HEAT WAVES

Designing a Heat Action Plan to Mitigate Disproportionate Impacts of Urban Heat Island Effect in Underserved Communities in Omaha, NE

Quarterly Report 4 - 12/17/2023

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1. EXECUTIVE SUMMARY

Abstract

This study builds on a transdisciplinary collaboration between the City of Omaha, University of Nebraska Medical Center, University of Nebraska - Lincoln College of Architecture, and Community-based Organizations to develop a Heat Action Plan to mitigate the disproportionate impacts of urban heat island effect in underserved communities in Omaha, NE.

Research Problem Statement

Extreme heat kills more people in the United States than any other natural disaster. These effects are more pronounced in urban environments, where buildings, roads, and other infrastructure absorb and re-emit the sun's heat, otherwise known as urban heat island effect. The increasing intensity, duration, and frequency of heat waves disproportionately impact underserved populations in a heightened state of precarity. There is a significant gap in the research on applied approaches to integrating mitigation and adaptation strategies for addressing extreme heat, particularly in underserved communities. Omaha, NE, a 'hypersegregated' city, would benefit from a transdisciplinary Heat Action Plan.

First Quarterly Task

In the first quarter, the research team focused on gathering resources to assist in the development of a heat action plan as well as produce a booklet of relevant heat mitigation and adaptation strategies.

Second Quarterly Task

In the second quarter, we traveled to Arizona with the third-year LARC 311 design studio to meet with leading heat researchers at the University of Arizona and Arizona State University and documented built examples of heat mitigation strategies. Additionally, a heat vulnerability assessment was conducted to identify locations for design prototypes in the City of Omaha. The team used a modified criteria to establish a baseline vulnerability assessment of Omaha. This criteria influenced the development of maps illustrated in section 3.3.

Third Quarterly Task

In the third quarter, the team has been working with the City of Omaha to develop partnerships with various community groups in the city with the goal of better understanding the qualitative impacts of heat. The coordination required for developing these partnerships has proven to be the biggest challenge of this research thus far. The initial goal was to coordinate multiple community meetings to explore heat resilience, but due to various levels of schedule conflicts, the team shifted to the development of a survey to establish a baseline qualitative understanding of heat impacts. We have partnered with Fabric Lab – which a Black-led, multi-modal, intergenerational urban design lab, and community hub in North Omaha, and the South Omaha Neighborhood Alliance, which is a community development organization located in South Omaha. The survey is currently undergoing IRB approval.

Fourth Quarterly Task

The next tasks for the fourth quarterly report will focus on continuing to work with community members to collect qualitative data for the impacts of extreme heat on the ground. The increasing frequency and intensity of extreme heat in urban environments pose significant public health risks, with underserved populations disproportionately affected. While heat action plans have gained traction as a process for mitigating the unequal distribution of intense surface temperatures, there is a need for more granular data to guide site-scale landscape planning decisions. The prevailing method of measuring Land Surface Temperature (LST) using United States Geological Survey (USGS) remote sensing data can only reach a resolution of 30m x 30m, and often overlooks the lived reality of the impacts of extreme heat. By scaffolding the quantitative data collected in this research with qualitative survey data, we can develop a stronger understanding of the tangible impacts of extreme heat.

2. INTRODUCTION

Urban heat resilience is a growing issue as extreme heat kills more people in the United States than any other natural disaster (Berko, 2014). The earth consistently faces increased heat waves, in which 15 of the 16 warmest years on record have occurred during this century. This year, 2022, is expected to rank among the 10 hottest years in annual global temperature readings (NOAA, 2022). Rising temperatures contribute to the intensification of environmental threats, such as drought and rising sea levels. Higher average temperatures also raise health risks by leading to increased energy use and subsequently pollution. According to the Intergovernmental Panel on Climate Change (IPCC), we face longer continuous stretches of higher temperatures that pose greater health

risks than isolated extreme heat events. Heat-related illnesses, such as heat stress, asthma, and malaria, are expected to claim an additional 250,000 lives between 2030 and 2050 (Neira, 2016). These effects are more pronounced in urban environments, where buildings, roads, and other infrastructure absorb and re-emit the sun's heat—a phenomenon known as urban heat island effect (EPA, 2022).

Today, researchers think of the heat island as more of an archipelago, where hot spots are heterogeneously distributed throughout a city in locations with higher concentrations of concrete and asphalt, whereas cooler temperatures can be found around trees, parks, or other open space (Borunda, 2021). The increasing intensity, duration, and frequency of heat waves have been found to disproportionately impact underserved populations in a heightened state of precarity. In a study of 108 urban areas nationwide, the formerly redlined neighborhoods of nearly every city studied were hotter than the non-redlined neighborhoods, some by nearly 13 degrees Fahrenheit (Hoffman, 2020). Redlining is the historical discriminatory practice of refusing home loans or insurance to whole neighborhoods based on a racially-motivated perception of safety for investment.

Omaha, NE is one such example of a city that suffers from the lingering impacts of redlining, consistently rated among the top 50 most segregated cities in the US (UC Berkeley, 2020). The Omaha metropolitan area has been categorized as a 'hypersegregated' city, which is a term used to describe metropolitan areas in which African Americans were highly segregated in at least four of five dimensions of segregation: unevenness, isolation, clustering, concentration, and centralization (Massey, 2015). An ongoing study of extreme heat in Omaha has found a 10 degree difference in historically redlined neighborhoods (Abdoulaye, 2022). Along with disproportionate heat intensity, redlined neighborhoods in Omaha are also faced with increased levels of lead and coal contamination. In 1999, the EPA found that residential yards in eastern Omaha, including the historically redlined and segregated Black community of North Omaha, had high concentrations of lead due to historic industrial air emissions; as a result, this area was designated as a Lead Superfund Site (EPA, 2017).

These environmental injustices have not gone without notice. The EPA has since remediated more than 13,000 residential properties at the superfund site between 1999 and 2015 (EPA, 2017) and recently, the City of Omaha has announced plans to develop a climate action plan to be completed by June 2024. According to Omaha Mayor, Jean Stothert, tackling extreme heat is among the goals of the plan. Heat action plans have been gaining traction as a process for identifying both mitigative and adaptive strategies for countering heat intensity, especially as a form of addressing environmental injustices (TNC, 2019)(Guardaro, 2020). Mitigating the inequitable distribution of intense surface temperatures requires a multifaceted approach incorporating policy, public health, urban

planning, and landscape strategies. Designing resilient cities requires an understanding of how they can “persist, adapt, and transform in the face of stress, while maintaining their function and identity” (Meerow & Newell, 2016).

This study aims to build upon a collaborative partnership between the City of Omaha Planning Department, University of Nebraska Medical Center, and the University of Nebraska - Lincoln College of Architecture to develop a Heat Action Plan. There are a myriad of potential solutions to extreme heat, but there is no one-size-fits-all approach. It is crucial to recognize that impactful collaborations require the “collective capacity of academic, health, and environmental leaders, along with the communities themselves” to develop a coordinated plan that transcends silo-based actions and limited nature-based solutions (NbS) (Kabisch, 2016)(Guardaro, 2020).

Developing a Heat Action Plan through a participatory process will contribute to the development of mitigation and adaptation strategies that work for a particular context. Urban heat solutions generally fall into two categories, mitigation and adaptation (TNC, 2019). Mitigation involves reducing the heat of the urban environment through a variety of nature-based and architectural interventions, including increasing shade through tree planting, using high albedo surfaces, and reducing greenhouse gas emissions. Adaptation is the adjustment to environmental conditions by changing behavior to deal with the increased intensity of extreme heat. These can include strategies such as taking alternative forms of transportation, providing free public drinking water, and opening a cooling center. Equitable access to shade and sensible microclimates are often perceived as an amenity, but should be considered a public health concern (Bloch, 2019). As deadly heat waves become commonplace, we must consider it as a civic resource shared by all.

3. METHODS

3.1 Study area

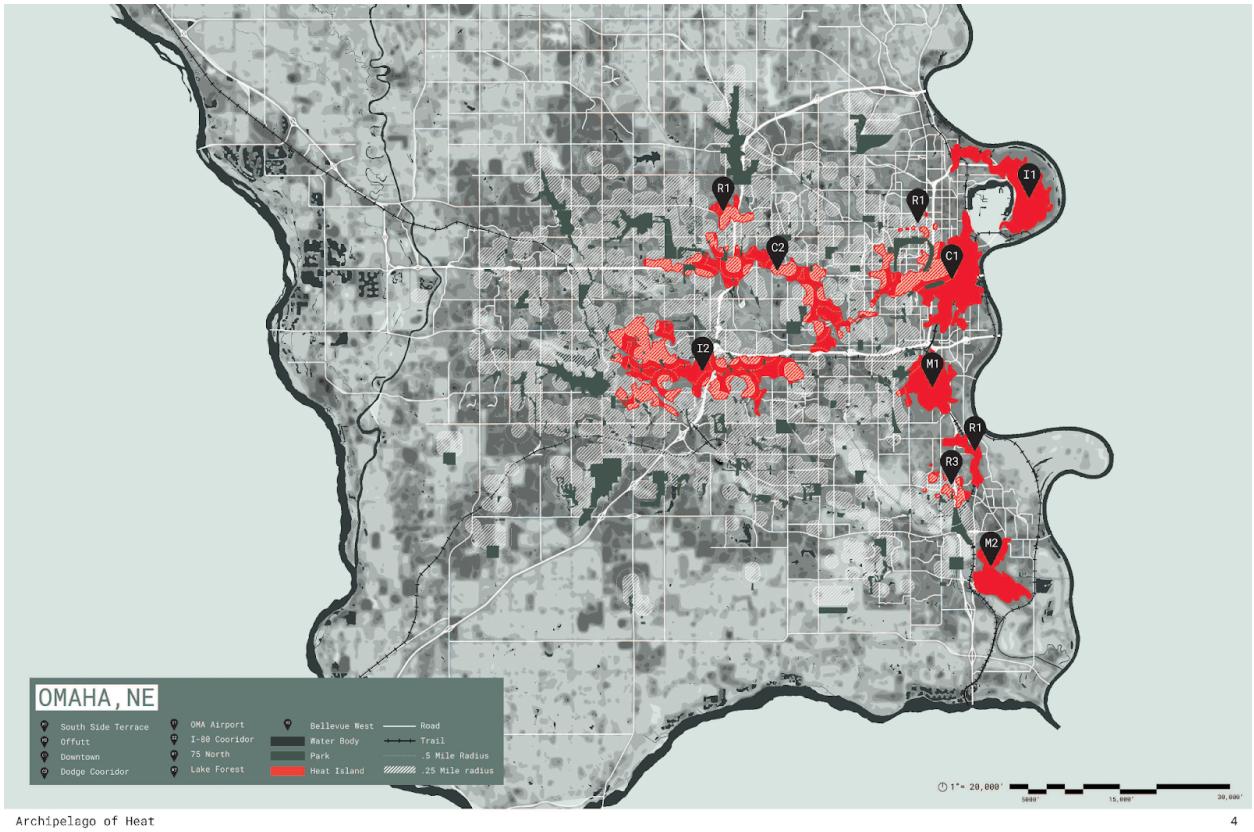

Figure 1. Sarpy and Douglas County area delineation with Landsat9 Land Surface Temperature data.

The study area includes Sarpy and Douglas County which encapsulates the municipal boundary of the City of Omaha (See Figure 1.). The Heat Action Plan focuses on the identification of the heat archipelago as a form of vulnerability assessment. Sarpy and Douglas County were used as a form of delineation due to readily available Geographic Information Systems (GIS) Data. The City of Omaha ranges in average high temperatures of 33°F (January) to 87°F (July)(See Figure 2.)(US Climate Data, 2023).

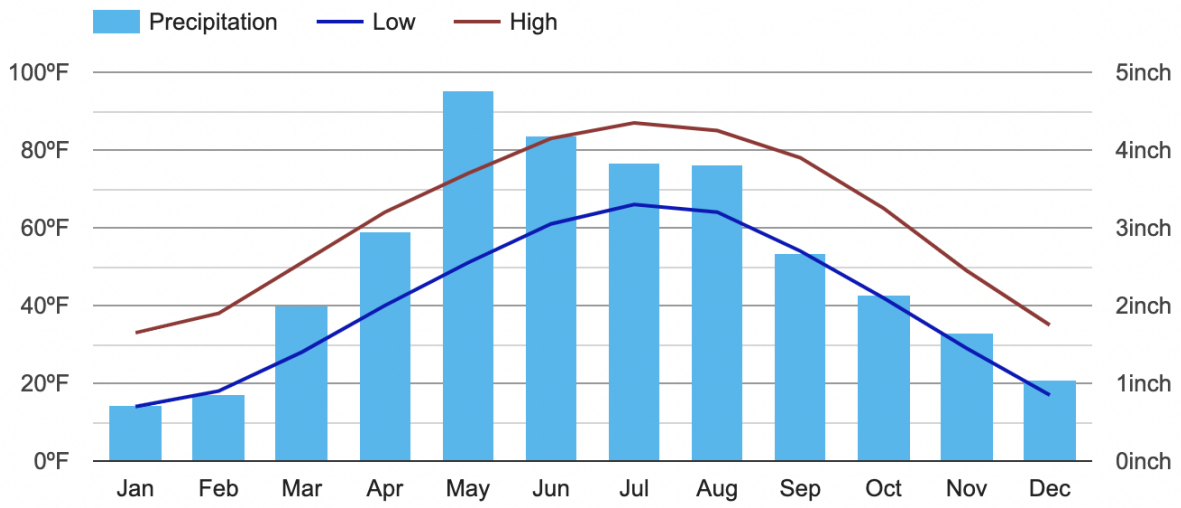

Figure 2. Omaha Climate Graph (US Climate Data, 2023).

3.2 Identifying Heat Resources

To guide the development of a heat action plan, the team began by compiling available resources and literature. It is not within the scope of this research to conduct a comprehensive literature review, although we found it necessary to develop a baseline understanding of available resources. A full list of references can be found at the end of this document. Two particular documents were referenced as primary sources to help guide this process: “Planning for Urban Heat Resilience” by Keith and Meerow, 2022 and “The Heat Action Platform” by the Adrienne Arsht-Rockefeller Foundation Resilience Center.

Figure 3. Adaptation Strategies.

By investigating these two resources, students in the third-year LARC 311 Design Studio IV: Ecological and Cultural Landscape Systems compiled strategies and case studies into a Thermal Tactics booklet (See Figure 3.). Additionally, the team conducted research into Heat Action Plan case studies, including: Greater Phoenix Heat Action Planning Guide (2019), Karachi Heat Action Plan (2017), Western Sydney Heat Action Plan (2018), and the Ahmedabad Heat Action Plan (2019). In the Greater Phoenix Heat Action Planning Guide, we found that urban heat solutions generally fall into two categories, mitigation and adaptation (TNC, 2019) (See Table 1.). Mitigation involves reducing the heat of the urban environment through a variety of nature-based and architectural interventions, including increasing shade through tree planting, using high albedo surfaces, and reducing greenhouse gas emissions. Adaptation is the adjustment to environmental conditions by changing behavior to deal with the increased intensity of extreme heat. These can include strategies such as taking alternative forms of transportation, providing free public drinking water, and opening a cooling center.

	Adaptation		Mitigation
Community	Energy bill assistance	Material	Permeable pavement
	Establishing urban forestry, tree, and landscape program		Public Shading Structures
	Heat awareness campaign		Heat resilient building materials
	Providing incentives and awards		Light pavement
	Thermal comfort policies	Architecture	Building orientation and massing
Emergency	Chief heat officers		Passage space under building
	Cool hospital preparedness mandate		Cool roofs / walls
	Heat emergency response plan		Exterior building shading
	Heat hotlines		Green building
	Public transit services during heat waves	Green Infrastructure	Tree protection
	Wellness check programs		Urban forests
Infrastructure	Building materials and standards		Open space
	Building waste heat limits		Water features
	Green building and energy efficiency standards and codes		Greenroofs
	Heat design guidelines		Community gardens
Assessment	Building energy benchmarking		Stormwater Retention
	Catastrophe (CAT) bond	Energy	Walkability
	Conduct a heat vulnerability assessment		Electric Vehicle Infrastructure
	Design a heat management plan		Waste heat reduction
	Heat-resilient environmental impact assessments		Microgrids

Table 1. Adaptation and Mitigation Strategies.

3.3 Mapping the Heat Archipelago

a. Landsat

To determine where both hot and cool islands occur, Landsat 9 satellite imagery was used. Imagery from August 3rd, 2022 over Omaha, Nebraska was collected from the USGS Earth Explorer website, with a focus on thermal bands 4,5, and 10 and the metadata contained within that Landsat data. Various calculations were performed using ArcGIS Pro to find the top of atmosphere (TOA), brightness temperature, normalized difference vegetation index (NDVI), vegetational cover, emissivity, and, ultimately, land surface temperature. The land surface temperature raster data was normalized to ten internals and then transformed into vector data for analysis. We located eight heat islands from the vector data which had four different predominant land uses: Commercial, Industrial, Mixed Use, and Residential.

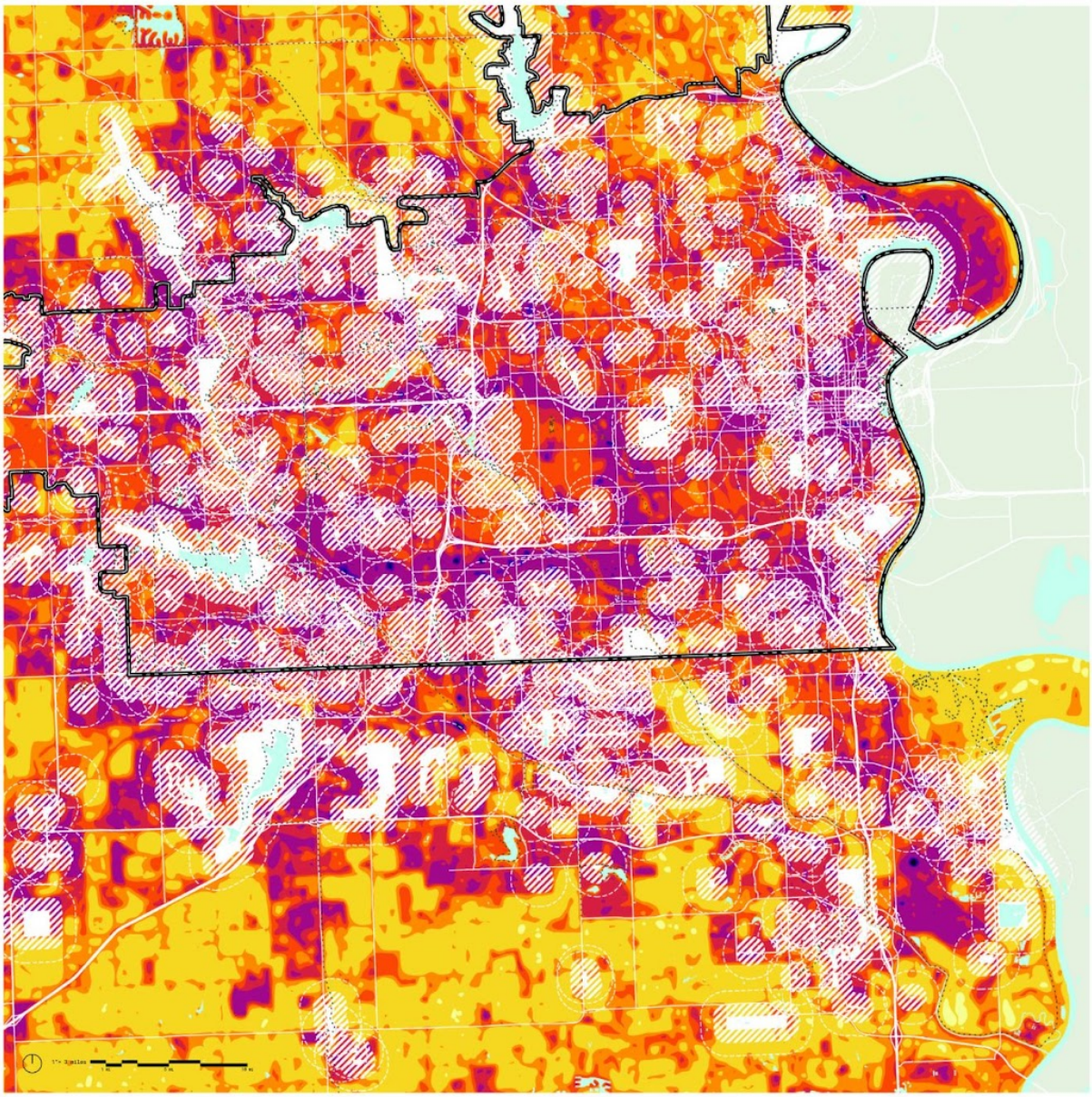

Figure 4. Land surface temperatures (Landsat Data) and urban green space in Omaha, NE.

b. Data

The study area for this research was the city of Omaha, Nebraska, USA. The data was collected using Geographic Information System (GIS) software. The data used in this portion of the methods included: Census Data from 2020, Tree Equity Score Data from 2020, and the shapefile from the previously defined heat islands of Omaha.

c. Heat Vulnerability Assessment

After locating the eight heat islands, more data was collected, including median income, the percentage of people of color, park tree equity score, trails, highways, bus stops, public transit, and health infrastructure. All layers were then clipped to the island boundary using a clip tool that cuts out a piece of one dataset using one or more features in another dataset as a cookie cutter. The island layers were exported to Illustrator and reassembled on top of each other to further investigate the layers and identify common patterns.

Starting with the base map, which includes the island and surrounding context, the second layer highlights the infrastructure, including the highway (represented in red), bus stops, and health infrastructure in the heat island area. The third layer is an environmental health, which includes the tree equity score (represented by a gradient color from light gray to dark green), parks (represented with white hatch), and trails (represented by dotted black lines). The last layer is sociodemographic, which includes the percentage of people of color (represented by red circles, with larger circles indicating higher numbers of people of color in that area), and median income (represented by a gradient color from gray to dark green, with darker colors indicating higher income levels).

Categories	**Criteria**
Environment/Health	Contamination Ecological Systems Green Amenities Surface Temperature (Landsat)
Social/Economic	Ethnic Distribution Population Density Age Distribution Wealth Distribution
Physical Infrastructure	Traffic Volume Public Mobility Transportation Infrastructure Zoning

Table 2. Criteria for heat vulnerability assessment.

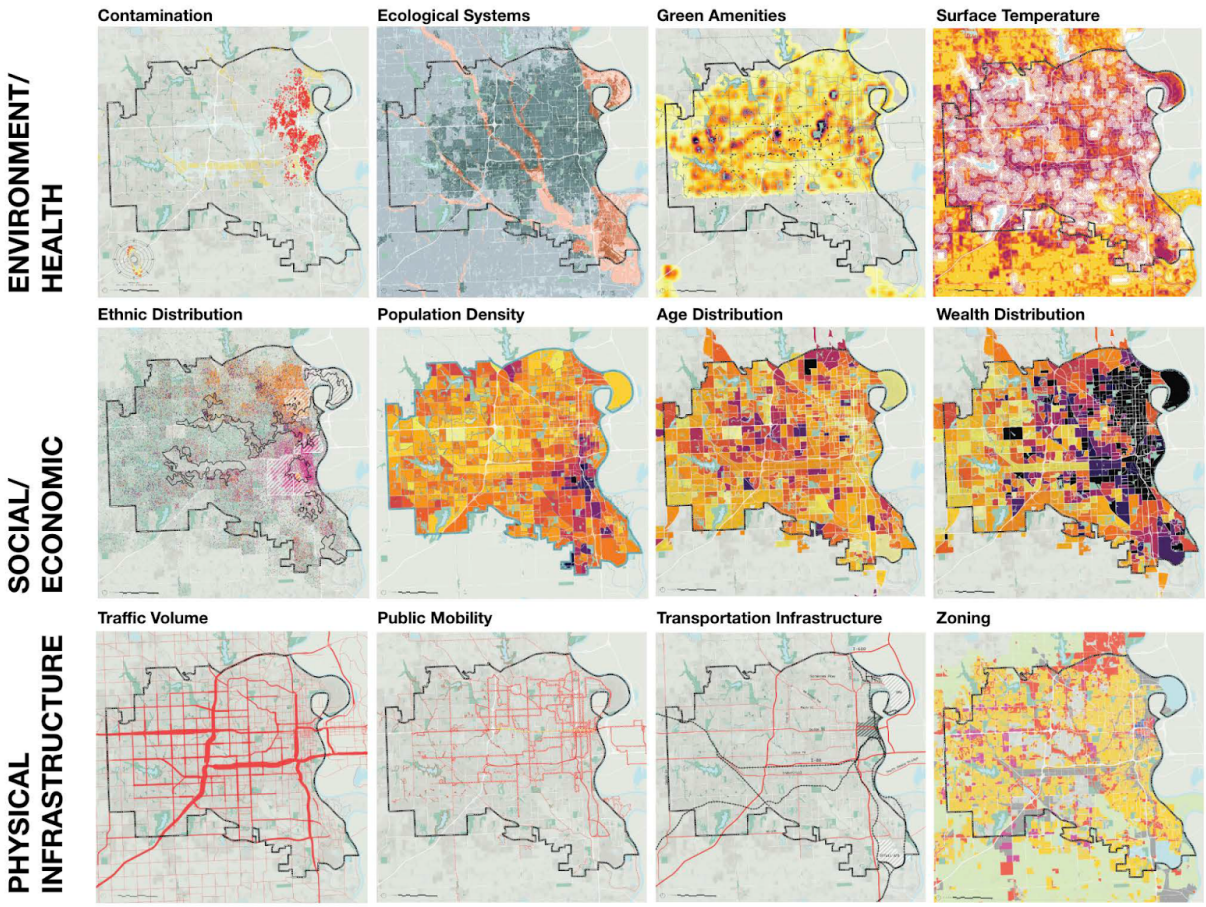

Figure 5. Conducting a heat vulnerability assessment by systems mapping the disproportionate impacts of heat.

d. Isolating the Heat "Islands"

Through comparing the heat vulnerability assessment to the land surface temperatures, heat "islands" were selected and isolated to better understand the criteria at a smaller scale. Environment/health, social/economic, and physical infrastructure data were mapped and compared to the city-wide data to better understand the extent of heat disparity in these "islands." The following metrics: average surface temperature, population, percent ethnic minority, poverty rate, household income, unemployment rate, physical health, and mental health, were compared to Omaha scale data. It was found that for all "islands," average surface temperature, percent ethnic minority, poverty rate, and unemployment rate were higher than the average data for Omaha. Household income, physical health, and mental health were lower on average.

3.4 Qualitative Assessment of Heat Vulnerability

In developing a holistic understanding of the tangible impacts of urban heat, it is crucial to collaborate with community partners to reveal the lived realities of the built environment. To gather frontline community perspectives on extreme heat in Omaha, we adapted questions from Abdelatty et. al. (2023) to develop a community survey as the source of data collection. The survey was distributed to Fabric Lab and the South Omaha Neighborhood Alliance. Both community groups are located in heat islands identified through the heat vulnerability study (sections R1 and M1 respectively).

The survey questions were designed with the following goals (See appendices for full list of questions):

Assessing Perceived Heat Exposure: One objective should be to gauge how residents perceive and experience heat in different parts of Omaha. This includes understanding how often they feel discomfort due to heat, which areas they consider hotter, and how they adapt to extreme heat events. This objective aims to gather subjective information about heat exposure.

Identifying Coping Strategies: Another important objective is to identify the coping strategies employed by residents to deal with urban heat. This can include questions about the use of air conditioning, access to cooling centers, altering daily routines, or other measures taken to mitigate the effects of heat. Understanding these strategies can inform urban planning efforts to enhance heat resilience.

Evaluating Health and Well-being Impacts: To comprehensively assess the impact of urban heat, the survey should include questions related to health and well-being. This objective aims to uncover how heat affects physical health, mental health, and overall quality of life. Questions could pertain to heat-related illnesses, sleep disturbances, and the emotional toll of prolonged heatwaves.

Assessing Awareness and Preparedness: Lastly, it is crucial to evaluate residents' awareness and preparedness for extreme heat events. This objective involves determining whether individuals are aware of heat advisories, emergency response plans, and community resources available during heatwaves. Understanding the level of preparedness can guide efforts to improve public awareness and safety measures.

Figure 6. Isolated heat "islands" with physical infrastructure mapping.

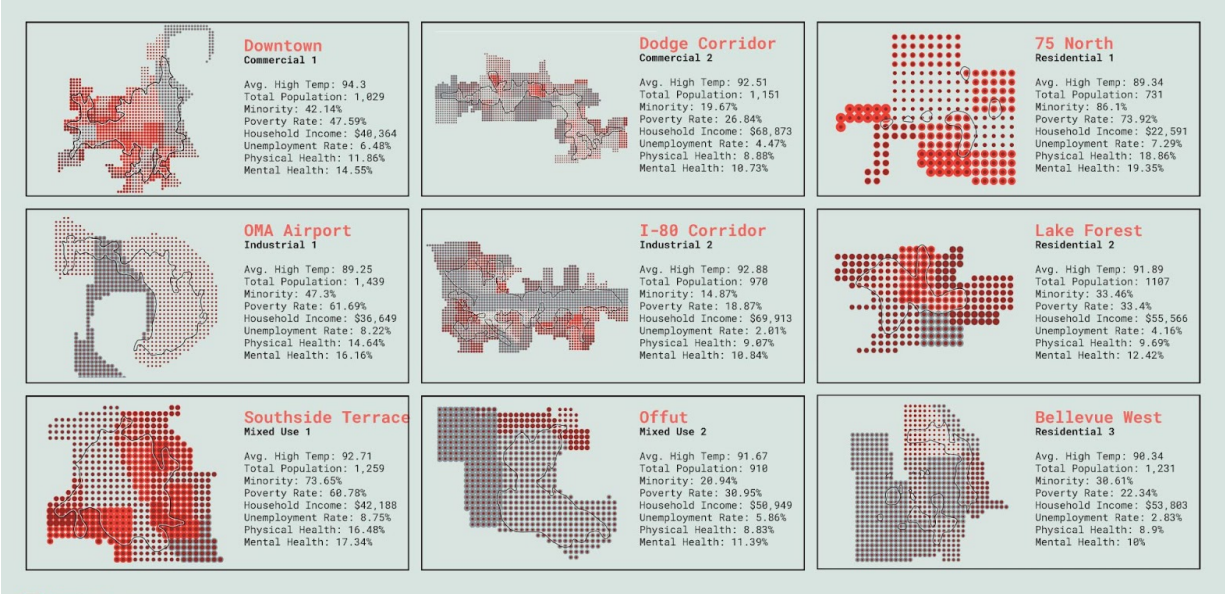

Figure 7. Measuring demographic data of the heat "islands" to the broader City of Omaha data.

4. RESULTS: CORRELATING HEAT ISLANDS TO LACK OF GREENSPACE

The distribution of urban heat islands tend to overlap with populations that were measured to have higher percent ethnic minority, poverty rate, and unemployment rate as well as lower household income, physical health, and mental health. These results are not surprising, as the development and proliferation of tree canopies require significant investment and long-term maintenance, which generally correlates with areas with higher tax revenue generation.

Regardless, if we consider heat and access to cooler environments as a public health concern, it is of critical importance to address the development and distribution of cool landscapes at a planning scale to prioritize spaces in the city that negatively impact vulnerable populations. This is reflected in the Omaha Community Heat Survey; when asked, "Please select the top three priorities for how the City should invest in heat mitigation," the top option selected was, "How much it prioritizes the most vulnerable/impacted communities." Participants in the survey also identified "More green space like parks, gardens and trees for more shade and cooling" as being the most preferred resources they would like to see more in their neighborhood (Figure 8 & 9).

Which resources would you like to see in your neighborhood?
Percentage of Responses

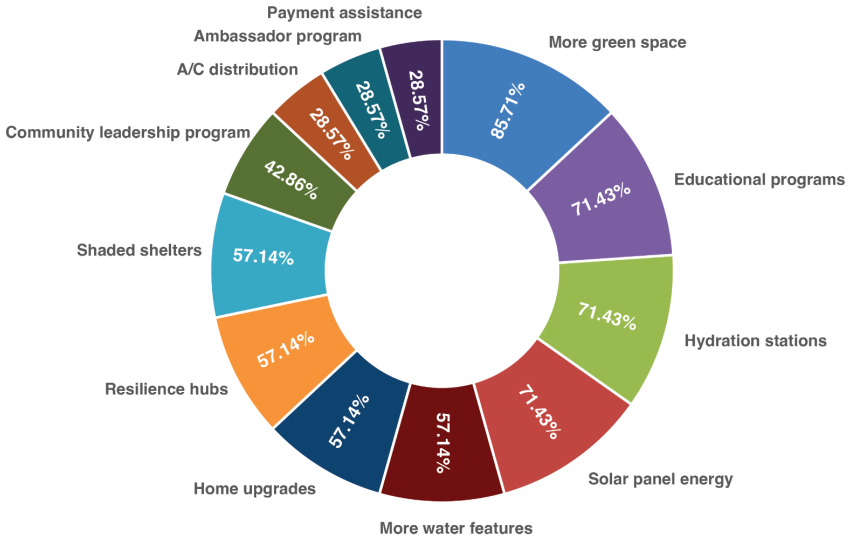

Figure 8. Which resources would you like to see in your neighborhood? Sorted by percentage of responses.

Select the top three priorities for how the City should invest.
Percentage of Responses

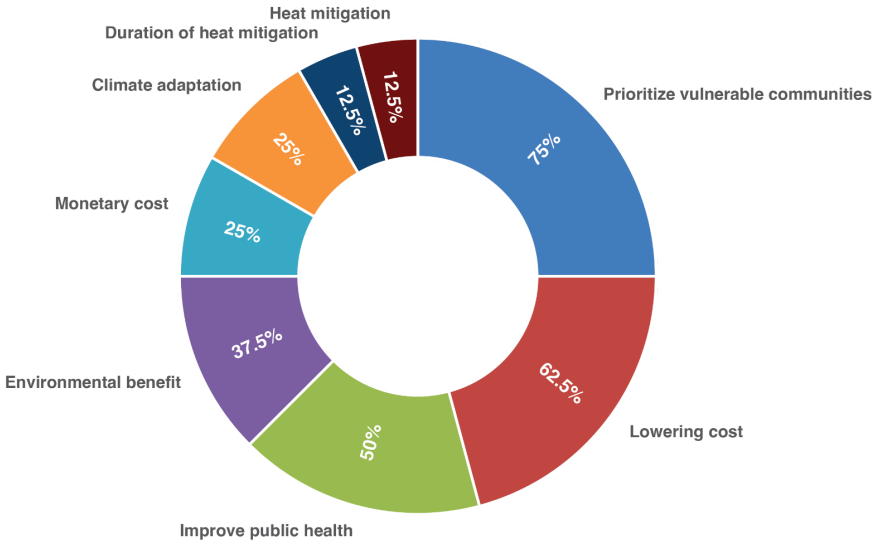

Figure 9. Select the top three priorities for investment. Sorted by percentage of responses.

5. DISCUSSION

The lack of green space can worsen the heat island effect in urban areas. The heat island effect occurs when the temperature in an urban area is significantly higher than in the surrounding rural areas due to the absorption and retention of heat by buildings and pavement. Green spaces such as parks, trees, and vegetation provide shade and reduce the amount of heat absorbed by buildings and pavement. They also provide a cooling effect by reducing the amount of heat radiation absorbed by surfaces. When there is a lack of green space in urban areas, there are fewer opportunities for shade and cooling, resulting in higher temperatures. This can lead to a vicious cycle where higher temperatures lead to increased energy use for cooling, which in turn contributes to even higher temperatures due to the waste heat generated by air conditioning systems. Therefore, understanding thermal disparity through a vulnerability assessment can help mitigate the heat island effect and improve the quality of life for urban residents.

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7. APPENDICES

Omaha Heat Survey

1. What is your age?
   Answer Options: (Under 18, 18-20, 21-29, 30-39, 40-49, 50-59, 60 or older)

2. How do you identify yourself?
   Answer Options: (White, Hispanic or Latino/a/x, Black or African American, American Indian or Alaskan Native or Native American, Indigenous, Indigenous Mexican, Asian, Native Hawaiian or other Pacific Islander, Middle Eastern or North African, Multiple Races, Prefer not to say, Other, please specify)

3. If you identify as Hispanic or Latino/a/x please check all that apply to you
   Answer Options: (Cuban, Guatemalan, Hispanic or Latino/a/x Indigenous, Mexican or Chicano, Puerto Rican, Salvadoran, Another Hispanic or Latino/a/x origin, I do not identify as Hispanic or Latino/a/x, Prefer not to say)

4. Which of the following genders do you identify with?
   Answer Options: (Female, Male, Non-Binary, Prefer not to say, Other)

5. What is your employment status?
   Answer Options: (Employed full-time, Employed part-time, Student with employment, Student without employment, Retired, Not currently employed)

6. If you are employed, do you primarily work indoors or outdoors?
   Answer Options: (Cool Indoors, Hot Indoors, Outdoors, Vehicle or car and it has A/C, A vehicle with no A/C, I am not employed)

7. If you are employed, does your employer provide any of the following accommodations or resources on a hot day? Check all that apply.
   Answer Options: (Extra water breaks to cool off, Access to shaded areas, Cooling fans, Training for how to prepare for heat and heat injury, A/C, My employer does not provide any accommodations or resources, I work from home, I am not employed, Other)

8. What is the highest level of school you have completed or the highest degree you have received?
   Answer Options: (Less than a high school degree, High school degree or equivalent (e.g., GED), Some college but no degree, Associate degree, Bachelor degree, Graduate degree)

9. How much total combined money did all members of your family household earn in 2022?
   Answer Options: Under $25,500, $25,500 – $37,499, $37,500 – $49,999, $50,000 – $69,999, $70,000 – $99,999, $100,000 – $125,000, Over $125,000

10. What language do you mainly speak at home? Select ALL that apply.
    Answer Options: (English, Spanish, Vietnamese, Arabic, Chinese, German, Other (please specify))

11. Do you, or any members of your household, have any of the following health conditions?
    Answer Options:(Asthma, Cancer, Heart Disease, Lung Disease, High Blood Pressure, Diabetes, Physical Disability which Limits Movement, Psychological/Mental Health Conditions, None, Prefer not to say, Other)

12. How much does this health condition affect your day-to-day activities?
    Answer Options: (1: Not at all, 2: A little bit, 3: Moderately, 4: A lot, 5: Severely, Does not apply)

13. How would you describe your current living situation?
    Answer Options: (Section 8 housing, Rented apartment, Owned apartment, Single-family rented home, Single-family owned home, Living with family/friend, Housing insecure (unstable living situation), Mobile home, Other)

14. Have you ever been housing insecure or had an unstable living condition in the past?
    Answer Options: (Yes, Maybe, No)

15. How many people live in your current home, including yourself?
    Answer Options: (1, 2-4, 5-8, 9 or more)

16. How many current residents are at or over the age of 60, including yourself?
    Answer Options: (0, 1-3, 4 or more)

17. What is your ZIP code?
    Answer Options: Open-ended

18. Which organization are you representing today?
    Answer Options: Open-ended

19. On a scale of 1-5, how much do you think extreme heat personally threatens your health, safety, and well-being?
    Answer Options: 1: Not at all , 2: Rarely, 3: Sometimes, 4: Often, 5: Very Often

20. Where are you most likely to go to stay cool if it is hot outside or at work?
    Answer Options: (Home, Mall, Pool, Park, Library, Place of Worship (Church, Mosque, Temple etc), Recreation Center, Senior Center, Friend/Neighbors home, Community center, Other)

21. When you stay at home on a hot day, how often do you feel hot in your home?
    Answer Options: (1: Not at all, 2: Rarely, 3: Sometimes, 4: Often, 5: Very Often)

22. When it is a very hot day, which of these do you use to stay cool inside your home?
    Answer Options: (Drinking cold water, Central A/C, Window A/C, Portable A/C, Cold showers, Closed shades or blinds, Ceiling fan, Portable fan, Shade trees keep my house cool, None of the above, Other)

23. If you do not use AC at home, what is the main reason your household does not use air conditioning?
    Answer Options: (Landlord won't provide it, Cost of AC unit too high, Cost of electricity too high, At work most of the day, Prefer a fan, Do not need it, Do not like it, Other, Does not apply)

24. Do you experience any of the following barriers going to a cooler building or place when it is very hot?
    Answer Options: (Hours of operation, Not accessible for people with disabilities, Distance from home, Lack of transportation, Personal safety, Cannot bring pets, Lack of information, Never needed to go to a cooled place, No, nothing prevents me, Other)

25. What is your main source of transportation?
    Answer Options: (Bus or Train, Bicycle, Scooter, Walking, Personal Vehicle, Rideshare (ie Uber, Lyft), Other)

26. There are enough trees and shade in my neighborhood on a hot day. Agree or Disagree?
    Answer Options: (Agree, Disagree)

27. How do you get alerted about extreme heat events that are going to affect your neighborhood? Check all that apply.
    Answer Options: (Radio, TV, Phone alerts, Social media (e.g., Facebook, Twitter, Instagram), By other people or my family, I have never been alerted)

28. On a scale of 1-5, how effective has the City been in responding to extreme heat?
    Answer Options: (1: Not effective at all, 2: Barely effective, 3: Somewhat effective, 4: Effective, 5: Very effective, Not sure)

29. Which resources would you like to see in your neighborhood? Check all that apply
    Answer Options: (Resilience hubs / cooling centers, Hydration water stations, A/C / Fan distribution, Utility / energy payment assistance programs, More green space like parks, gardens and trees for more shade and cooling, Access to more public water features like ponds, fountains, or the beach, Solar panel energy on homes, Home upgrades / retrofitting to increase energy efficiency, Shaded bus stops and other shade structures, Community leadership programs to practice advocating policy needs, Educational workshops on the negative impacts of heat on health and wellbeing and awareness about extreme heat programs by the City, Community ambassador program to spread information and provide wellness resources to adapt to heat)

30. Survey Question: Please select the top three priorities for how the City should invest in the resources identified above.
    Answer Options: (Monetary cost for the City, How long it is effective in lowering the negative impact of heat, How much it lowers costs for residents, How much it improves public health and safety, How good it is for the environment, How much it helps Omaha adapt to climate change, How much it prioritizes the most vulnerable/impacted communities, How much it lowers the exposure to extreme heat for everyone, Other)

31. Please share any other problems your household has experienced with heat in your neighborhood or what might help you and your neighbors stay cool.
    Answer Options: Open-ended