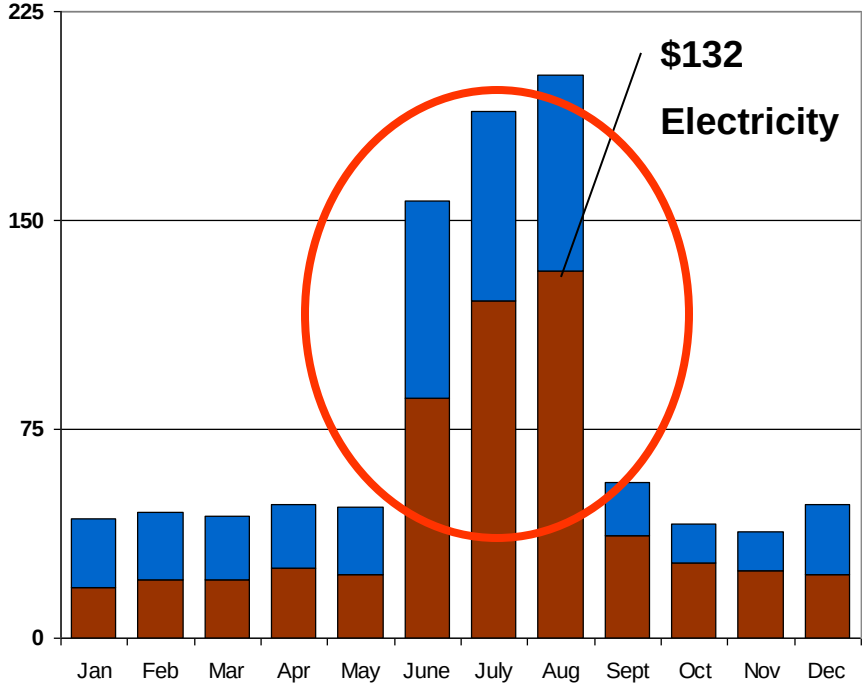
operational costs

Energy Costs

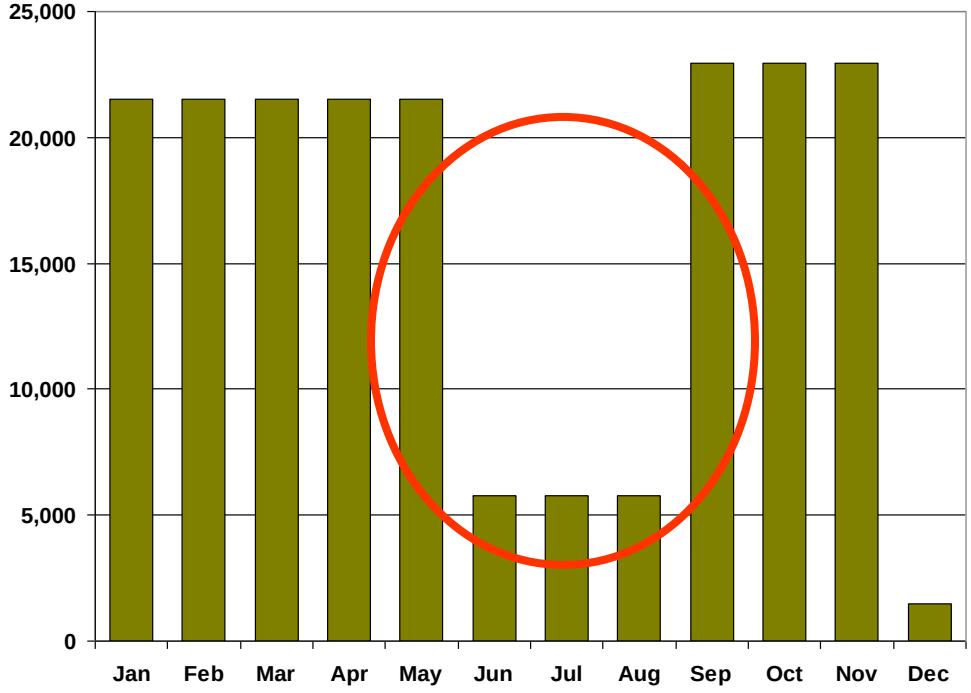
Cost spent per capita:

electricity: $18 per month to $132 per month
natural gas: $14 per month to $71 per month

Per Capita Costs



Population



economic development

Economic Partnerships

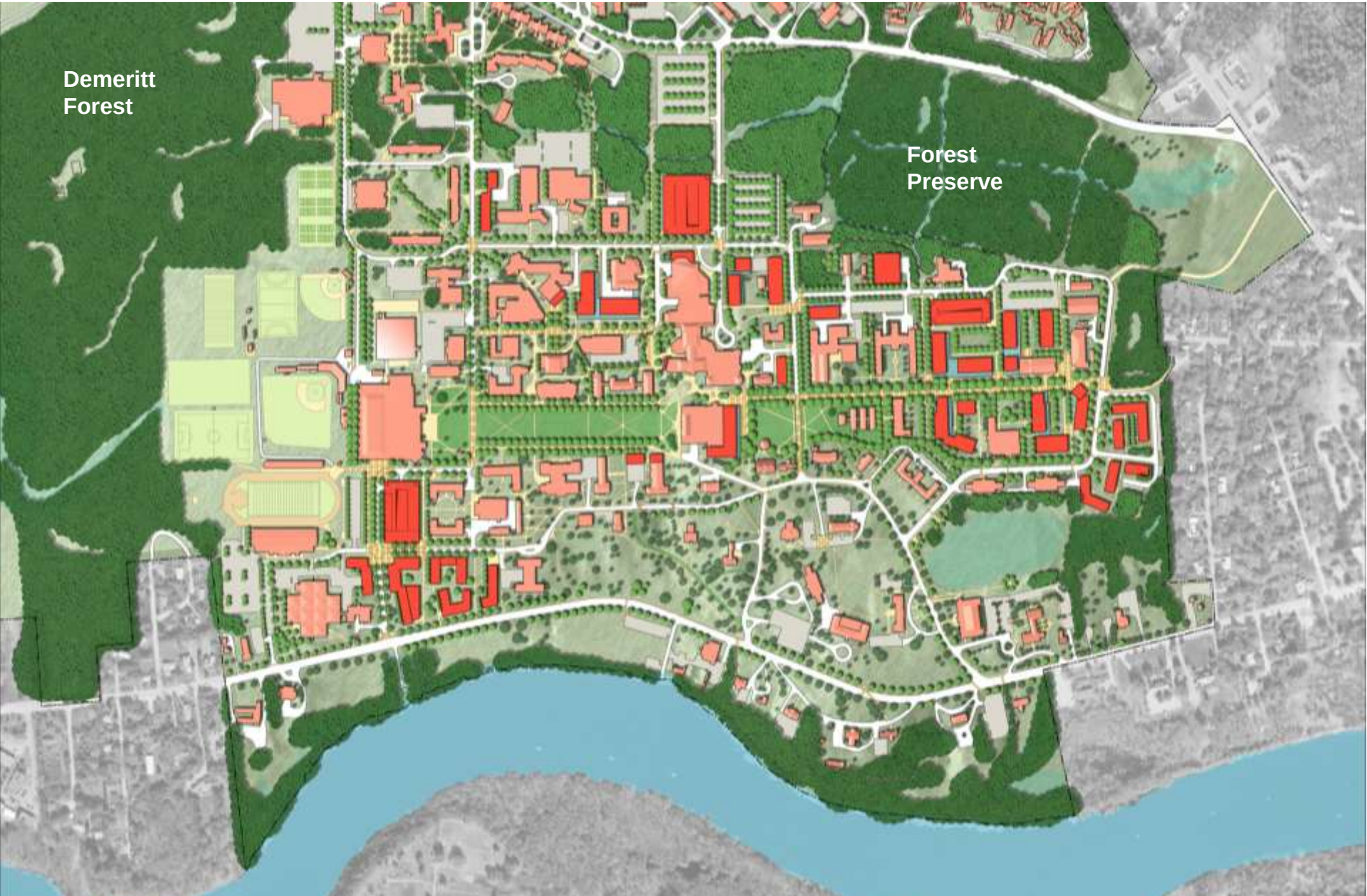
University of Maine Master Plan Case Study

AWARDS:
SCUP / AIA MERIT AWARD FOR EXCELLENCE IN PLANNING, 2009
BSA CAMPUS PLANNING MERIT AWARD, 2010

1865 THE UNIVERSITY OF MAINE

SASAKI

A VISION FOR THE FUTURE



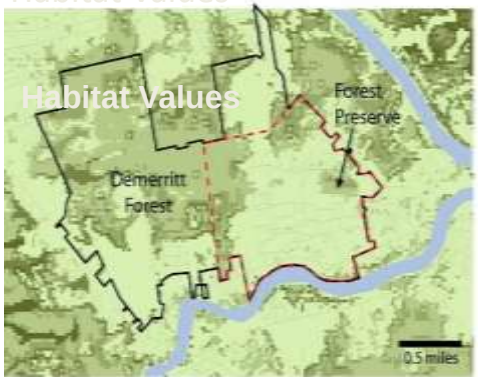
A VISION FOR THE FUTURE

Sustainability Metrics

Habitat : :

- **Goals**
  - Increase connectivity
  - Preserve woods and farm land
- **Strategies**
  - Growth boundary
  - Reforestation
  - Riverfront restoration
  - Wetland restoration
  - Windbreaks
- **Outcomes**
  - Reforestation / Habitat Corridors
  - Wetland restoration
  - 800 acres of forest preserved

Habitat Values



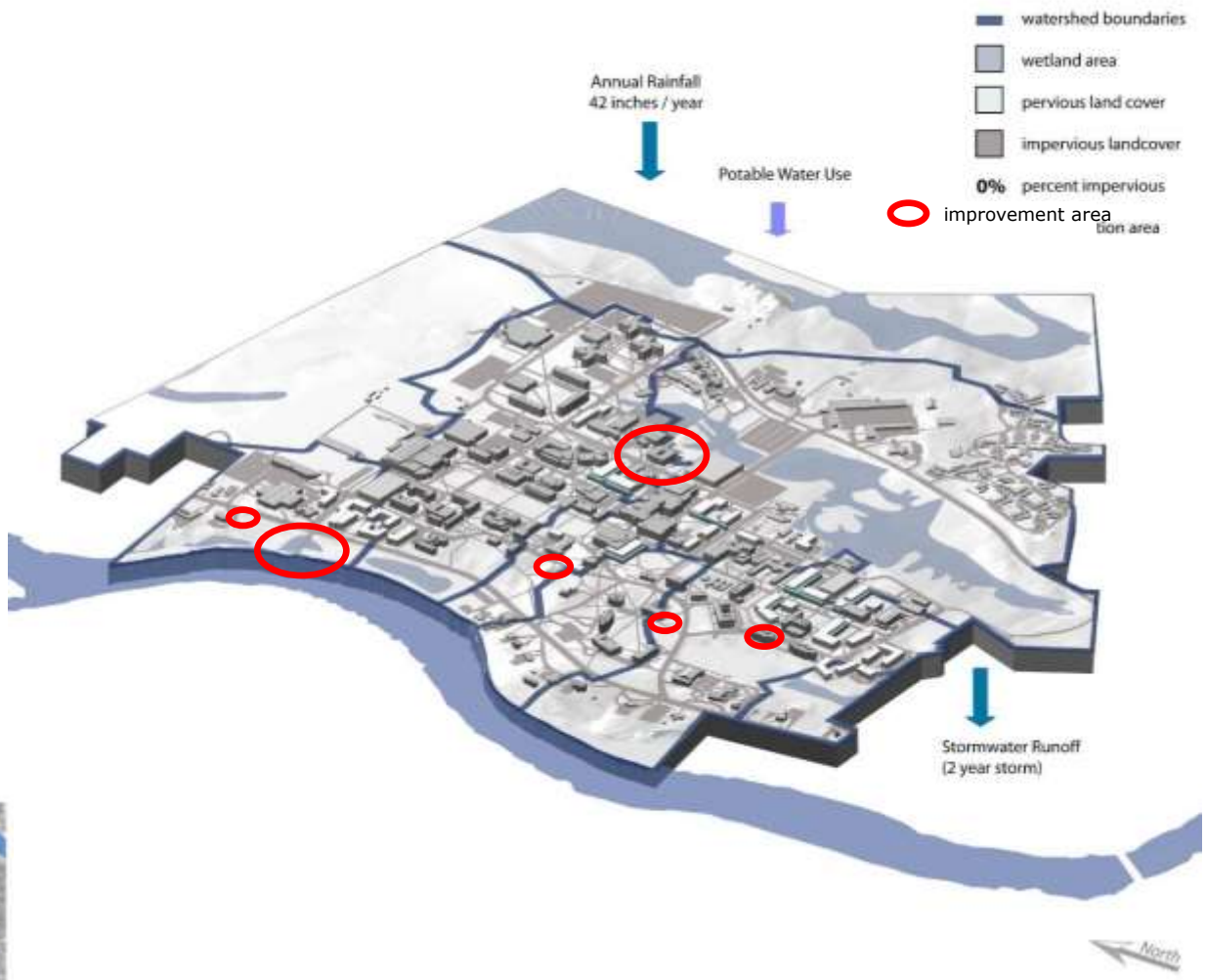
Demerritt Forest :

Spruce 29%
White Pine 27%
Red Maple 18%
Balsom Fir 14%
Hemlock 10%

Sustainability Metrics

Water Resources : :

- **Goals**
  - Comprehensive stormwater management plan
  - Reduce impervious area
  - Increase water retention time
  - Decrease potable water use
- **Strategies**
  - Re-establish wetlands
  - Restore riverfront floodplain
  - Create detention areas
- **Outcomes**
  - Decrease in impervious area
  - Decrease in run-off volume (cubic feet)
  - Decrease in run-off rates (cubic feet / second)



Soil Analysis

Land Cover

Sustainability Metrics

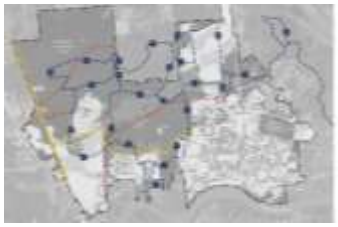
Access / Mobility : :

- **Goals**
  - Improve the pedestrian experience
  - Plan for transportation options / reduce parking demand
  - Connectivity: interior/exterior circulation/community network

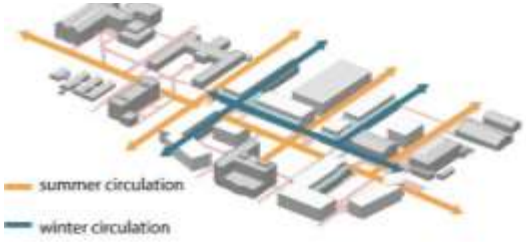
- **Strategies**
  - Establish pedestrian priority zone
  - Park once and walk policy
  - Relocate parking to the periphery
  - Create campus shuttle / transit service
  - Connectivity to community path

- **Outcomes**
  - Pedestrianized core
  - Improved transit access/modal split
  - Increase in resident population

Campus Trail Network



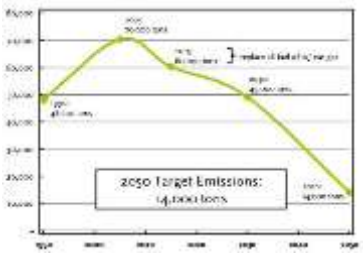
Coordinated Interior / Exterior Pedestrian Network

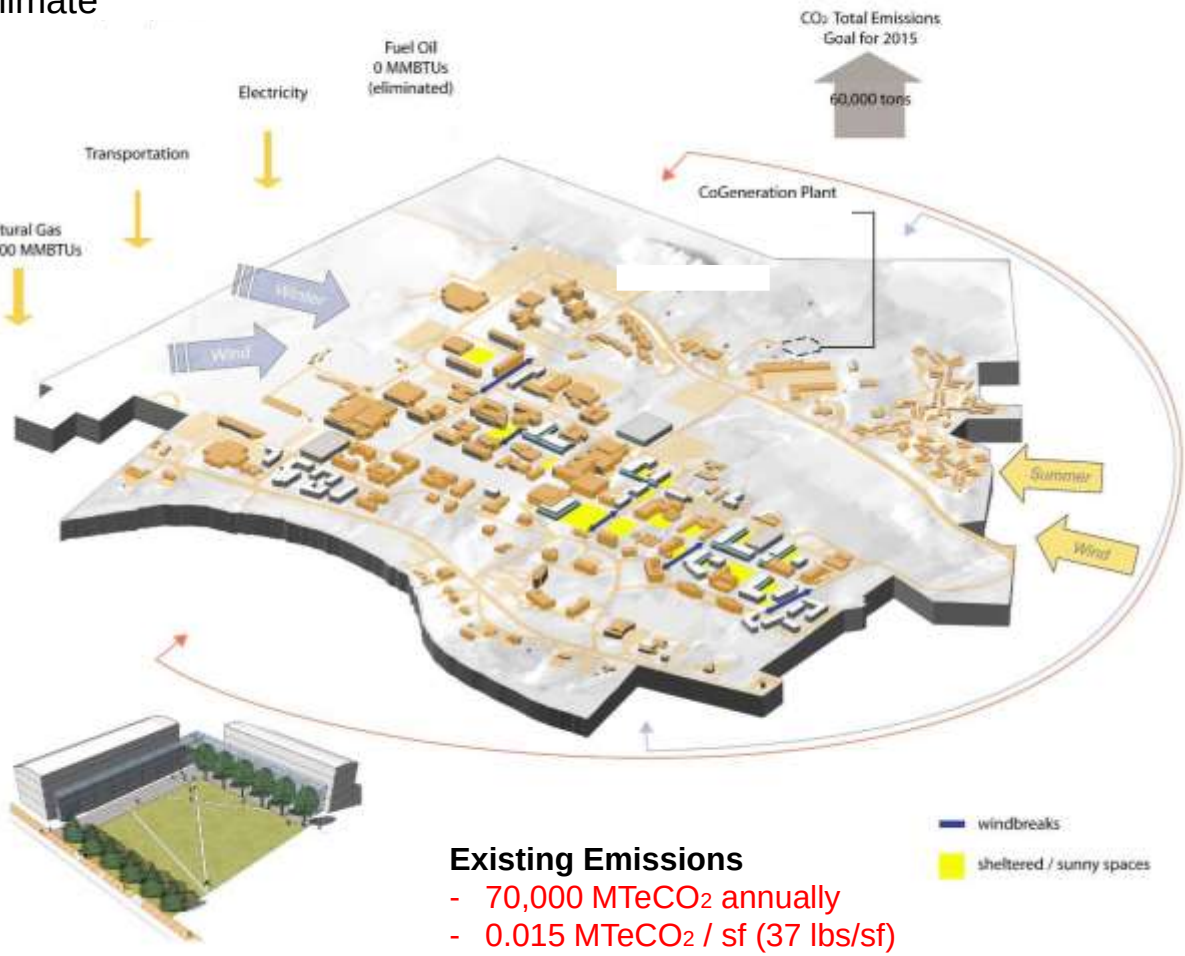


Sustainability Metrics

Energy & Emissions : :

- Goals
  - Presidents' Climate commitment (climate neutrality)
  - Reduce CO_2 emissions
  - Reduce energy costs
- Strategies
  - Cogeneration
  - Transition fuel sources
  - Creating working landscapes
  - Building performance guidelines
  - Solar adaptability
  - Emissions reduction targets
- **Outcomes**
  - 1.7 million additional SF
  - Potential eCO2 increase – 25,800 MTeCO2 (assuming current fuel mix/power sources)

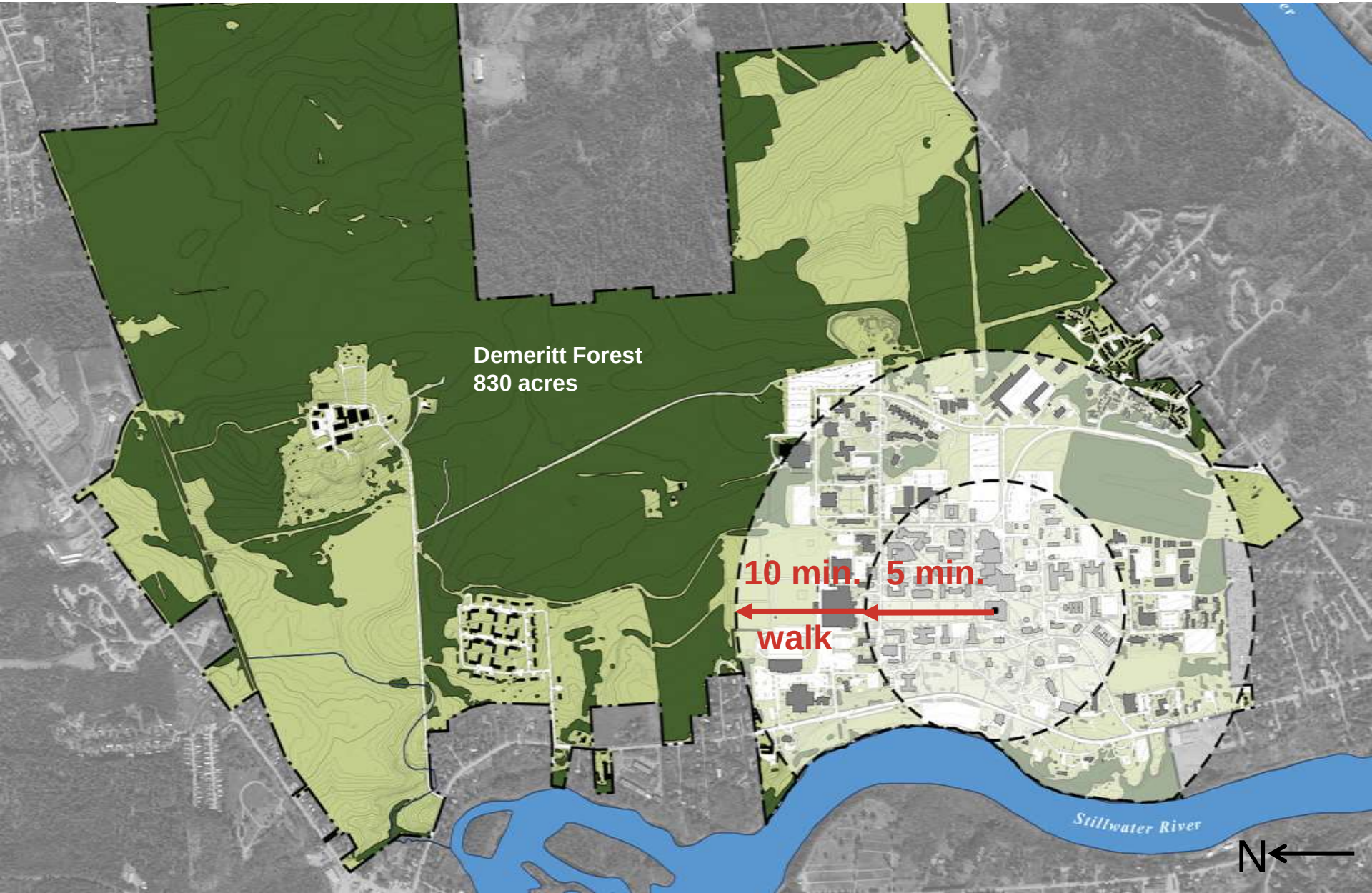




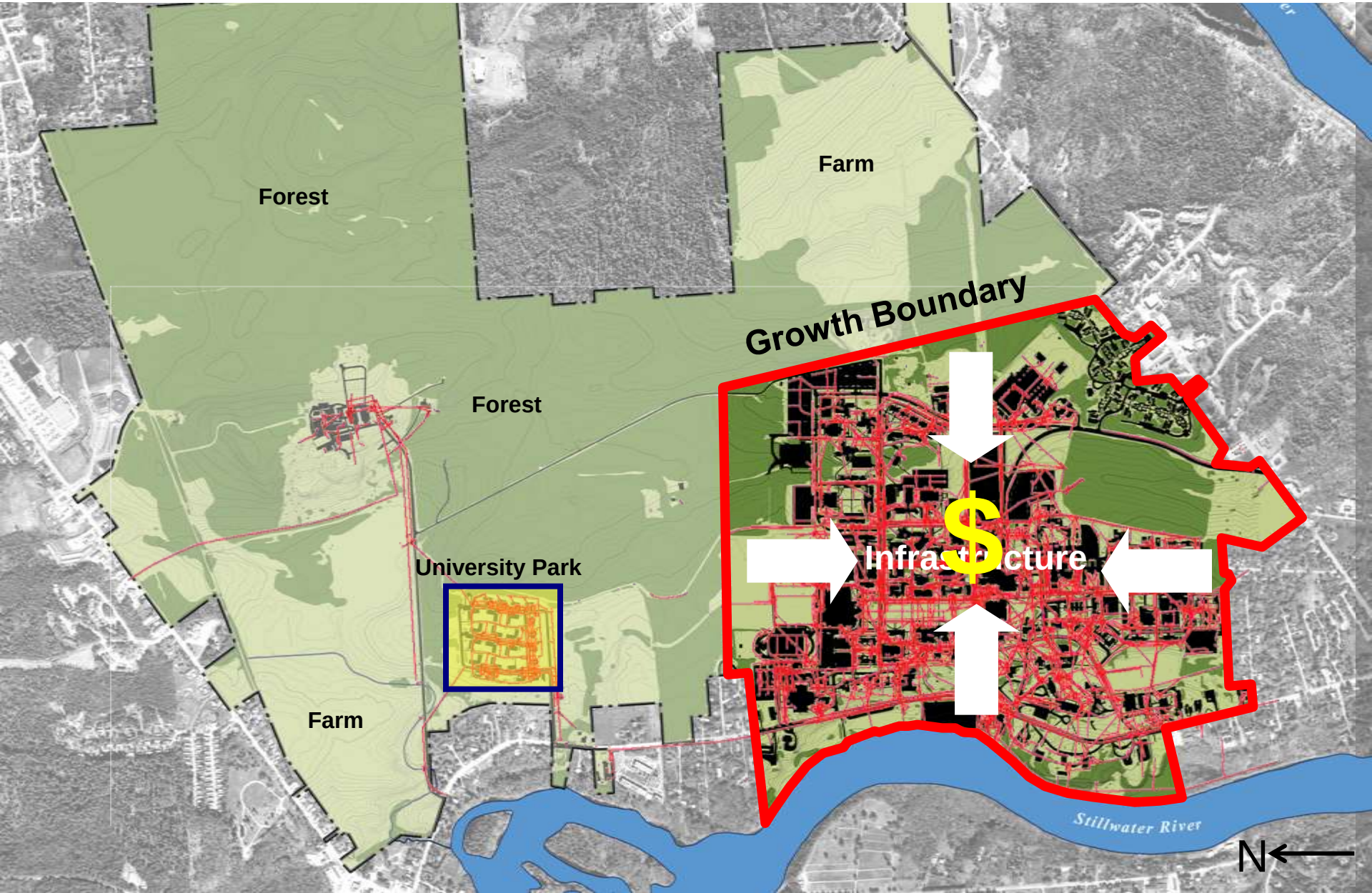
Existing Emissions

- 70,000 $MTeCO_2$ annually
- 0.015 $MTeCO_2$ / sf (37 lbs/sf)
- 6.1 $MTeCO_2$ per capita

LAND USE


Demeritt Forest
830 acres
10 min.
5 min.
walk
Stillwater River
N

LAND USE


Forest
Farm
Growth Boundary
Forest
$
Infrastructure
University Park
Farm
Stillwater River
N

THANK YOU

Greg Havens, AIA, AICP
Sasaki Associates, Inc.
64 Pleasant Street
Watertown, MA 02472

+1 617 926 3300
ghavens@sasaki.com