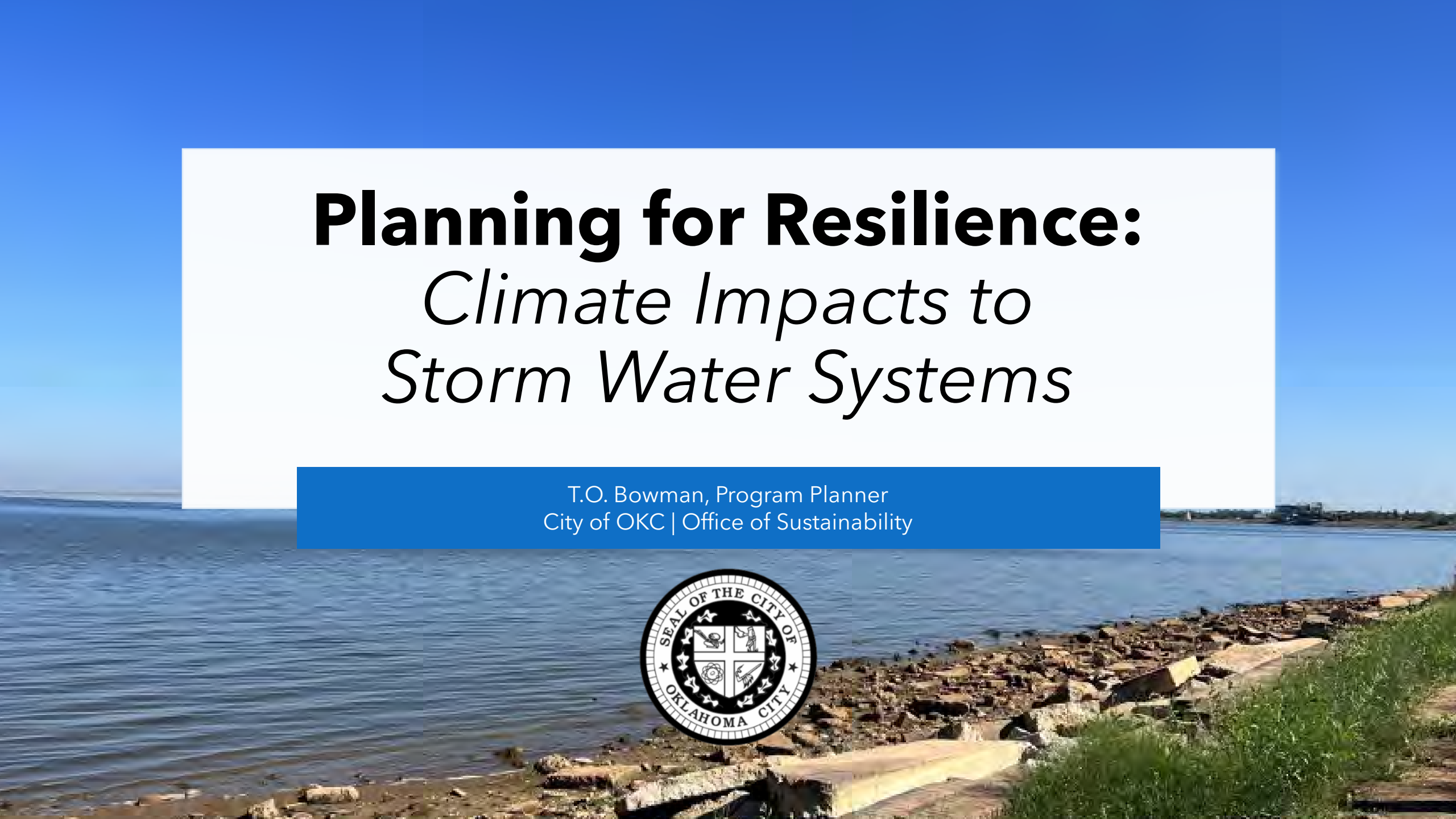
Planning for Resilience: *Climate Impacts to Storm Water Systems*

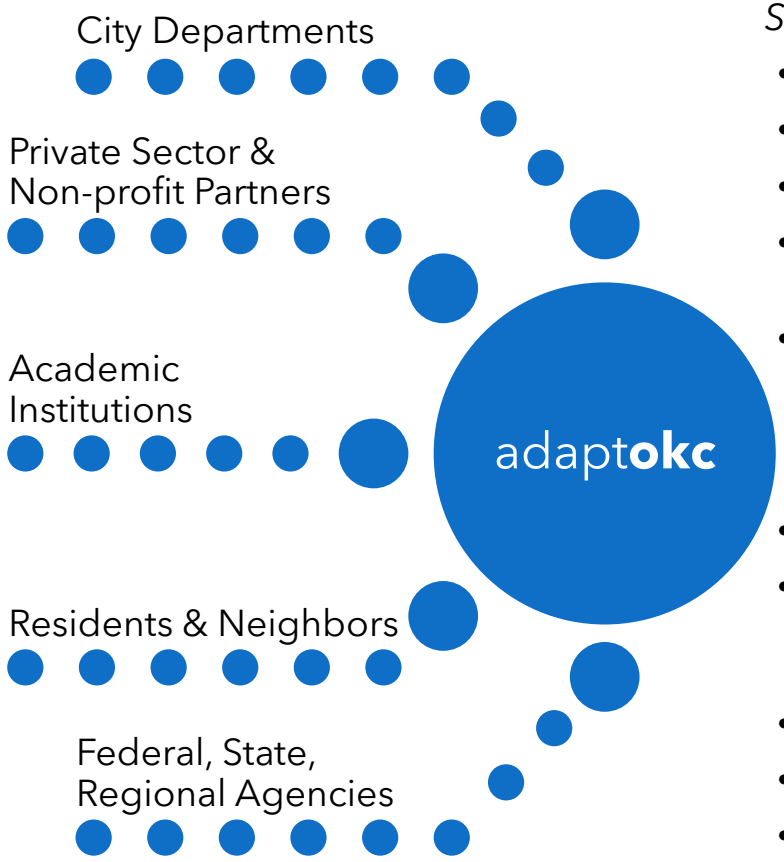
T.O. Bowman, Program Planner
City of OKC | Office of Sustainability



Agenda

1. How adapt**okc** works
2. Why have a sustainability / adaptation plan?
3. adapt**okc** Implementation Overview
4. Natural & Built Environment
    - *Goals & Initiatives*
    - *Policy Implementation*
    - *Poll Questions*
5. adapt**okc** Workgroup Sign-up

How adaptokc works



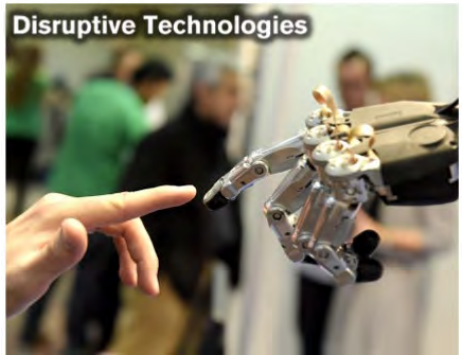
The Office of Sustainability:

- ***Coordinates Action***
- ***Facilitates Dialogue***
- ***Conducts Studies***
- ***Tracks & Reports Progress***
- ***Forms & Manages Partnerships***
- ***Collects Data***
- ***Supports Departments & Residents***
- ***Develops Policy***
- ***Addresses Barriers***
- ***Researches & Recommends Solutions***

plan**okc**

sustain**okc**
connect**okc**
green**okc**
live**okc**
enrich**okc**
play**okc**
strengthen**okc**
serve**okc**

Challenges!


Disruptive Technologies


Disproportionate Vulnerability


Extreme Heat


Transportation Costs


Environmental & Public Health


Preparedness & Resilience


Economic Diversification


Urban Flooding

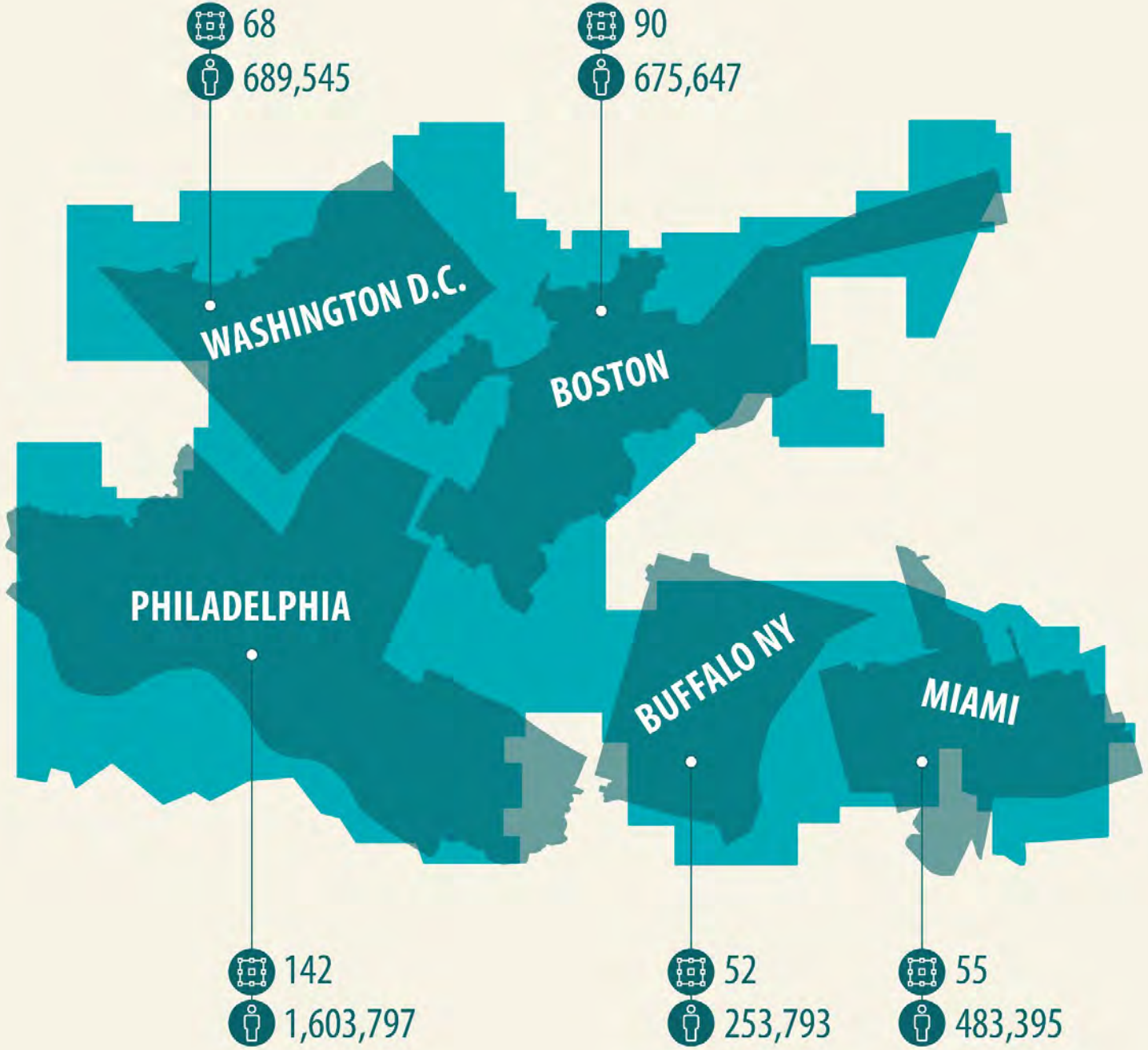
OKC IS BIG

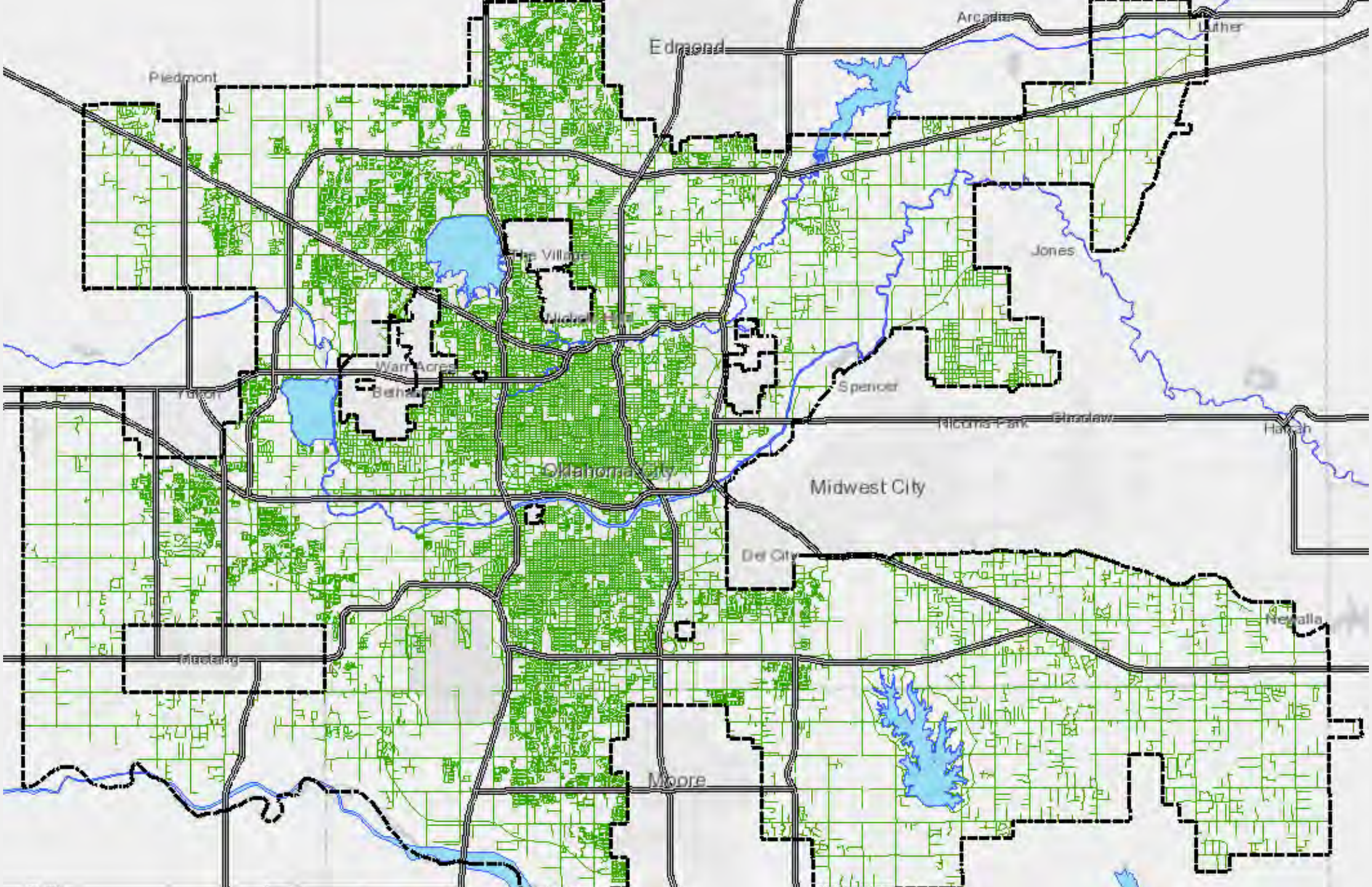
622

676,492

land area in sq. miles

population



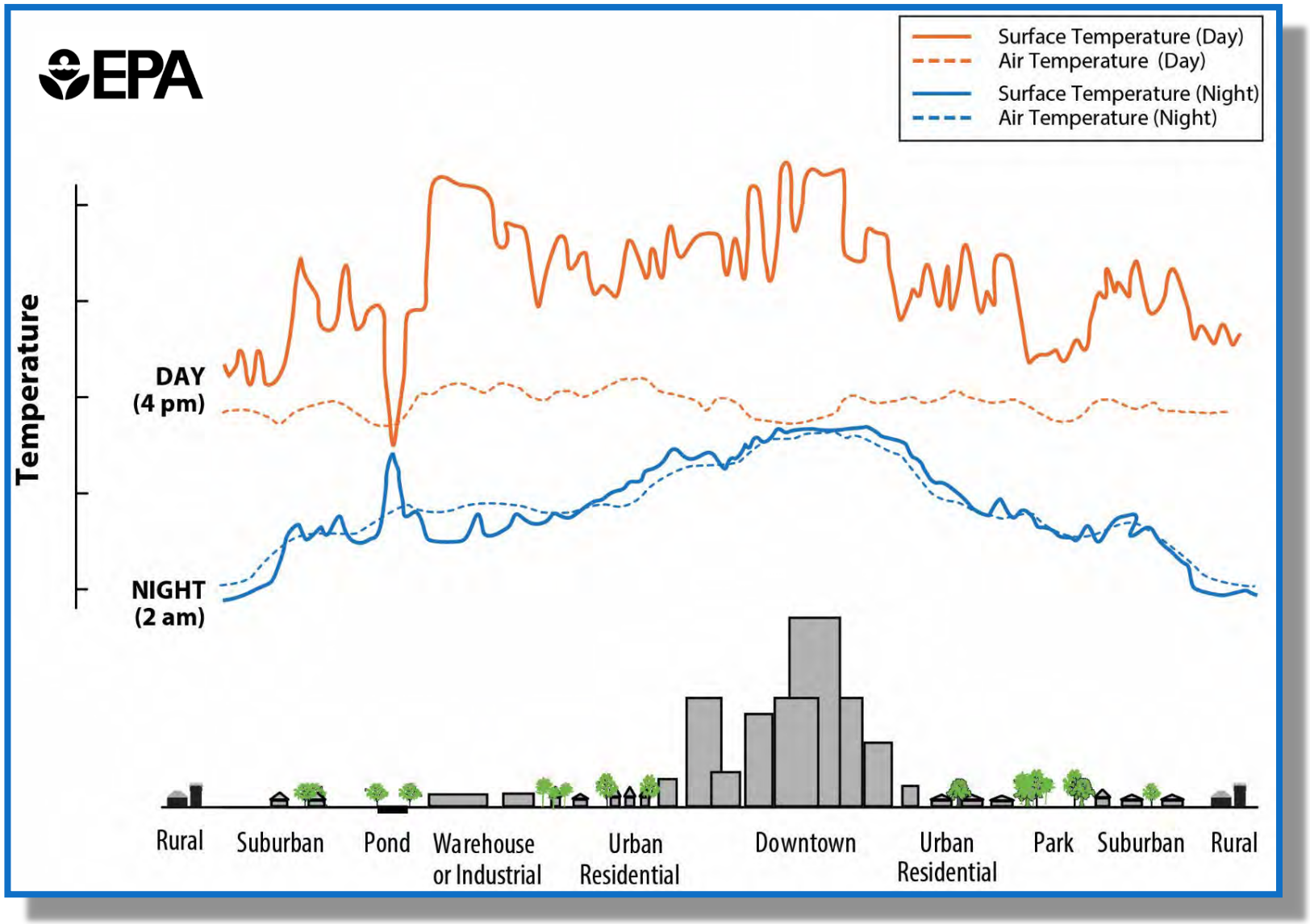

Edmond
Piedmont
Arcadia
Luther
Jones
Spencer
Nicoma Park
Bethany
Warr Acres
Oklahoma City
Midwest City
Del City
Moore
Mustang
Newalla
Harrah

5%

Parking Lots

URBAN HEAT ISLAND

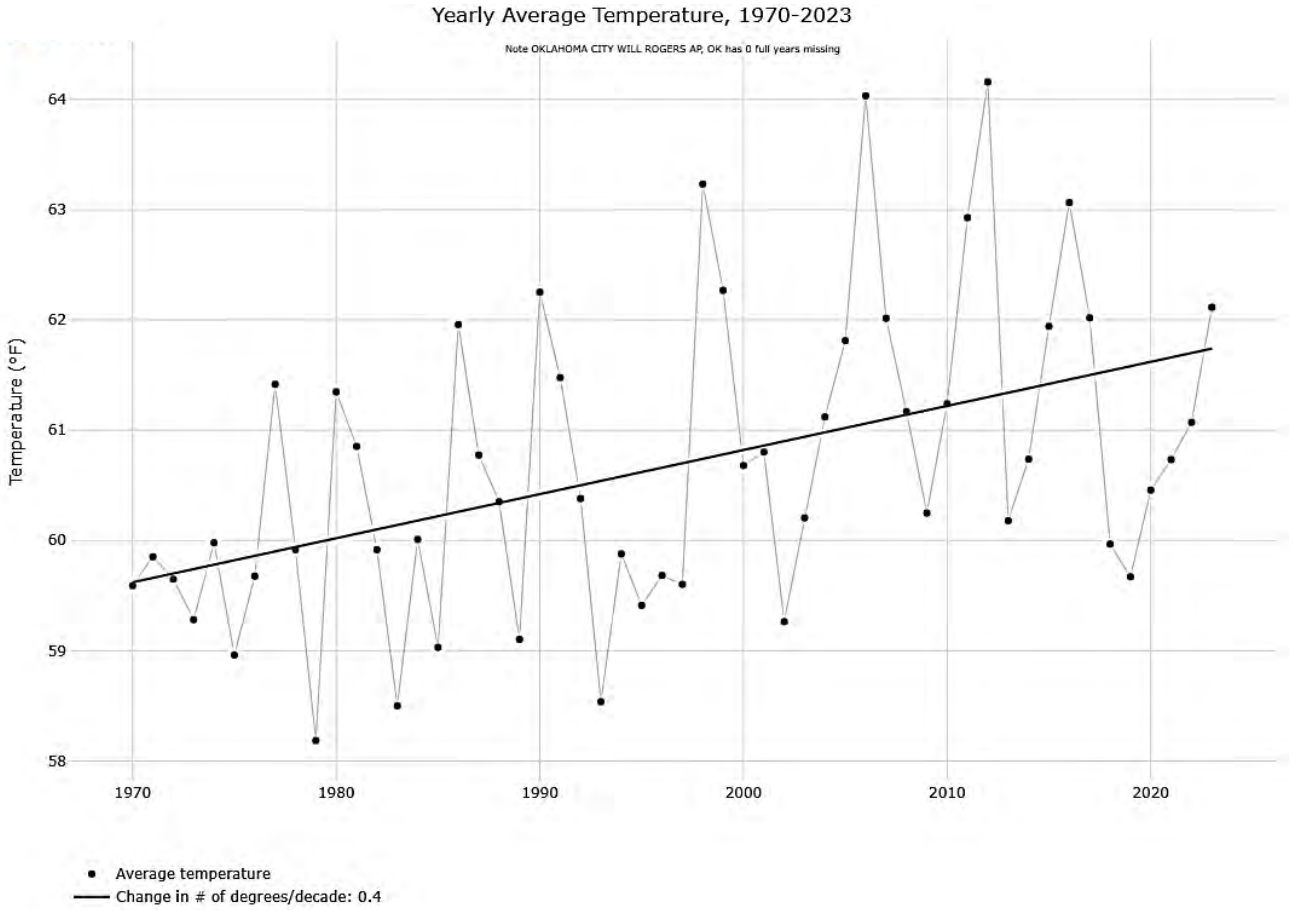
Unshaded areas, concrete or asphalt where temperatures can be at least 7° hotter than vegetated areas

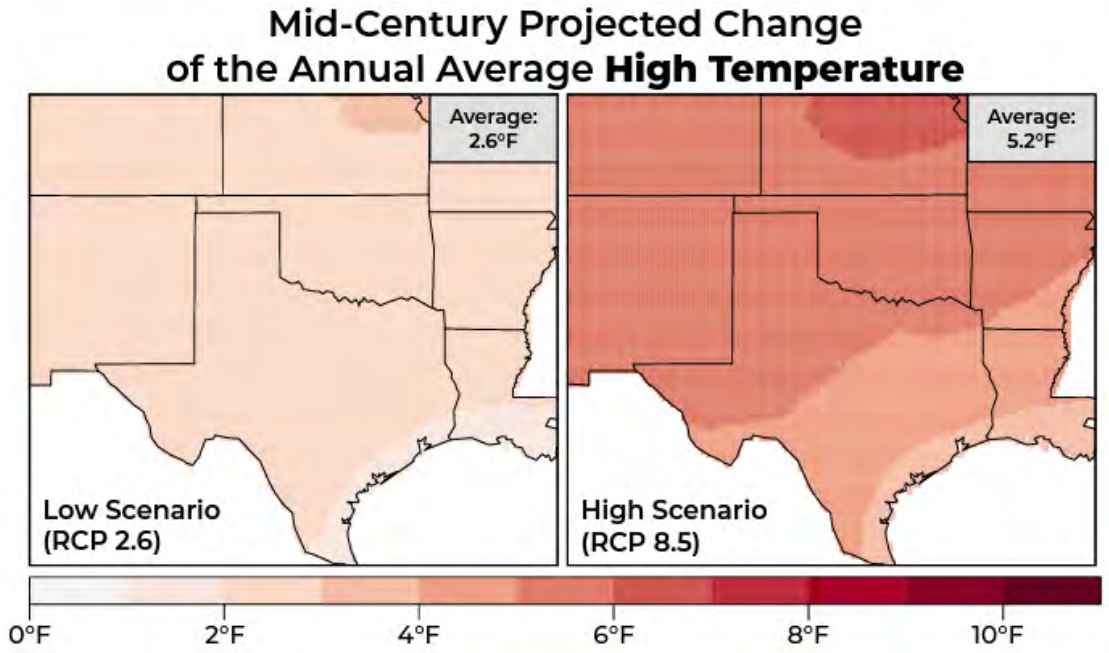


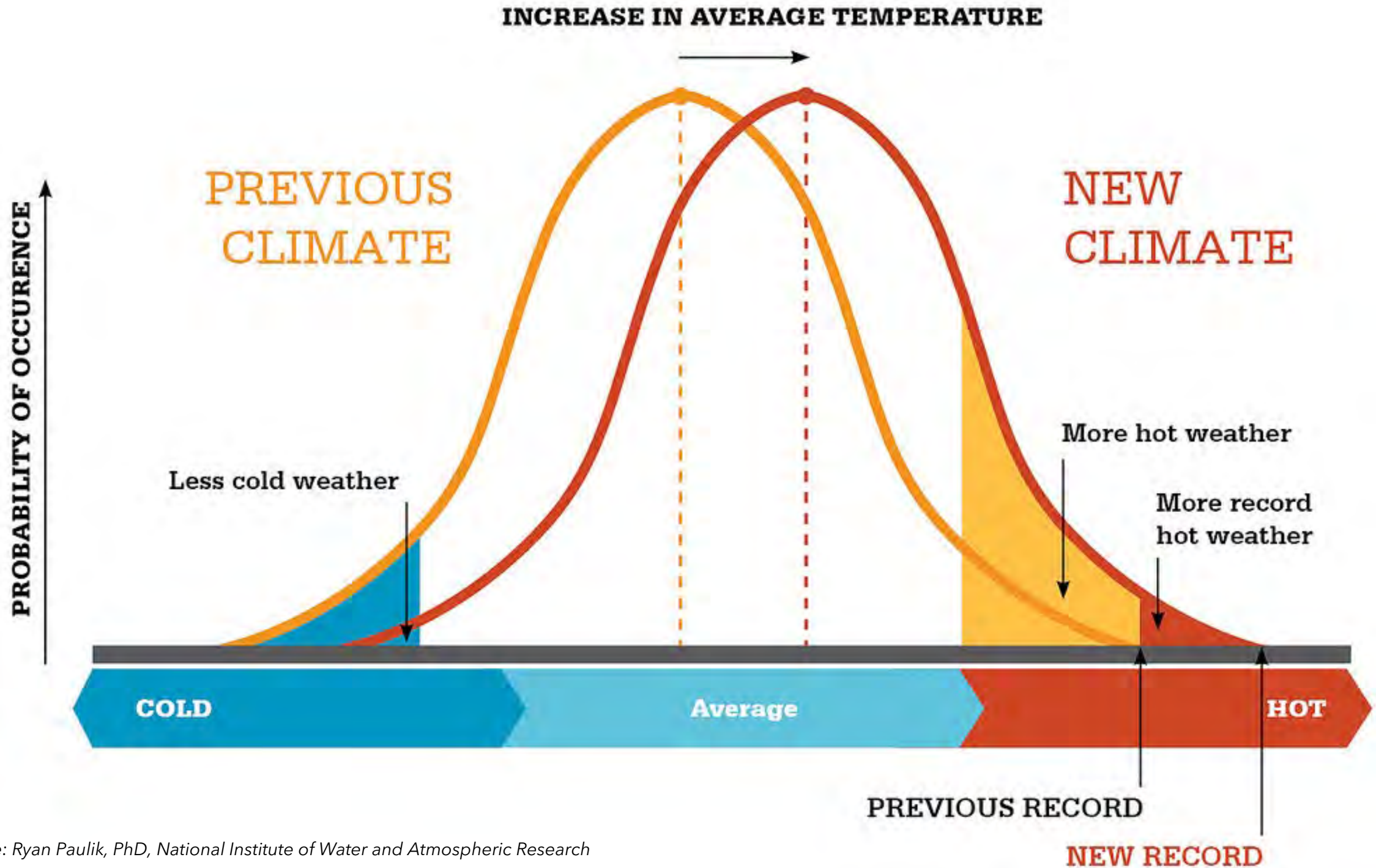
Extreme Heat

SCIPP
A NOAA CAP TEAM

SOUTH CENTRAL
CLIMATE ADAPTATION SCIENCE CENTER



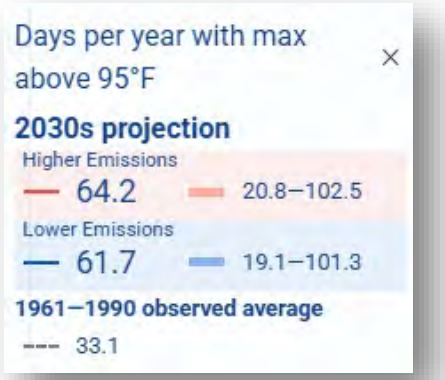


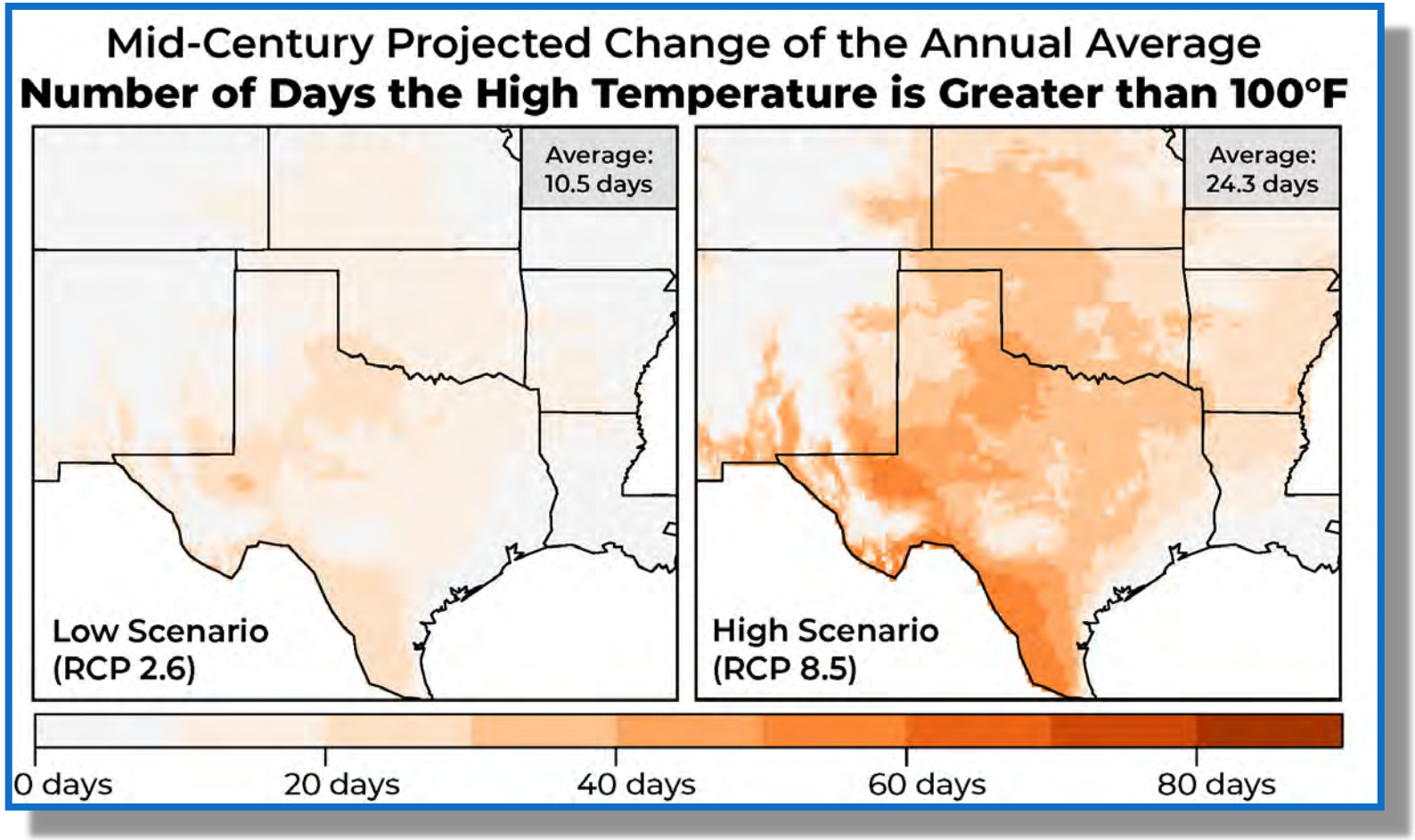


Source: Ryan Paulik, PhD, National Institute of Water and Atmospheric Research

Extreme Heat

Average Temperature Increase means more extremely hot days per year



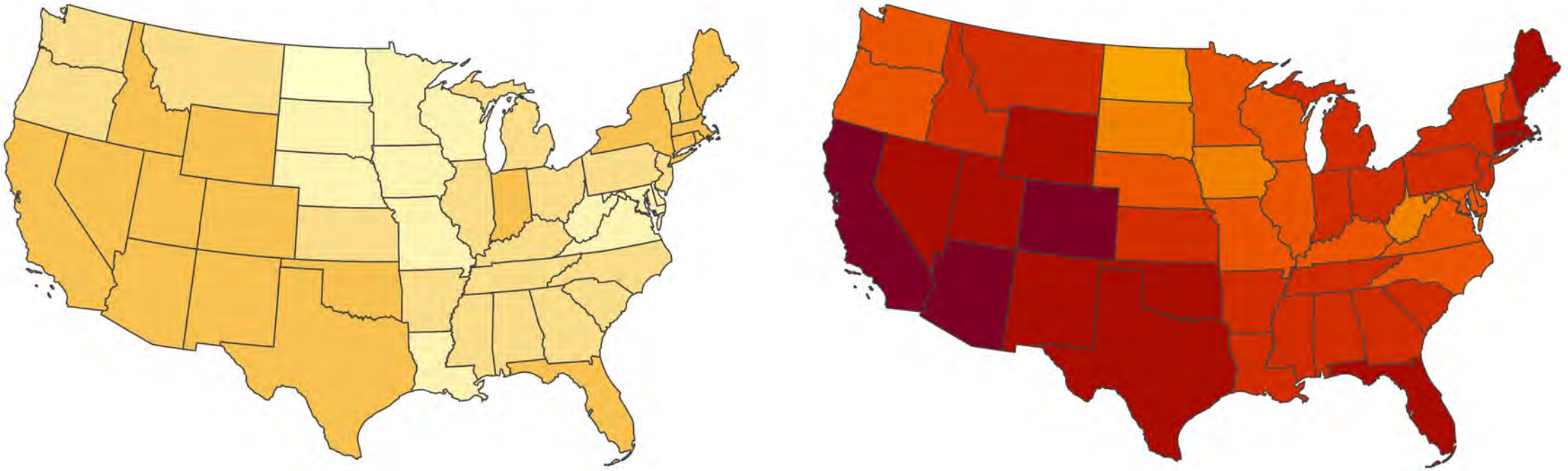


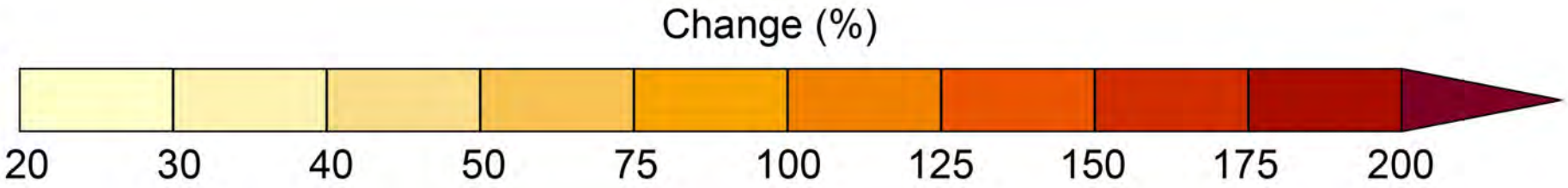
SOUTH CENTRAL
CLIMATE ADAPTATION SCIENCE CENTER

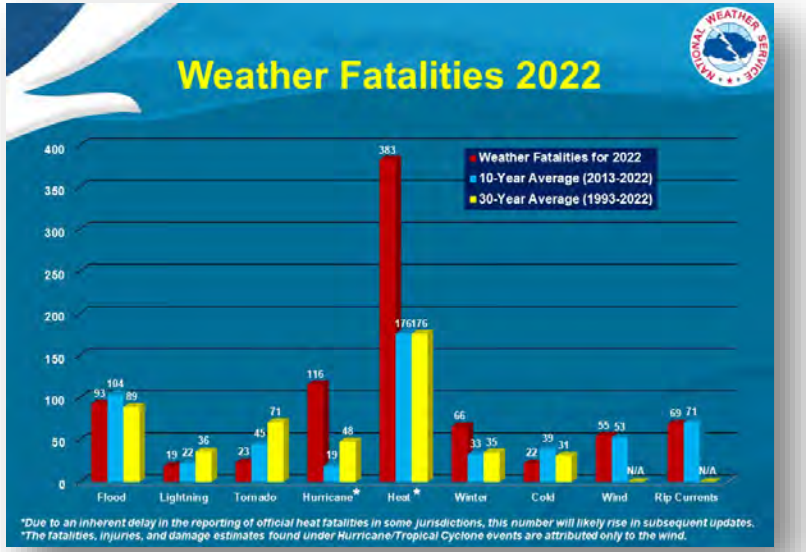
Projected Changes in Electricity Demand

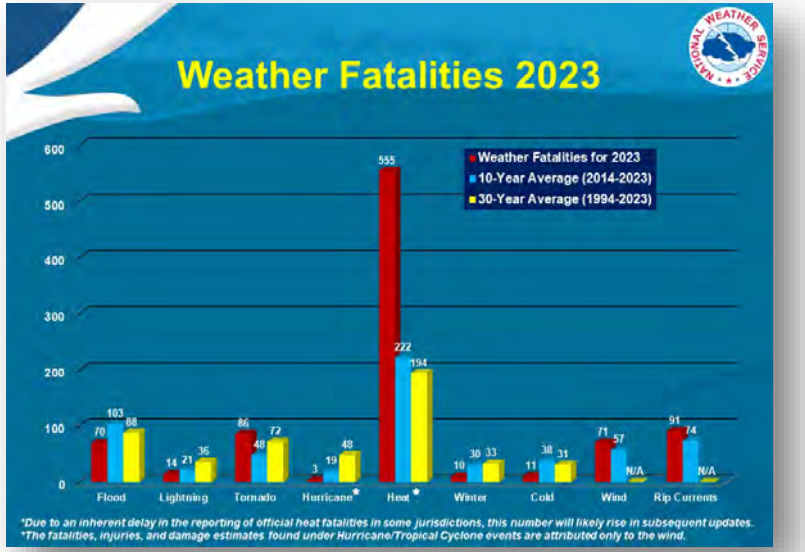
a) Percent change in annual electricity demand from 2020 to 2050 (SSP5-8.5)

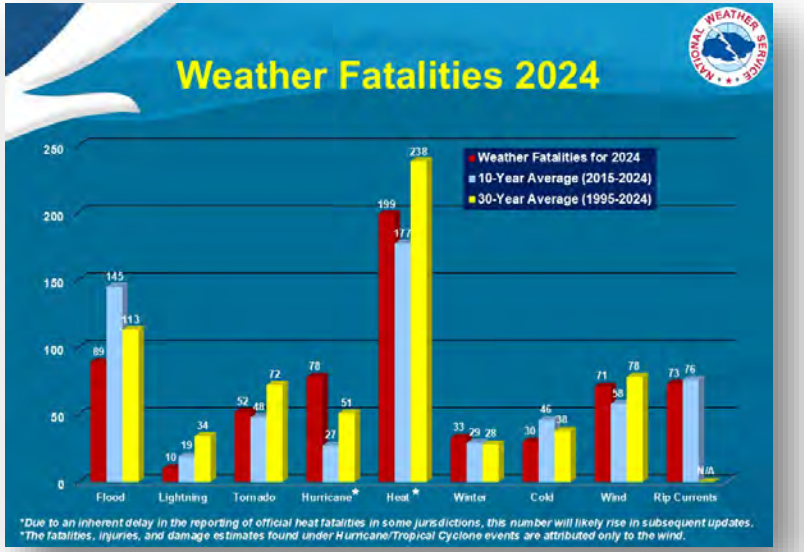
b) Percent change in annual electricity demand from 2020 to 2100 (SSP5-8.5)



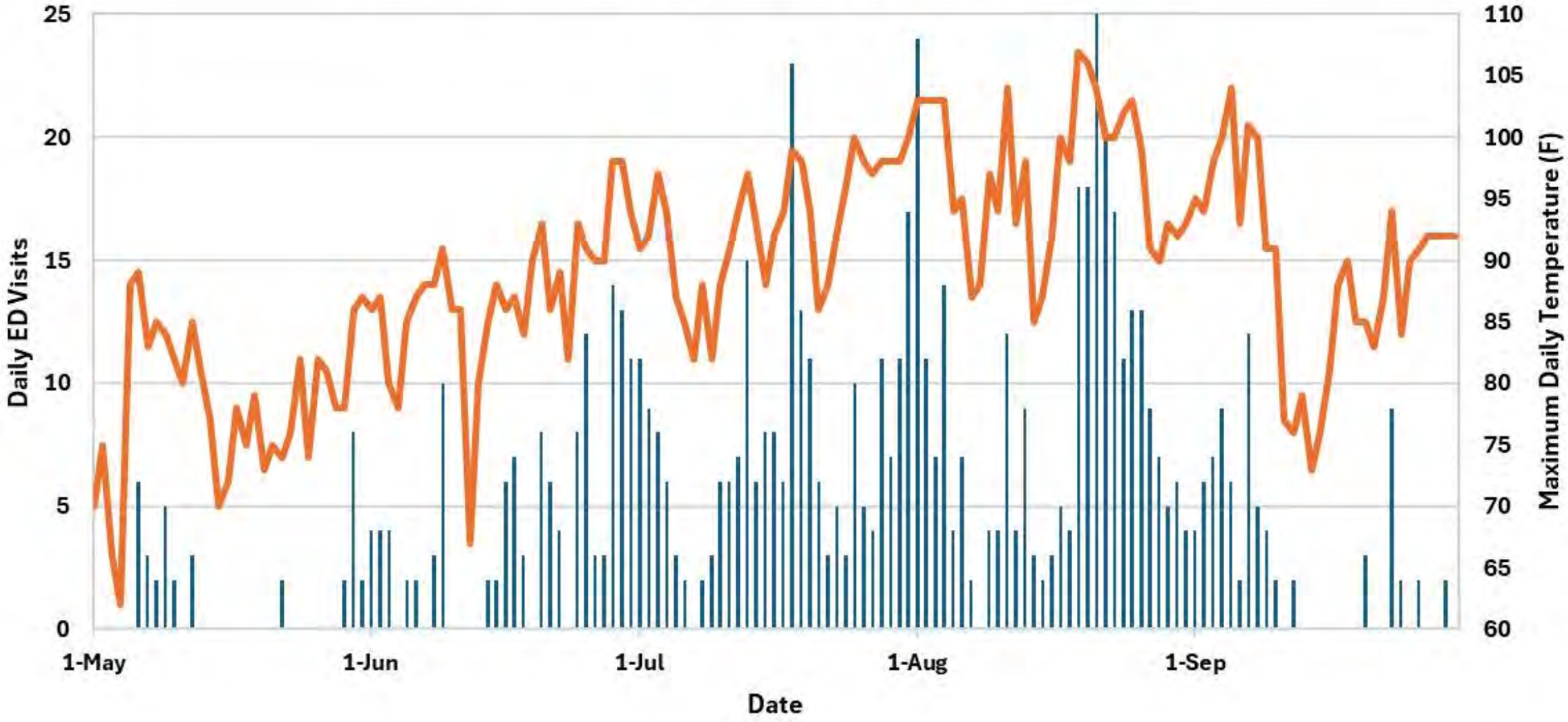



Weather Fatalities 2022
Weather Fatalities for 2022
10-Year Average (2013-2022)
30-Year Average (1993-2022)
400
350
300
250
200
150
100
50
0
93 104 89
19 22 36
23 45 71
116 19 48
383 176 176
66 33 35
22 39 31
55 53 N/A
69 71 N/A
Flood
Lightning
Tornado
Hurricane*
Heat*
Winter
Cold
Wind
Rip Currents
*Due to an inherent delay in the reporting of official heat fatalities in some jurisdictions, this number will likely rise in subsequent updates.
*The fatalities, injuries, and damage estimates found under Hurricane/Tropical Cyclone events are attributed only to the wind.


Weather Fatalities 2023
Weather Fatalities for 2023
10-Year Average (2014-2023)
30-Year Average (1994-2023)
600
500
400
300
200
100
0
70 103 88
14 21 35
86 48 72
3 19 48
555 222 194
10 30 33
11 38 31
71 57 N/A
91 74 N/A
Flood
Lightning
Tornado
Hurricane*
Heat*
Winter
Cold
Wind
Rip Currents
*Due to an inherent delay in the reporting of official heat fatalities in some jurisdictions, this number will likely rise in subsequent updates.
*The fatalities, injuries, and damage estimates found under Hurricane/Tropical Cyclone events are attributed only to the wind.


Weather Fatalities 2024
Weather Fatalities for 2024
10-Year Average (2015-2024)
30-Year Average (1995-2024)
250
200
150
100
50
0
89 145 113
10 19 34
52 48 72
78 27 51
199 177 238
33 29 28
30 46 38
71 58 78
73 76 N/A
Flood
Lightning
Tornado
Hurricane*
Heat*
Winter
Cold
Wind
Rip Currents
*Due to an inherent delay in the reporting of official heat fatalities in some jurisdictions, this number will likely rise in subsequent updates.
*The fatalities, injuries, and damage estimates found under Hurricane/Tropical Cyclone events are attributed only to the wind.

ED Visits for Heat Related Illness at OKC-County Facilities and Maximum Daily Temperature, May-September 2023



Wet Bulb Globe Temperature

Unacclimated and Acclimated Work/Rest and Water Intake Chart

Heat Risk Category		Wet Bulb Globe Temp	Light Work		Moderate Work		Heavy Work	
			Work/Rest	Water Intake (quart/hr)	Work/Rest	Water Intake (quart/hr)	Work/Rest	Water Intake (quart/hr)
No Risk	Unacclimated	78 – 79.9	50/10 min	½	40/20 min	¾	30/30 min	¾
	Acclimated	78 – 79.9	continuous	½	continuous	¾	50/10 min	¾
Low	Unacclimated	80 – 84.9	40/20 min	½	30/30 min	¾	20/40 min	1
	Acclimated	80 – 84.9	continuous	½	50/10 min	¾	40/20 min	1
Moderate	Unacclimated	85 – 87.9	30/30 min	¾	20/40 min	¾	10/50 min	1
	Acclimated	85 – 87.9	continuous	¾	40/20 min	¾	30/30 min	1
High	Unacclimated	88 – 90	20/40 min	¾	10/50 min	¾	avoid	1
	Acclimated	88 – 90	continuous	¾	30/30 min	¾	20/40 min	1
Extreme	Unacclimated	> 90	10/50 min	1	avoid	1	avoid	1
	Acclimated	> 90	50/10 min	1	20/40 min	1	10/50 min	1

Adapted from: 1) USGS Survey Manual, Management of Occupational Heat Stress, Chapter 45, Appendix A. 2) Manual of Naval Preventive Medicine, Chapter 3: Prevention of Heat and Cold Stress Injuries. 3) OSHA Technical Manual Section III: Chapter 4 Heat Stress. 4) National Weather Service Tulsa Forecast Office, Wet Bulb Globe Temperature.

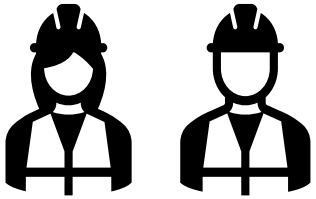
Disproportionate Effects

VULNERABLE POPULATIONS

Elderly people, children and those with already existing conditions such as heart, respiratory or kidney disease are particularly vulnerable

ENERGY BURDEN

People experiencing low or moderate incomes are more likely to live in older homes and unable to afford weatherization



OUTDOOR WORKERS

Farm workers, public safety, landscaping crews, parks staff, water/sewer line maintenance workers, roofers, construction workers, etc.

PUBLIC TRANPORTATION

Residents without a personal vehicle are more exposed to extreme heat than others on average summer days

CAPACITY TO ADAPT

Some do not have the economic, political, or social capacity to adapt to extreme temperatures as effectively as others

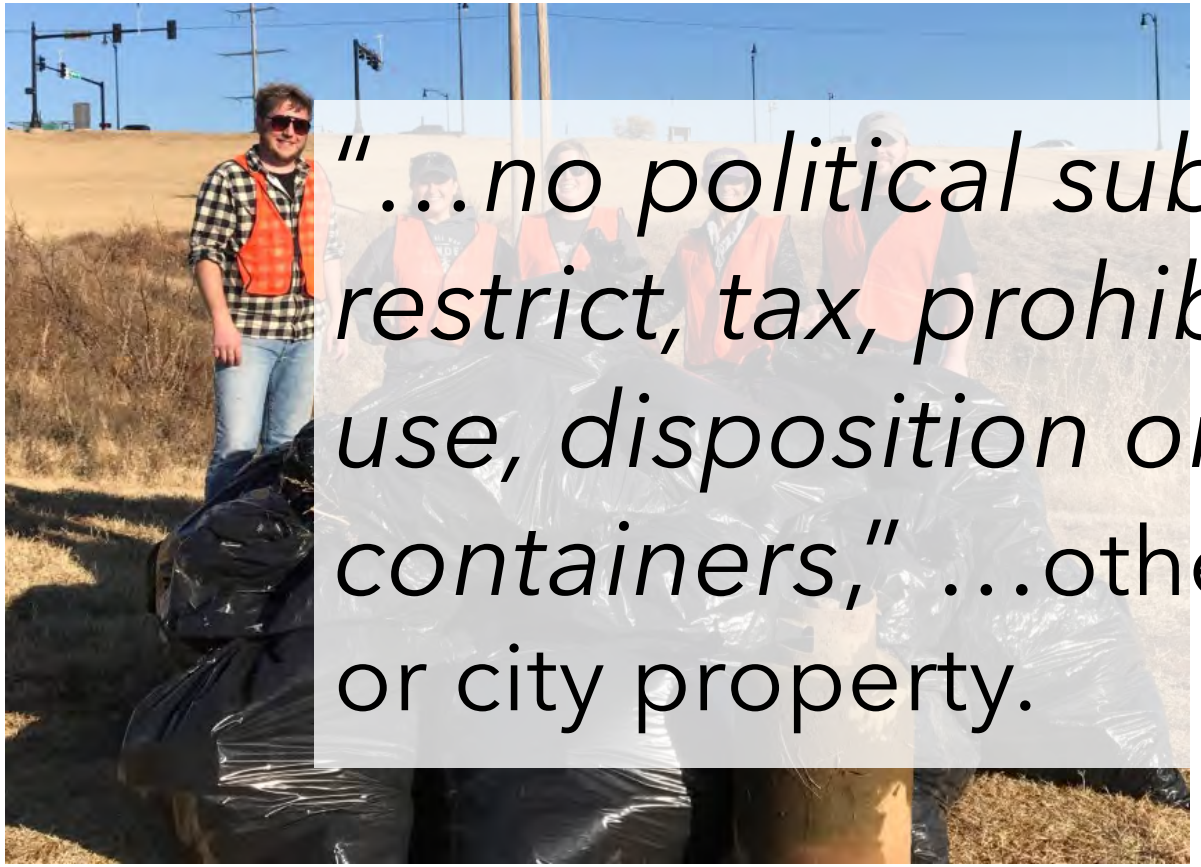
Heavy Rain & Flooding

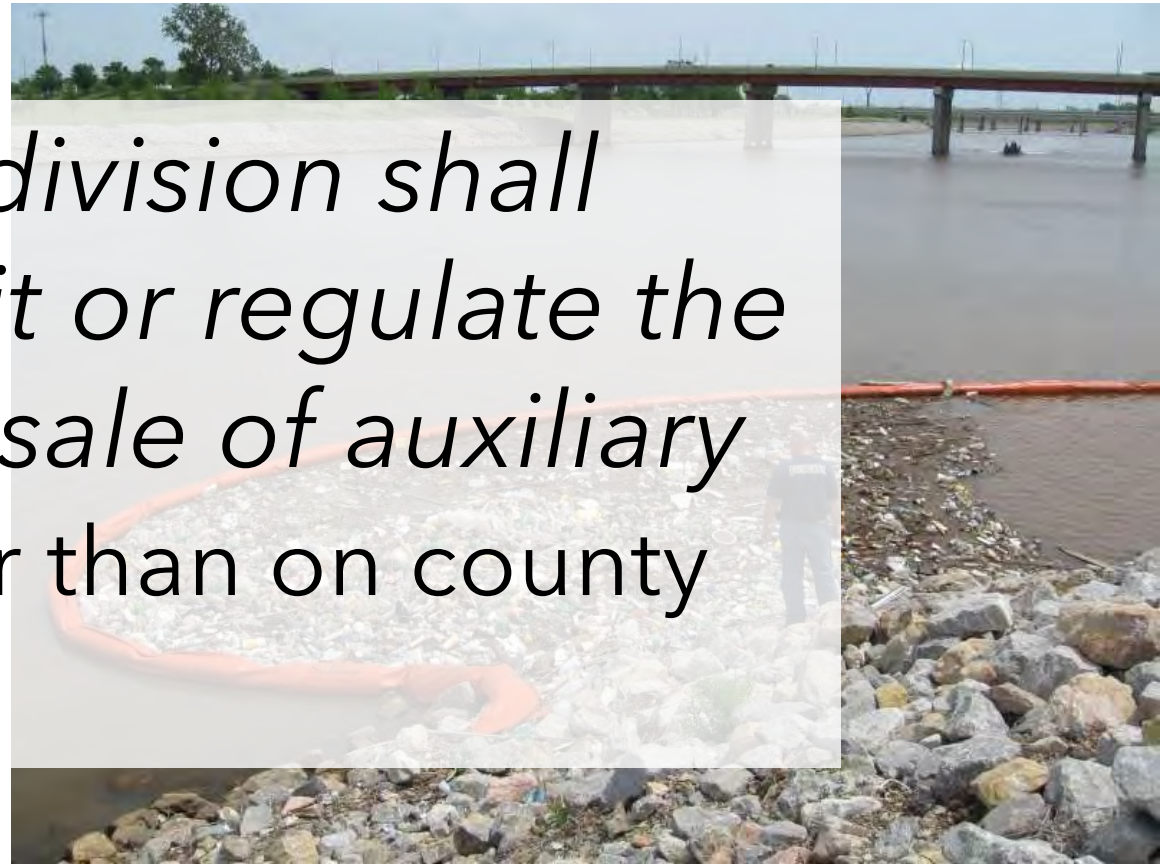
Storm Water Runoff & Pollution


PEOPLE HELP CLEAN UP WHEELER PARK WETLAND
OKLAHOMA'S NEWS 4
12:09 PM 52°KFOR.COM


EMERGENCY RESPONSE
F250
The City of
OKLAHOMA CITY
STORMWATER QUALITY
0825228

Prevention Preemption

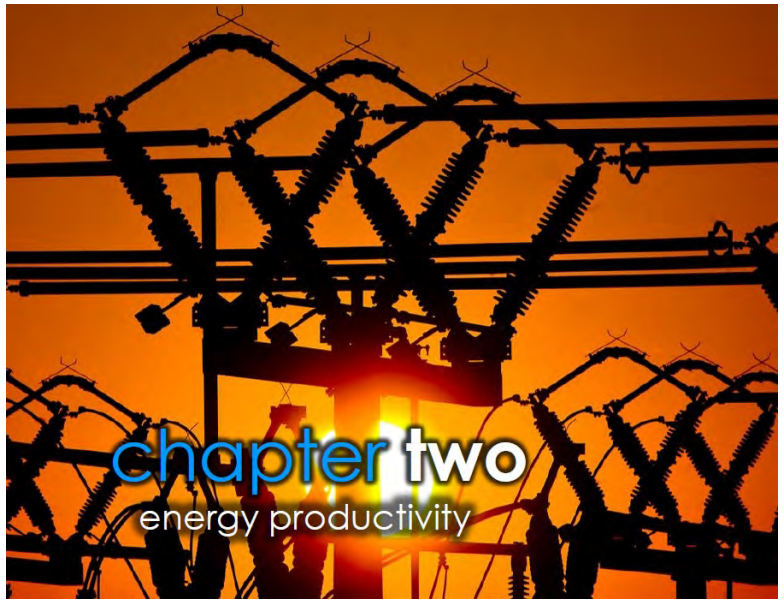




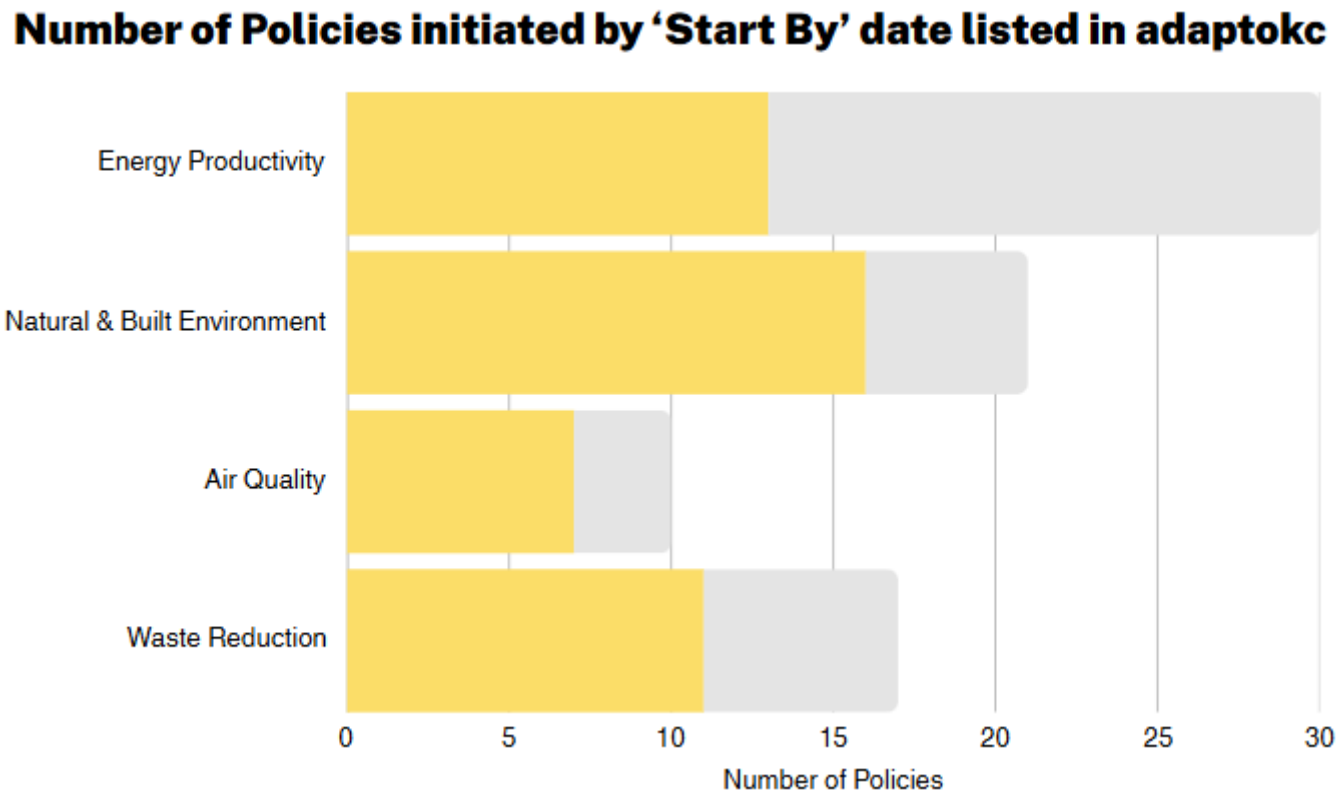
"…no political subdivision shall restrict, tax, prohibit or regulate the use, disposition or sale of auxiliary containers," …other than on county or city property.

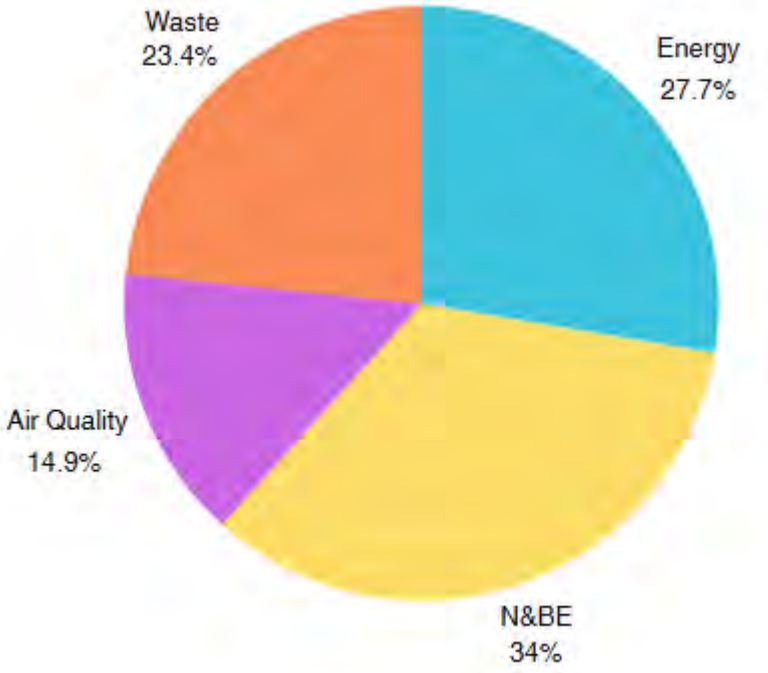

adaptokc
adapting for a healthy future

adaptokc chapters



Implementation Overview






NATURAL & BUILT ENVIRONMENT

Goals & Initiatives

Goals	1. Protect Water Quality 2. Prevent damage caused by flooding. 3. Mitigate effects of extreme heat. 4. Ensure residents have access to healthy food.
Initiatives	1. Strategically Use Low-Impact Development in City Projects 2. Codify LID Policies and Best Practices for Private Development 3. Mitigate Flood Vulnerabilities 4. Mitigate Areas of High Heat Exposure 5. Support Small-Scale Food Production on Vacant Public Land or Underutilized Park Space

Policy Highlights

NB-1: Provide low-impact development training for City staff involved in design, review, inspection, and maintenance for LID systems.

NB-2: Initiate a multi-departmental process to develop a low-impact development implementation strategy.

NB-5: Create a low-impact development guide/manual for architects, engineers, and developers.


A. Goldstein

Landscaped detention area, Seattle, Wash.


A. Goldstein

Stormwater retention area, Saint Paul, Minnesota


J. Wright, Tetra Tech

Permeable pavers, Los Angeles Zoo, California


M. Frey, Tetra Tech

Curb bump-out creates narrower streets and captures runoff, Gresham, Oregon


USEPA

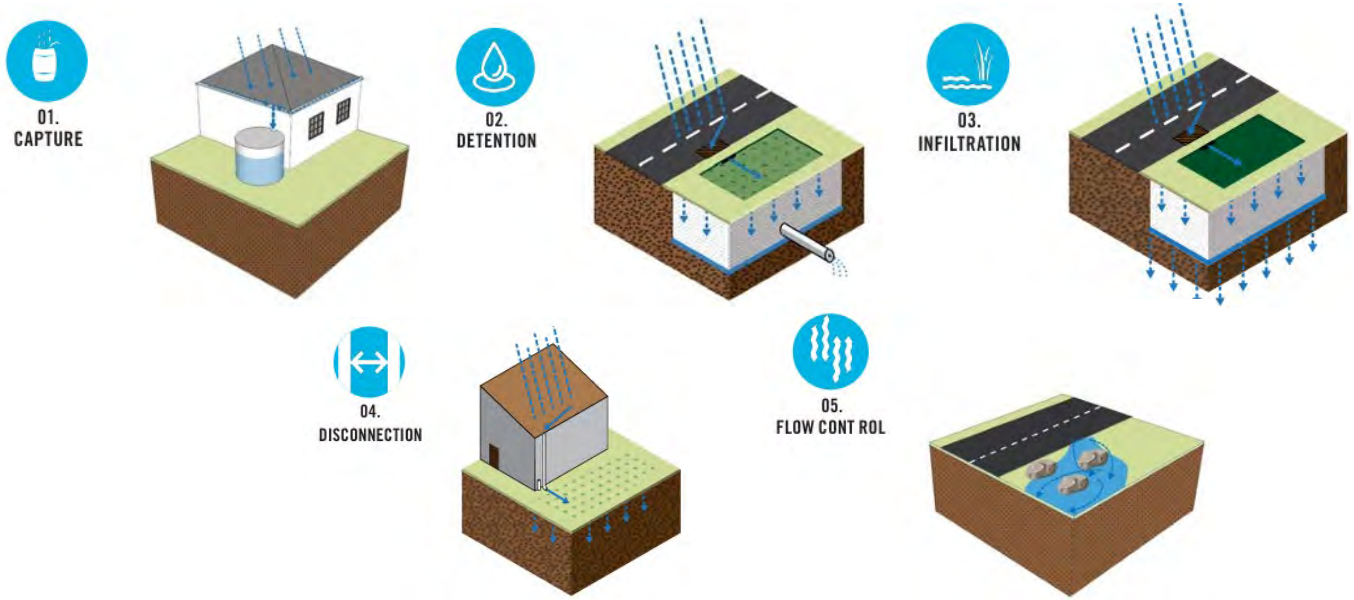
Stormwater infiltration trench, Stafford County, Virginia


USEPA

Parking lot island with curb cuts, Portland, Oregon

Policy Highlights

NB-3: Incorporate low-impact development techniques developed in NB-2 in City projects and new facilities.



Low-Impact Development

jamesforokc • Follow
Paseo Arts District

jamesforokc Witnessing OKC's Paseo placemaking project become a reality

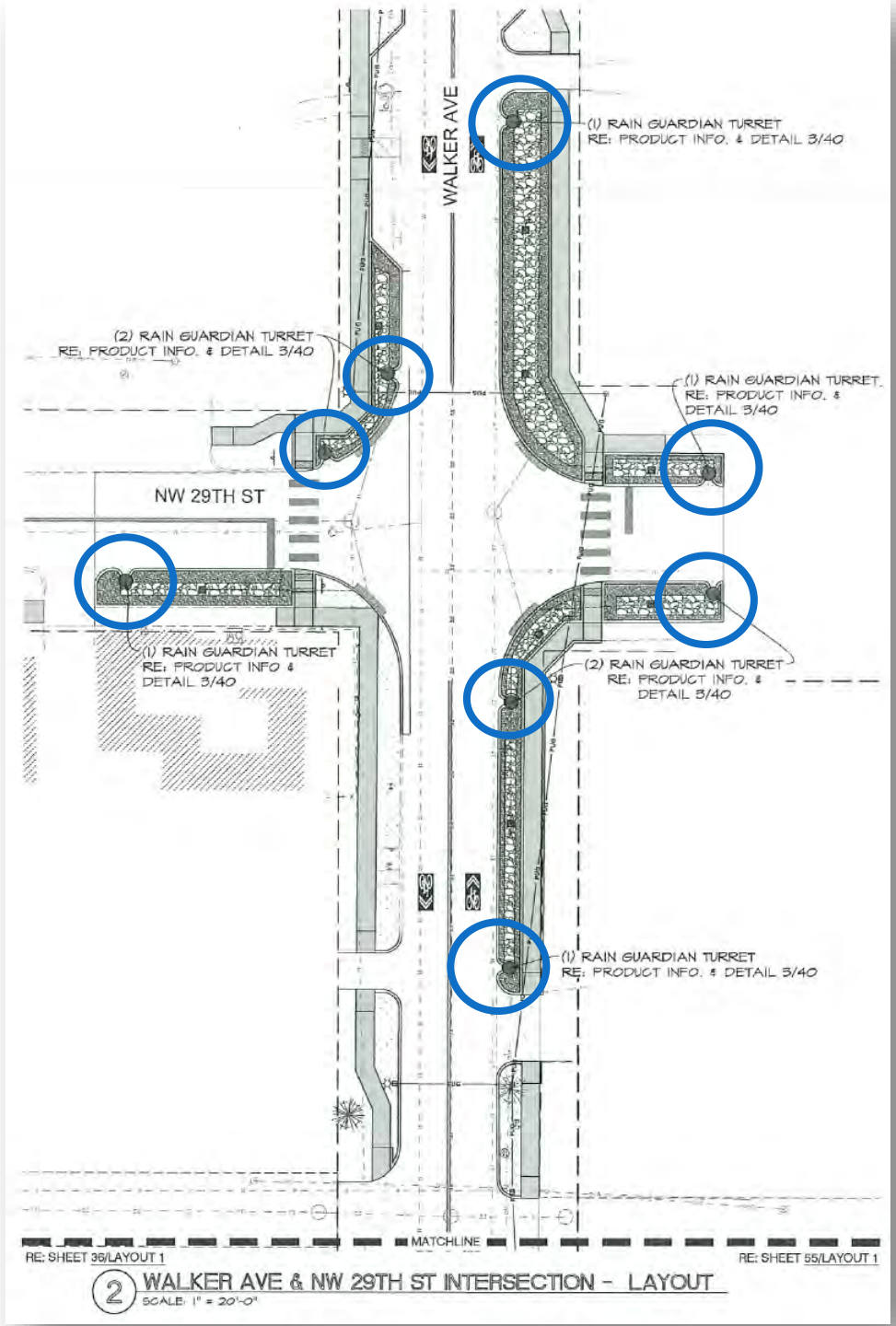
This $4 million Ward 2 streetscape includes new sidewalks, streetlights, street resurfacing, ADA ramps, accessibility improvements, and rain gardens at specific intersections—thanks to 2017's Better Streets, Safer City election

Soon, a $3 million streetscape begins on Walker Avenue from NW 23rd to NW 30th, specifically focusing on pedestrian safety.

@uptown23rd will see similar placemaking improvements when this work concludes in time for our 2024 Paseo Arts Festival

714 likes
June 11, 2023

Log in to like or comment.



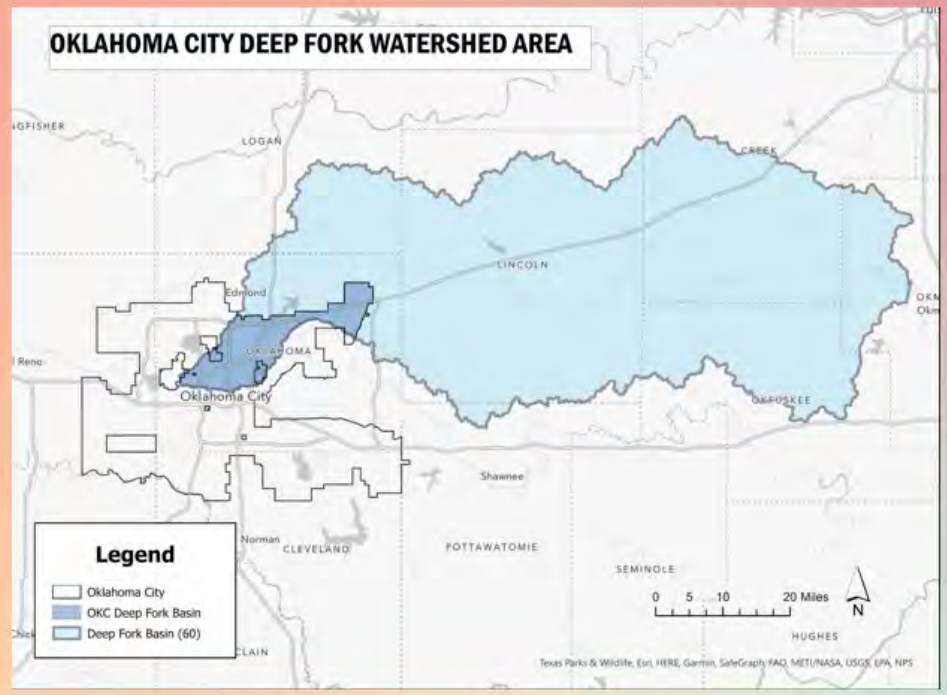
Policy Highlights

NB-4: Promote low-impact development features at City facilities with signage and an online map

Storm Drain Art: Recommendations

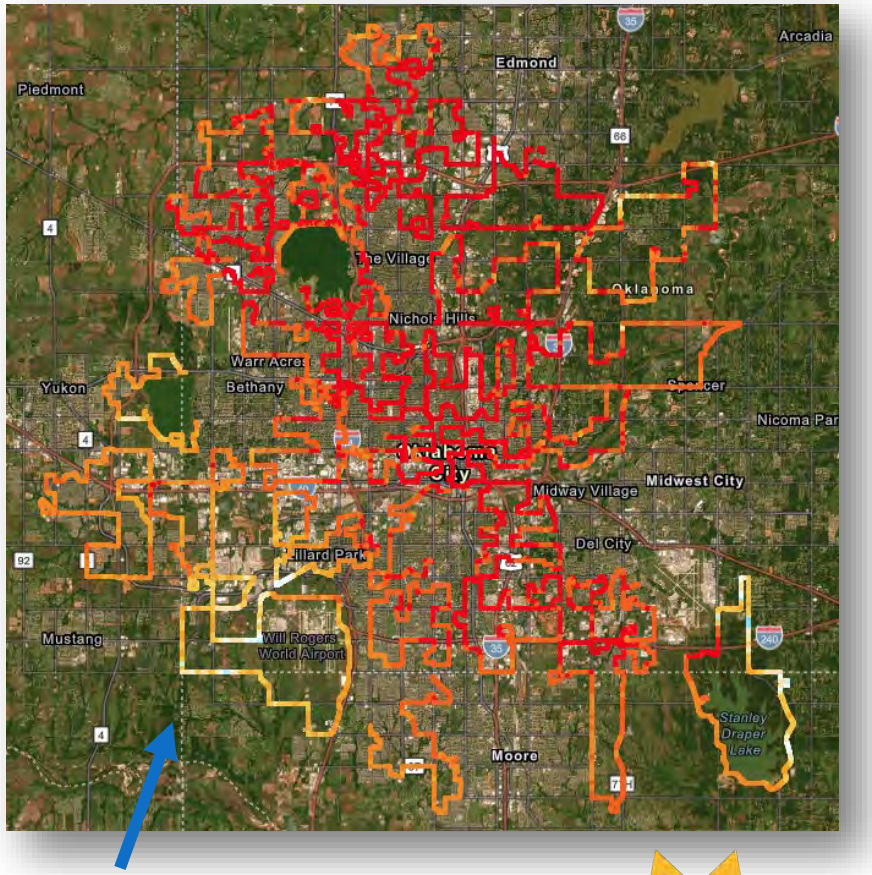
Emily Hamilton
Course-Credit Intern
Office of Sustainability

Project Area Boundaries



Policy Highlights

NB-15: Determine methods to measure, monitor, and report local urban heat island conditions



14.7°F Differential

Heat Watch

Steering Committee & Partners

OKC PARKS

acog
ASSOCIATION OF CENTRAL OKLAHOMA GOVERNMENTS

OKLAHOMA Environmental Quality

okc Beautiful
KEEP AMERICA BEAUTIFUL AFFILIATE

nacok
Neighborhood Alliance of Central Oklahoma

FERTILE GROUND
COOPERATIVE

OKLAHOMA CITY COMMUNITY FOUNDATION
Your Connection for Good

SOUTH CENTRAL
CLIMATE ADAPTATION SCIENCE CENTER

OKC ZOO
BOTANICAL GARDEN
AQUARIUM

COLLEGE OF ATMOSPHERIC AND GEOGRAPHIC SCIENCES
The UNIVERSITY of OKLAHOMA

CHRISTOPHER C. GIBBS COLLEGE OF ARCHITECTURE
The UNIVERSITY of OKLAHOMA

HUDSON COLLEGE OF PUBLIC HEALTH
The UNIVERSITY of OKLAHOMA HEALTH SCIENCES CENTER

INSTITUTE FOR RESILIENT ENVIRONMENTAL AND ENERGY SYSTEMS
The UNIVERSITY of OKLAHOMA

Local Funding Partners

	1.1 Extended Study Area	1.3 Heat Perception Survey	1.4 Air Quality Mapping	1.4.1 Air Quality Mapping (+10 Sensors	1.6 Jurisdictional Scan	1.7 Intervention Guidebook	1.8 Synthesis and Reporting	Agency Total
Funders	*$12,500*	*$8,200.00*	*$9,500.00*	*$5,000.00*	*$10,000.00*	*$10,000.00*	*$8,000.00*	
City	$7,500.00	x	x	x	x	x	x	$7,500.00
ACOG	x	x	$9,500.00	x	$5,000.00		$1,750.00	$16,250.00
OCCF	x	$8,200.00	x	x	$5,000.00	$10,000.00	$6,250.00	$29,450.00
DEQ	$5,000.00			$5,000.00				$10,000.00
								$0.00
								$0.00
								$0.00
	$0.00	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	$63,200.00

CPO Climate Program Office

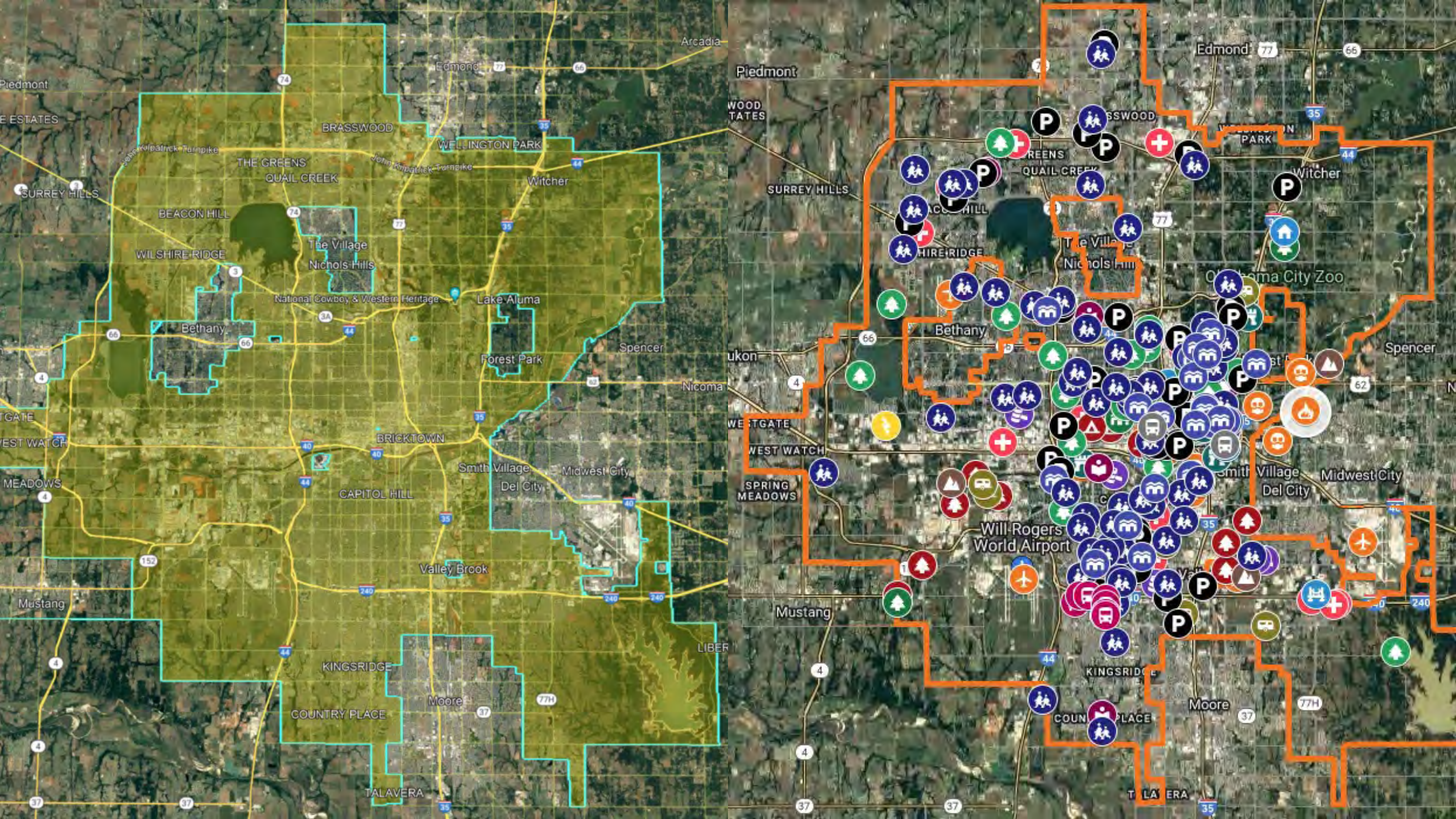
NIHHIS National Integrated Heat Health Information System

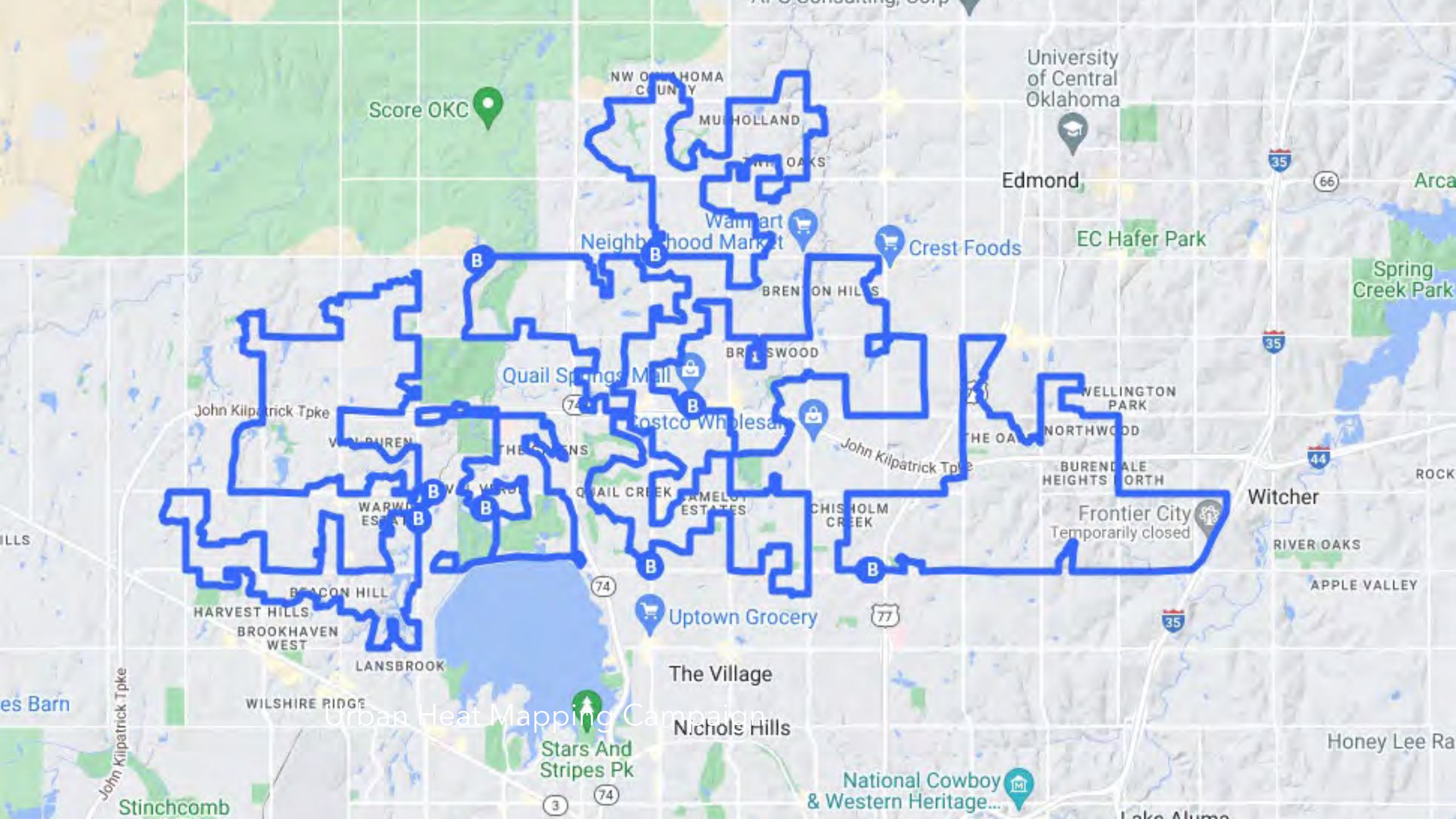
NOAA National Oceanic and Atmospheric Administration, U.S. Department of Commerce

Oklahoma City Community Foundation
Your Connection for Good

Oklahoma Environmental Quality

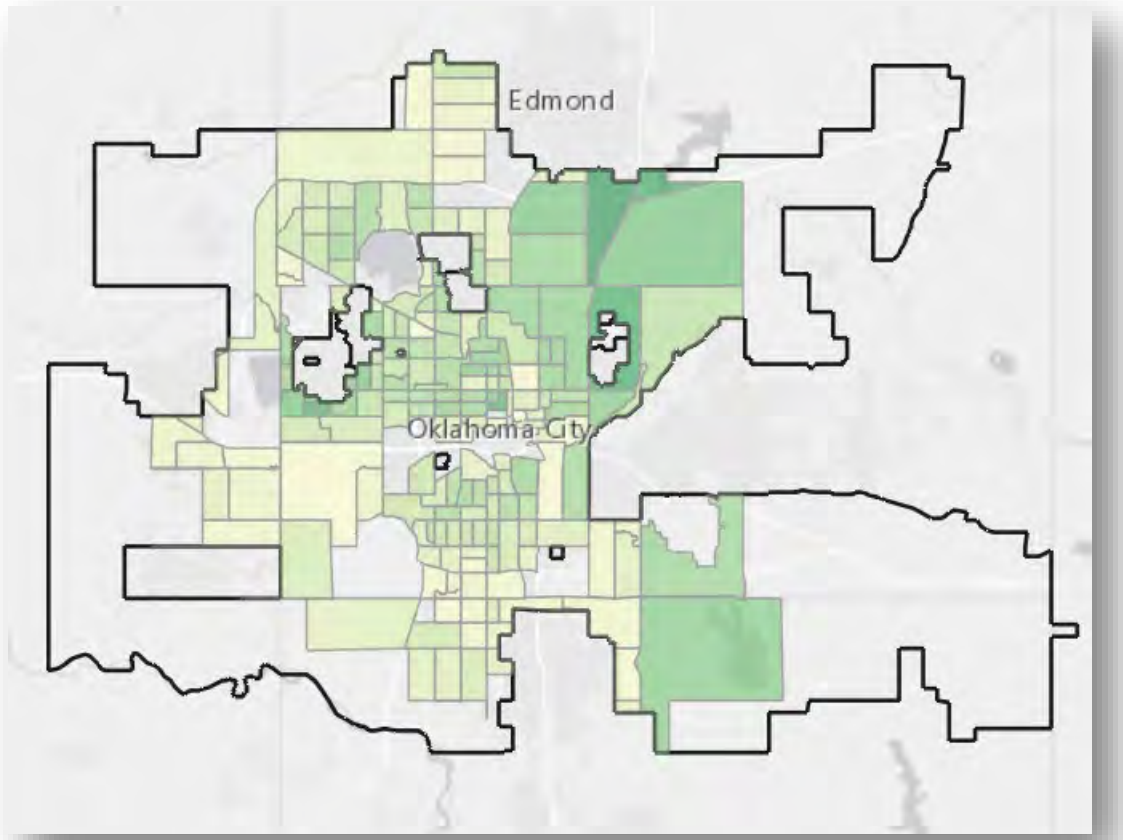
acog Association of Central Oklahoma Governments


Piedmont
Arcadia
Edmond
BRASSWOOD
WELLINGTON PARK
THE GREENS
QUAIL CREEK
John Kilpatrick Turnpike
Witcher
SURREY HILLS
BEACON HILL
WILSHIRE RIDGE
The Village
Nichols Hills
National Cowboy & Western Heritage
Lake Aluma
Bethany
Spencer
Forest Park
Nicoma
BRICKTOWN
Smith Village
Midwest City
Del City
CAPITOL HILL
MEADOWS
Valley Brook
Mustang
KINGSRIDGE
Moore
COUNTRY PLACE
TALAVERA
Oklahoma City Zoo
Will Rogers
World Airport
SPRING
WEST WATCH

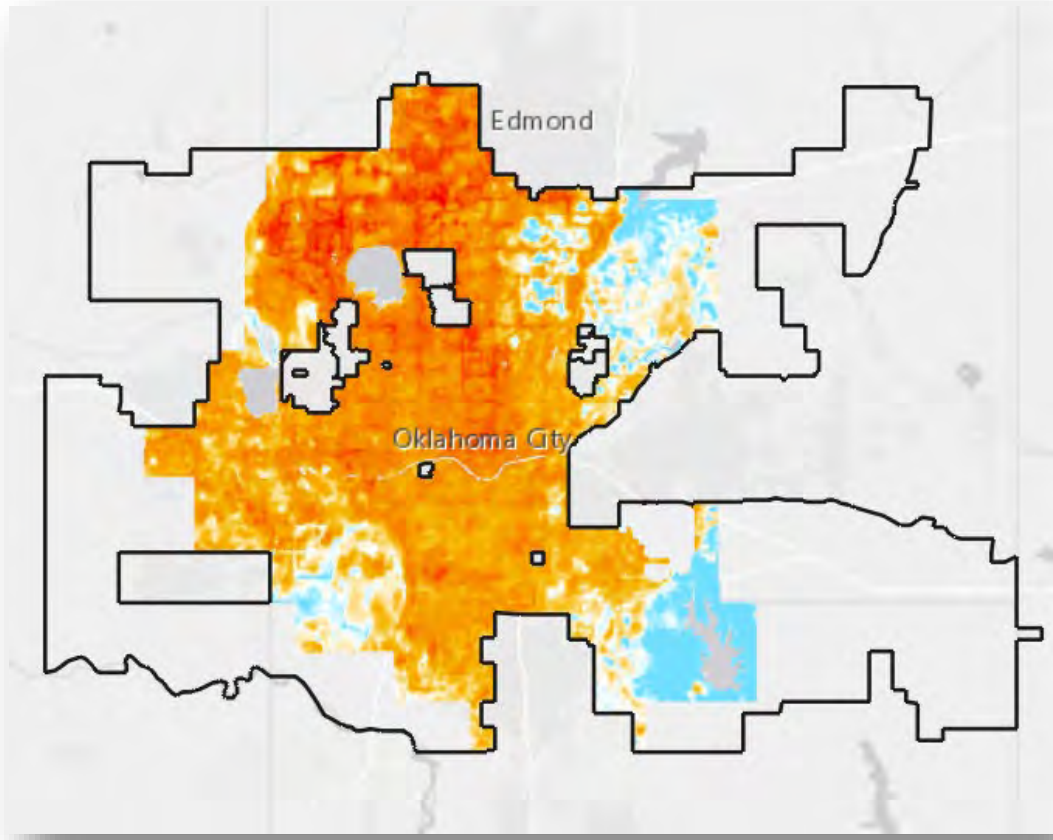

Urban Heat Mapping Campaign
Score OKC
University of Central Oklahoma
Edmond
Walmart Neighborhood Market
Crest Foods
EC Hafer Park
Spring Creek Park
Quail Springs Mall
Costco Wholesale
John Kilpatrick Tpke
Frontier City
Temporarily closed
Witcher
Uptown Grocery
The Village
Nichols Hills
Stars And Stripes Pk
National Cowboy & Western Heritage...
Stinchcomb
Honey Lee Ra
BRENTON HILLS
BRIARWOOD
WELLINGTON PARK
NORTHWOOD
BURENDALE HEIGHTS NORTH
RIVER OAKS
APPLE VALLEY
QUAIL CREEK
CAMELOT ESTATES
CHISHOLM CREEK
BEACON HILL
HARVEST HILLS
BROOKHAVEN WEST
LANSBROOK
WILSHIRE RIDGE


Heat Watch

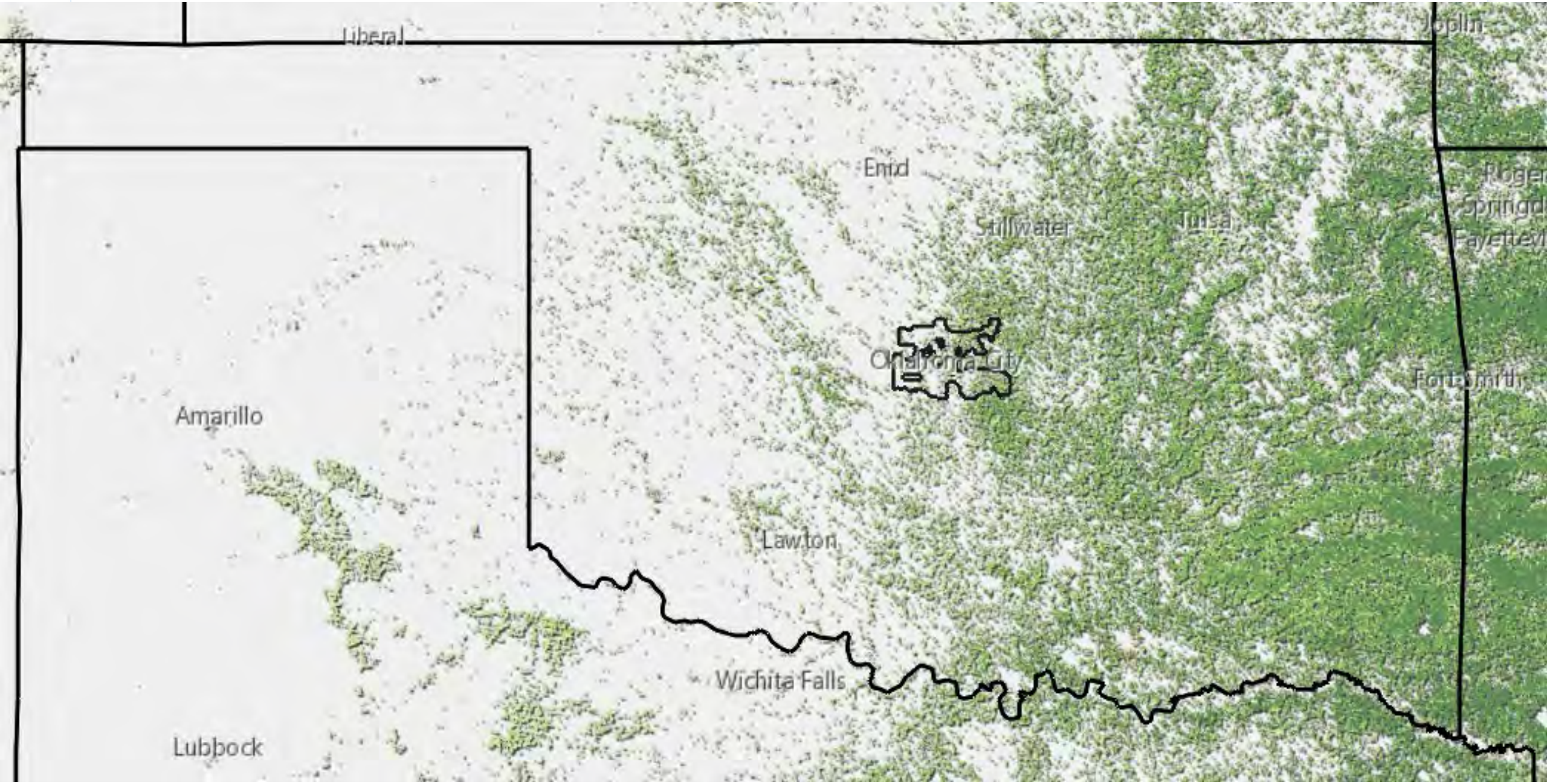
Tree Canopy Study Area

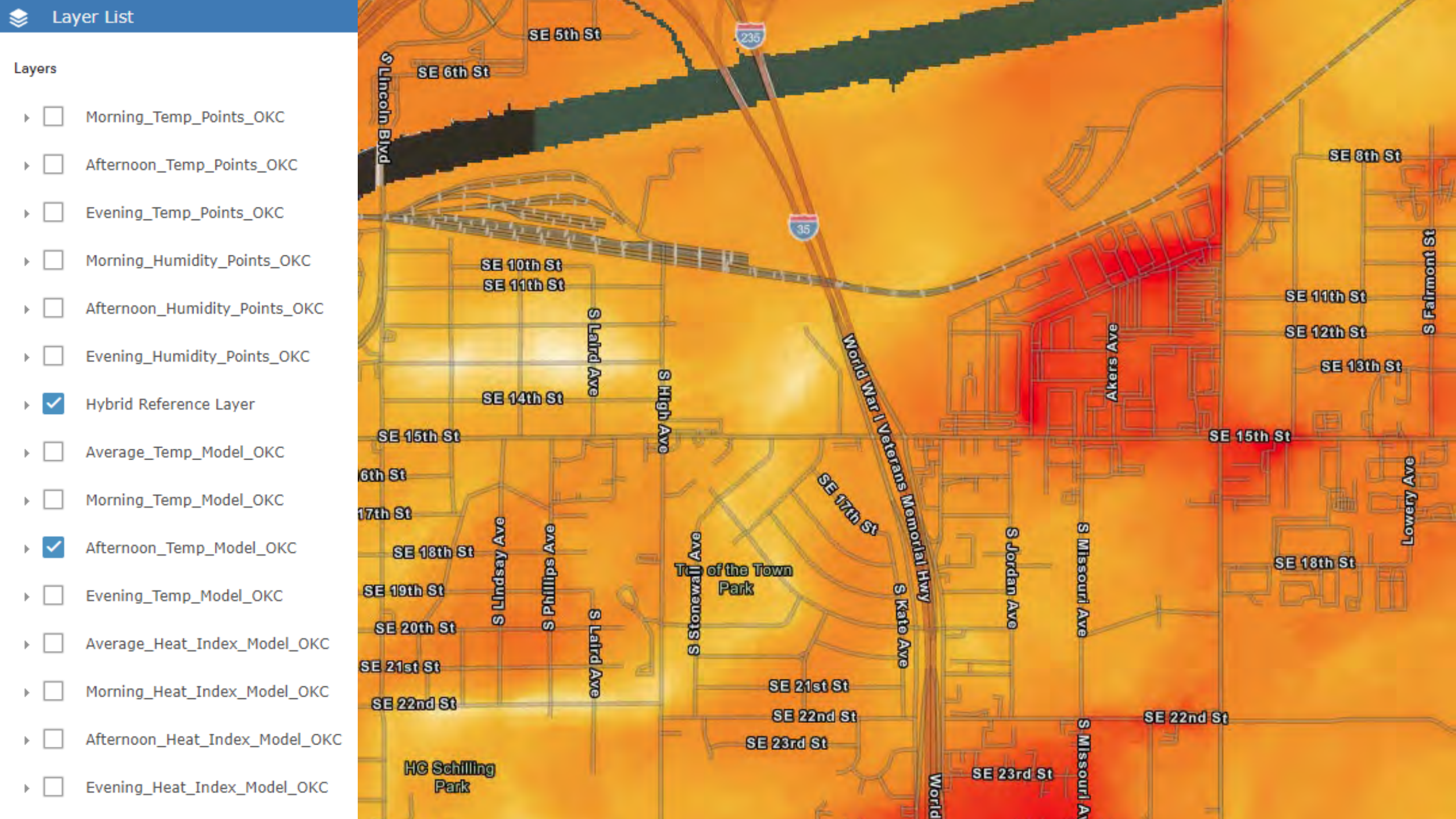


2019 Tree Canopy Study



2023 Urban Heat Island Study


Liberal
Joplin
Enid
Stillwater
Tulsa
Oklahoma City
Fort Smith
Amarillo
Lawton
Wichita Falls
Lubbock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Afternoon_Temp_Points_OKC
Evening_Temp_Points_OKC
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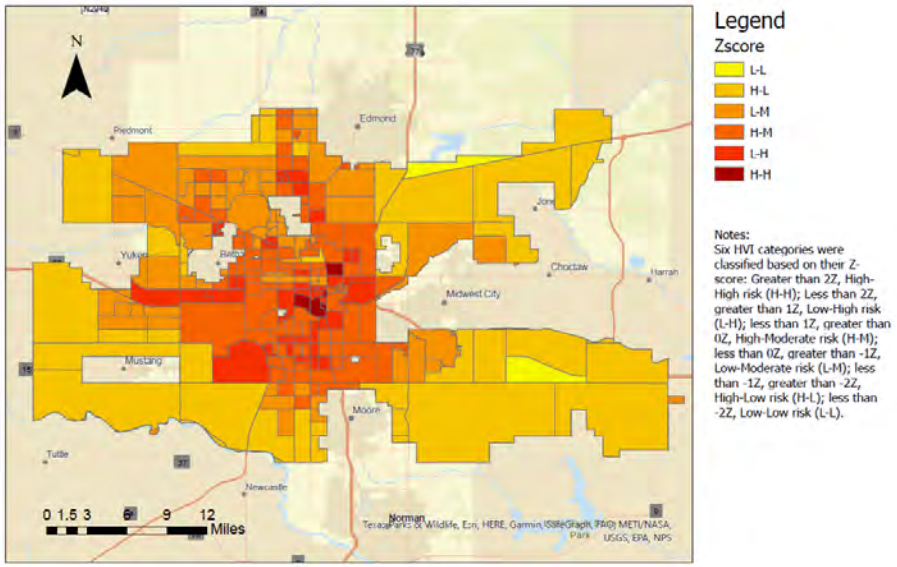
Afternoon_Humidity_Points_OKC
Evening_Humidity_Points_OKC
Hybrid Reference Layer
Average_Temp_Model_OKC
Morning_Temp_Model_OKC
Afternoon_Temp_Model_OKC
Evening_Temp_Model_OKC
Average_Heat_Index_Model_OKC
Morning_Heat_Index_Model_OKC
Afternoon_Heat_Index_Model_OKC
Evening_Heat_Index_Model_OKC
SE 5th St
SE 6th St
S Lincoln Blvd
235
35
SE 8th St
SE 10th St
SE 11th St
S Laird Ave
S High Ave
World War I Veterans Memorial Hwy
Akers Ave
S Fairmont St
SE 12th St
SE 13th St
SE 14th St
SE 15th St
Lowery Ave
SE 17th St
S Stonewall Ave
Ti of the Town Park
S Kate Ave
S Jordan Ave
S Missouri Ave
SE 18th St
SE 19th St
S Lindsay Ave
S Phillips Ave
SE 20th St
SE 21st St
SE 22nd St
SE 23rd St
HC Schilling Park

Data Collection

Heat Watch

Heat Vulnerability Index



Available on data.okc.gov

Groups of Factors:

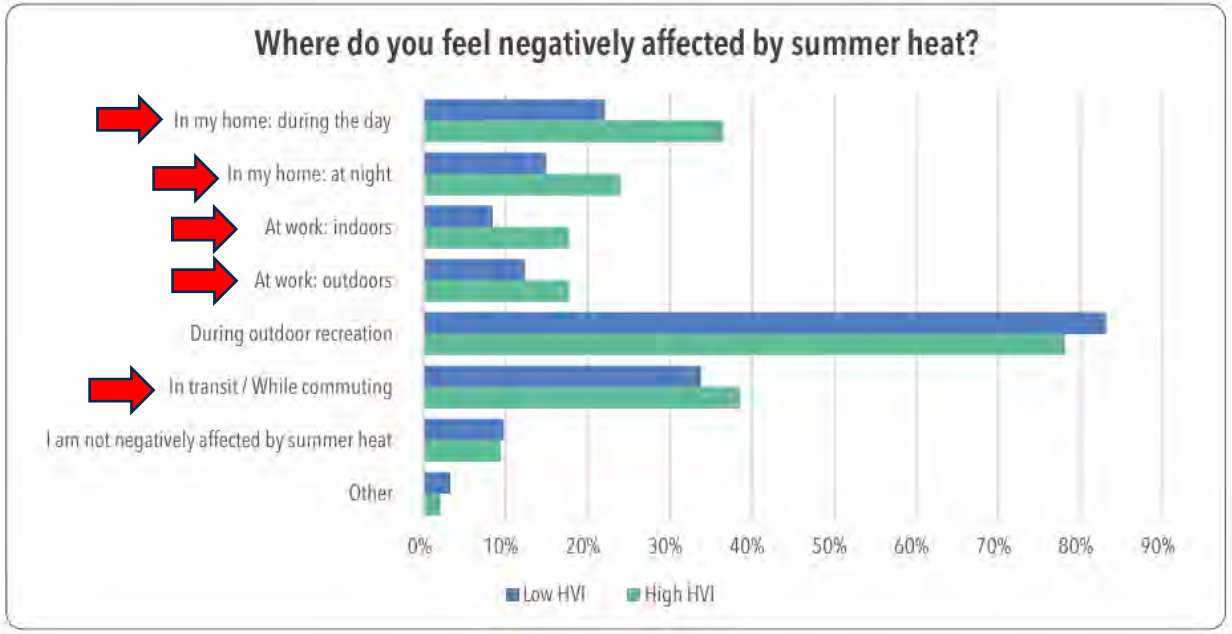
1) **Sensitivities**
2) **Adaptive Capacity**
3) **Exposure**

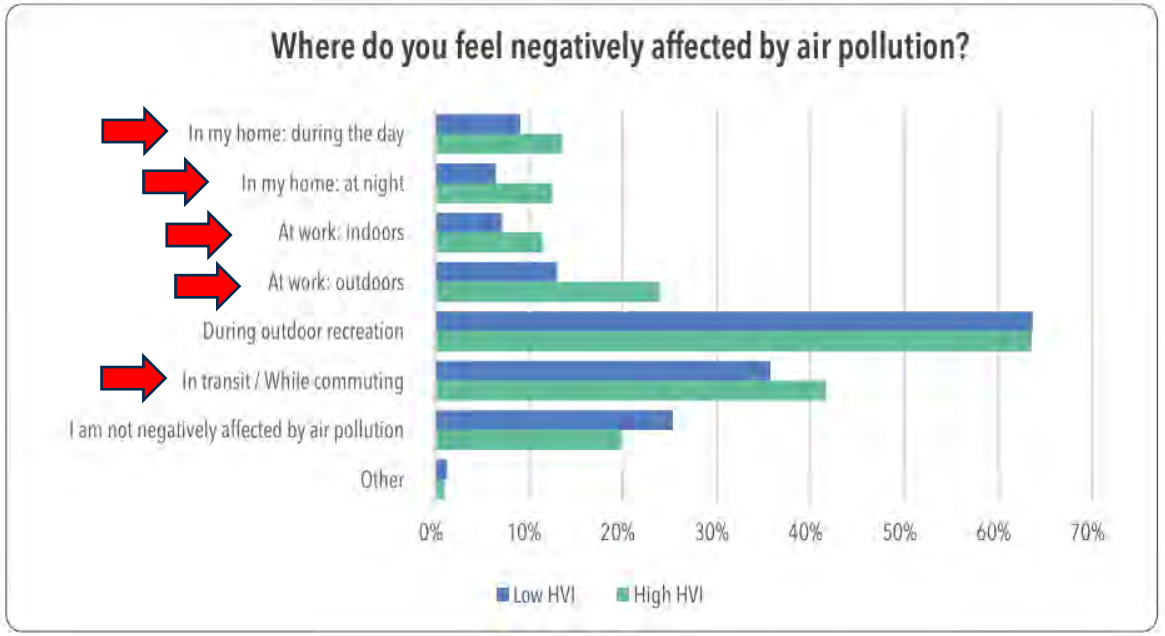
CHRISTOPHER C. GIBBS COLLEGE OF ARCHITECTURE The UNIVERSITY of OKLAHOMA

HUDSON COLLEGE OF PUBLIC HEALTH The UNIVERSITY of OKLAHOMA HEALTH SCIENCES CENTER

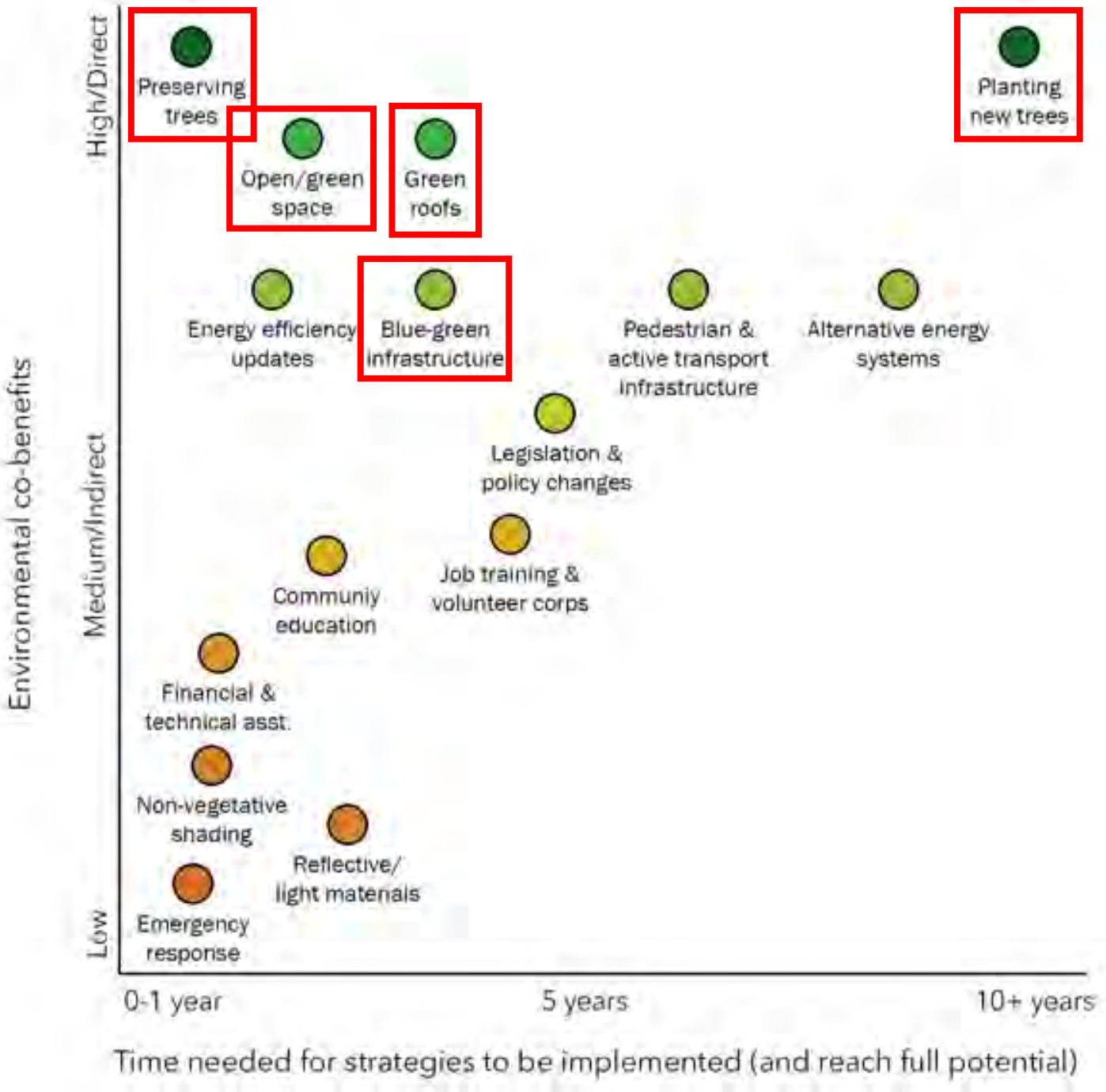
COLLEGE OF ATMOSPHERIC AND GEOGRAPHIC SCIENCES The UNIVERSITY of OKLAHOMA

Summer Heat Survey Report

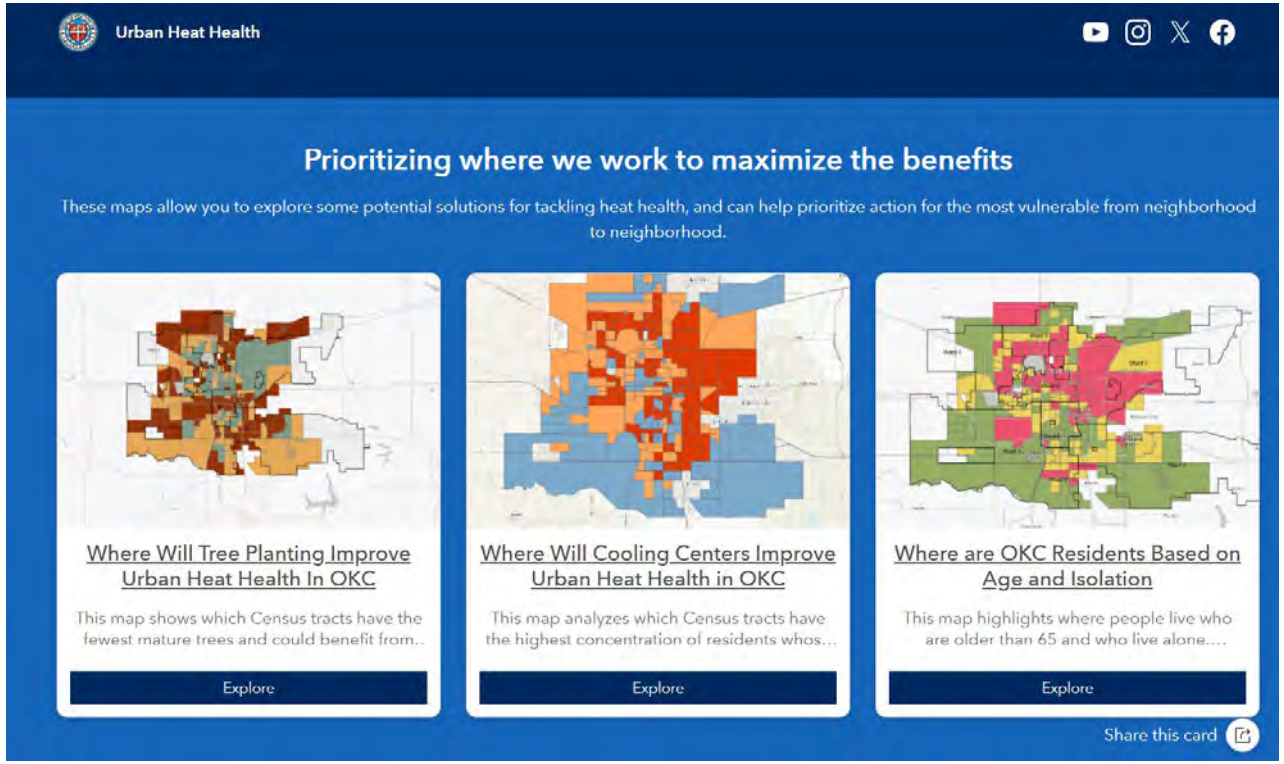




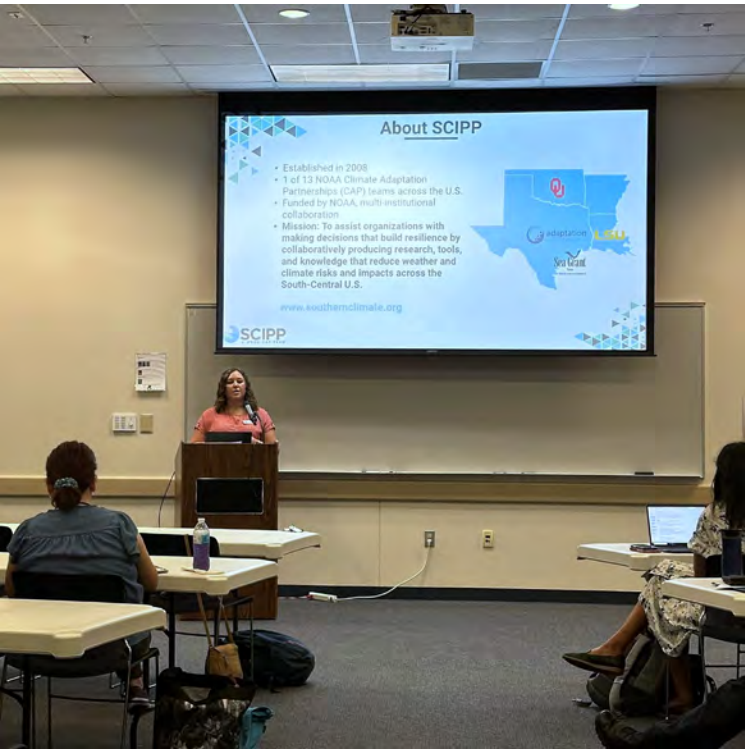
Heat Mitigation & Adaptation Guidebook



Story Map & Resource Hub



okc-urban-heat-health-okc.hub.arcgis.com



Extreme Heat Tabletop Exercise

August 13-14, 2024

CPO Climate Program Office

NIHHIS National Integrated Heat Health Information System

NOAA National Oceanic and Atmospheric Administration, U.S. Department of Commerce

Read more

Policy Highlights

OKC Development Codes Update

NB-6: Identify resources to increase compliance with landscape code

NB-16: Develop and adopt a tree preservation ordinance

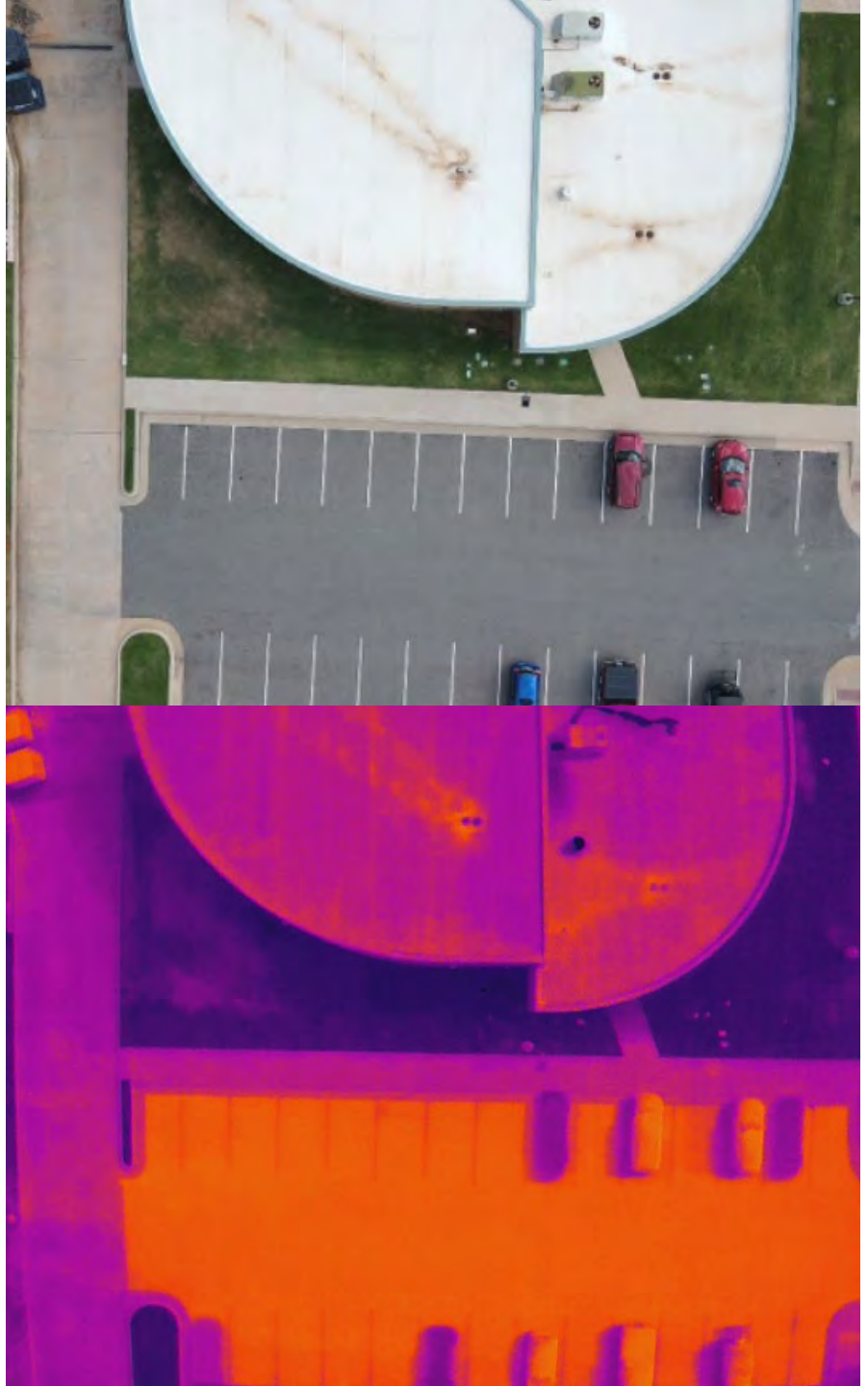
NB-17: Update municipal code to eliminate minimum parking requirement for new developments

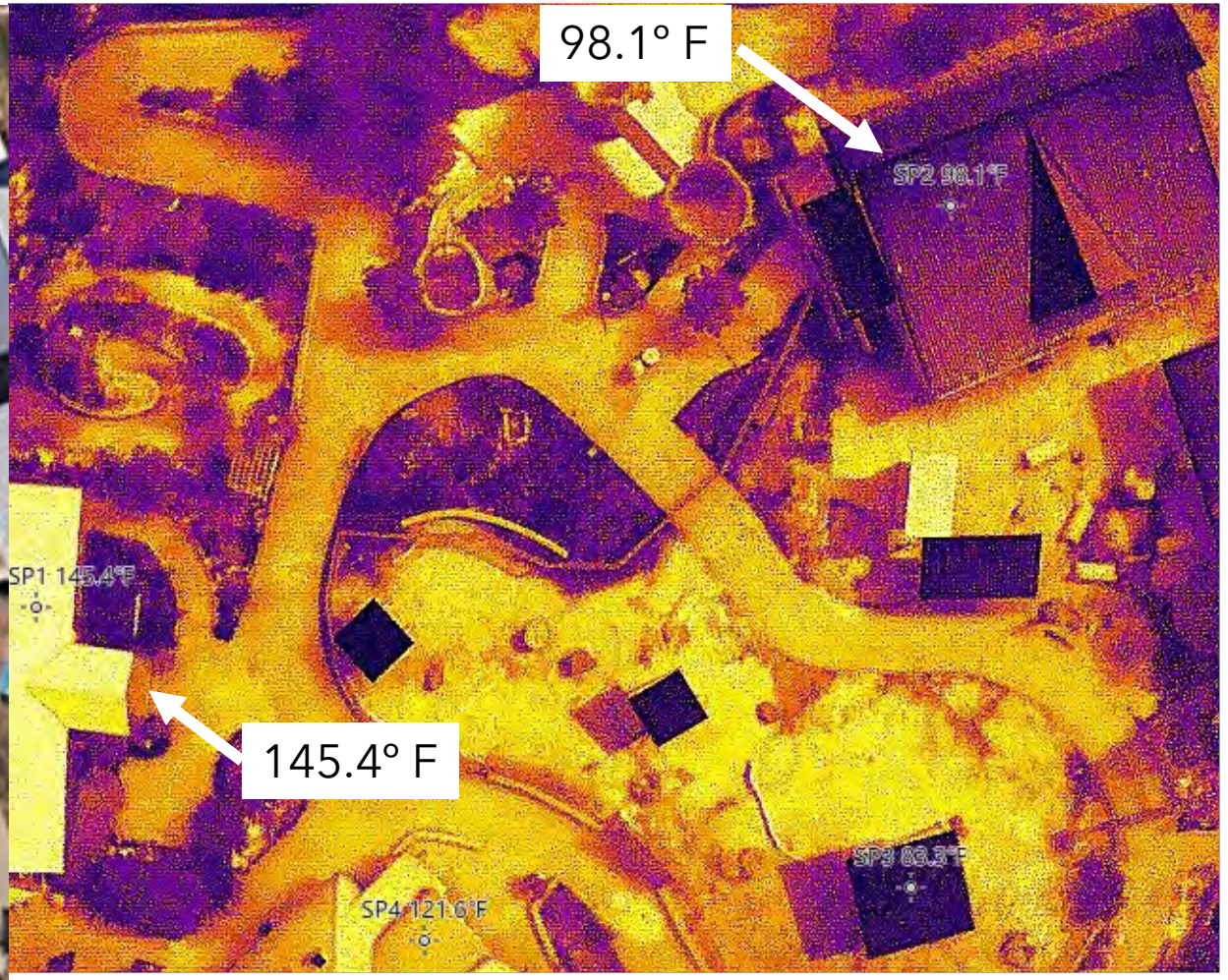
Conference Registration
$66.63 per day

Policy Highlights

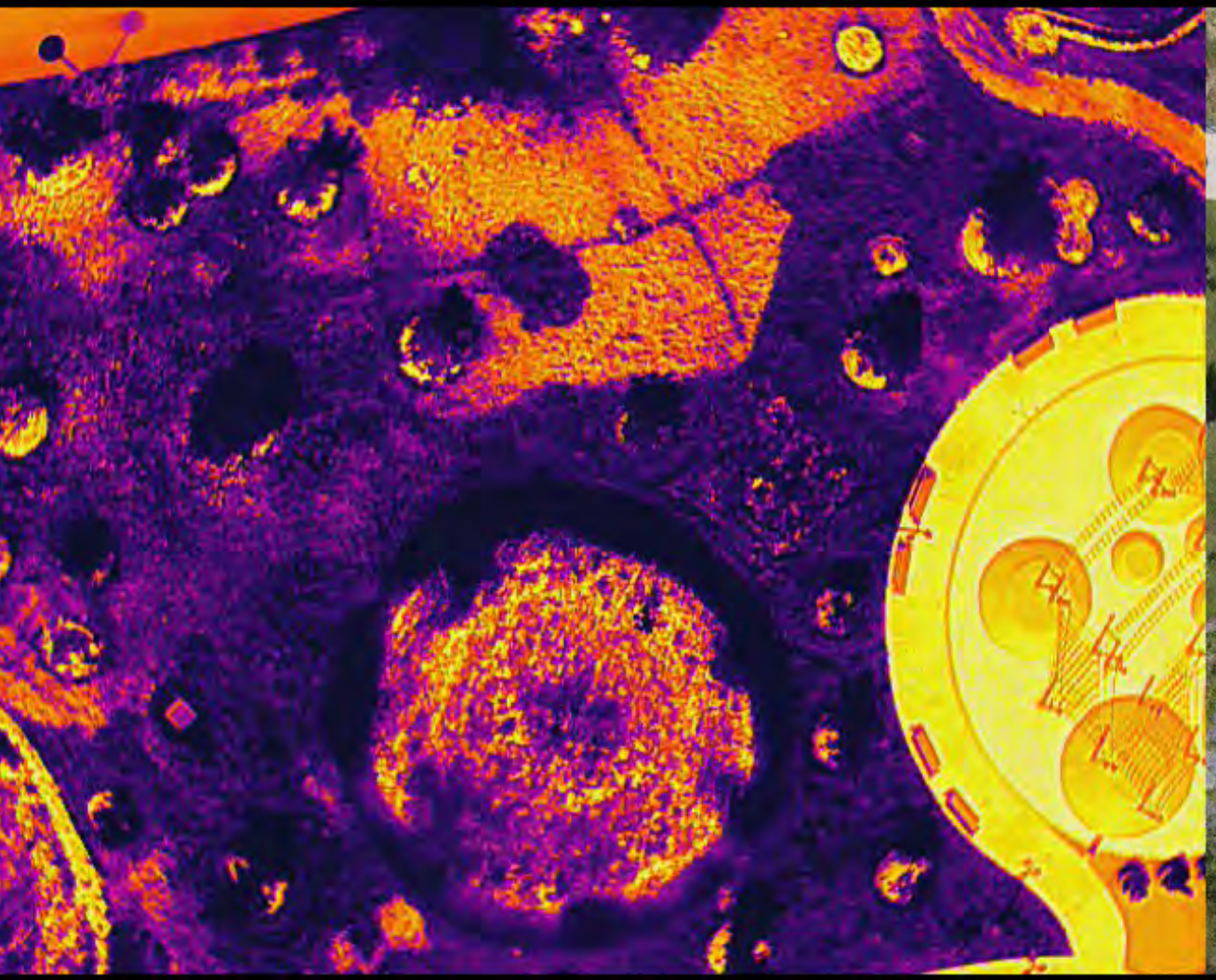
NB-18: Use highly-reflective materials for new or replacement roofing on City facilities.

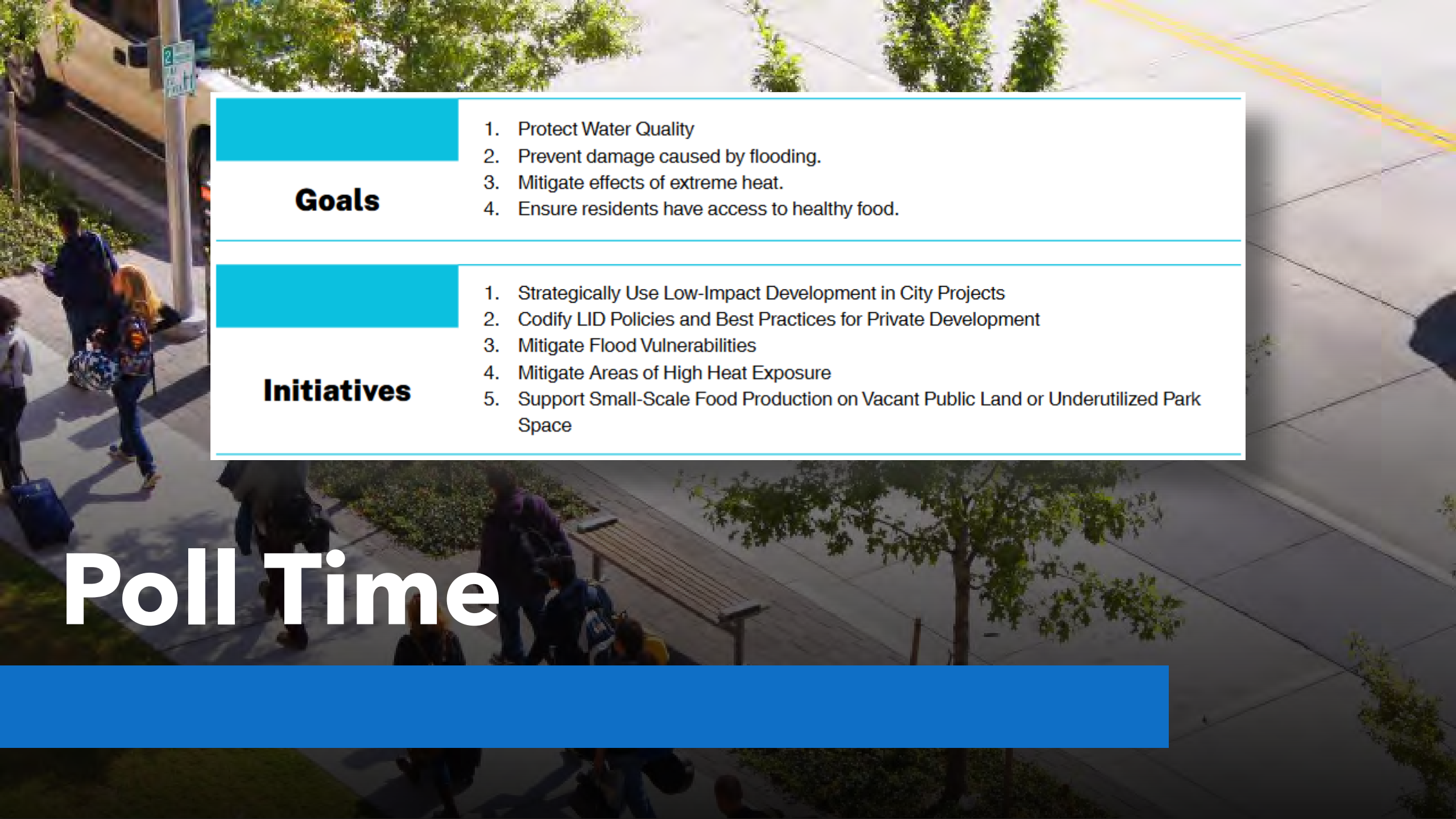
NB-21: Develop a pilot leasing program for urban garden plots on public land




98.1° F
SP2 98.1°F
SP1 145.4°F
145.4° F
SP4 121.6°F
151.0°F
148.3°F
75.5°F
70.0°F


WOODLAND
Cross Timbers Transition
Oklahoma City
prairie
savanna
woodland





Goals	1. Protect Water Quality 2. Prevent damage caused by flooding. 3. Mitigate effects of extreme heat. 4. Ensure residents have access to healthy food.
Initiatives	1. Strategically Use Low-Impact Development in City Projects 2. Codify LID Policies and Best Practices for Private Development 3. Mitigate Flood Vulnerabilities 4. Mitigate Areas of High Heat Exposure 5. Support Small-Scale Food Production on Vacant Public Land or Underutilized Park Space

Poll Time

Workgroup Sign-up

"Relax. Pot temperatures have been going up and down for centuries."

Credit: GRANT MCALOON, Weekly Humorist

T.O. BOWMAN, LEED GA

SARAH TERRY-COBO

sustainability@okc.gov

okc.gov/sustain

The Office of
SUSTAINABILITY