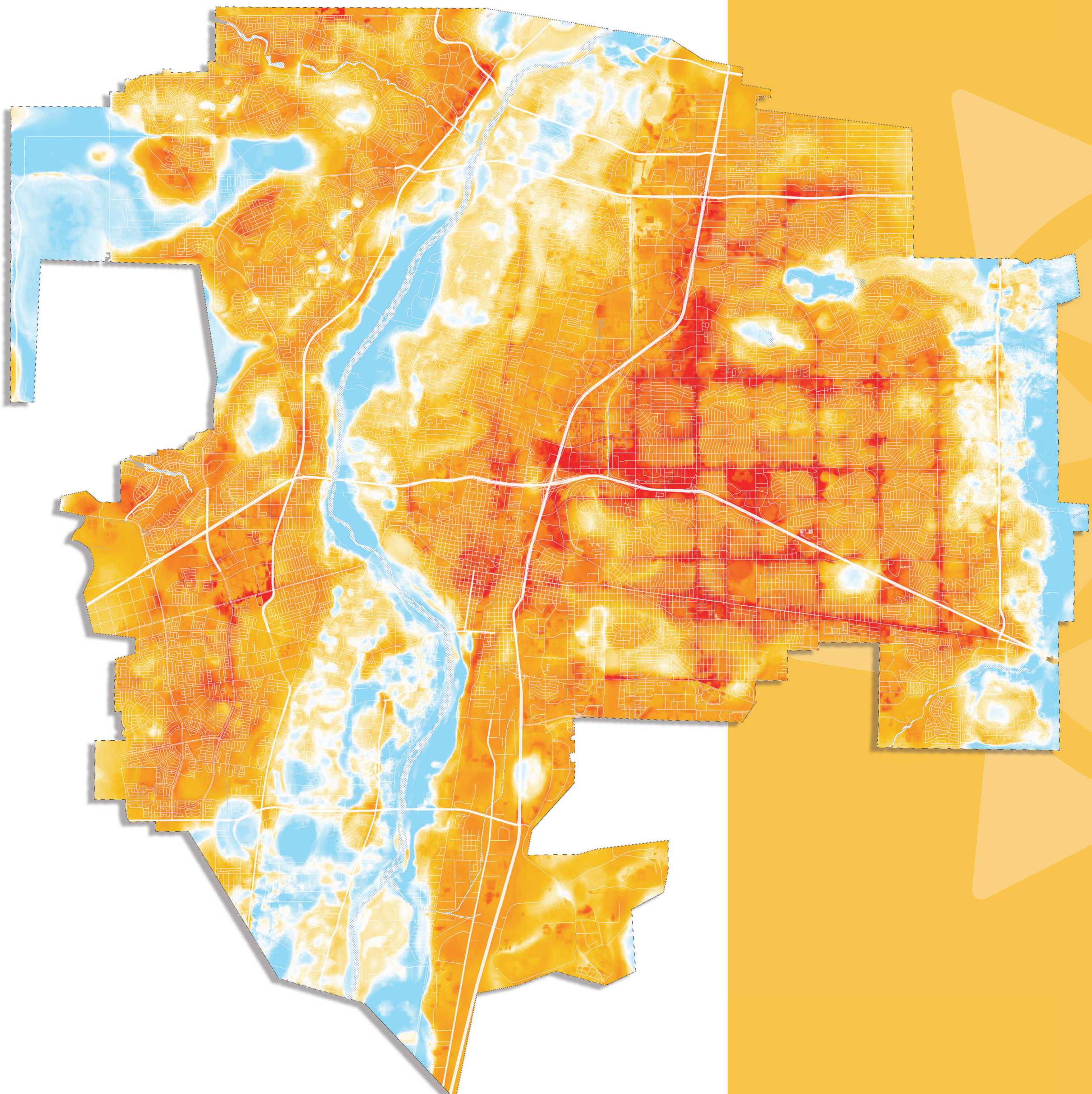
Albuquerque

New Mexico



CAPA strategies

HEAT WATCH Report

CAPA strategies

HEAT WATCH

The CAPA Heat Watch program, equipment, and all related procedures referenced herein are developed through a decade of research and testing with support from national agencies and several universities. Most importantly, these include our partners at the National Integrated Heat Health Information System, the National Oceanic and Atmospheric Administration's (NOAA's) Climate Program Office, and National Weather Service, including local weather forecast offices at each of the campaign sites, The Science Museum of Virginia, and U.S. Forest Service (USDA). Past support has come from Portland State University, the Climate Resilience Fund, and the National Science Foundation. We are deeply grateful to these organizations for their continuing support.

CPO NOAA CLIMATE PROGRAM OFFICE

NIHHIS NATIONAL INTEGRATED HEAT HEALTH INFORMATION SYSTEM

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

This report was prepared by CAPA Strategies, LLC
Summer 2021

Credit: Jesse Wood

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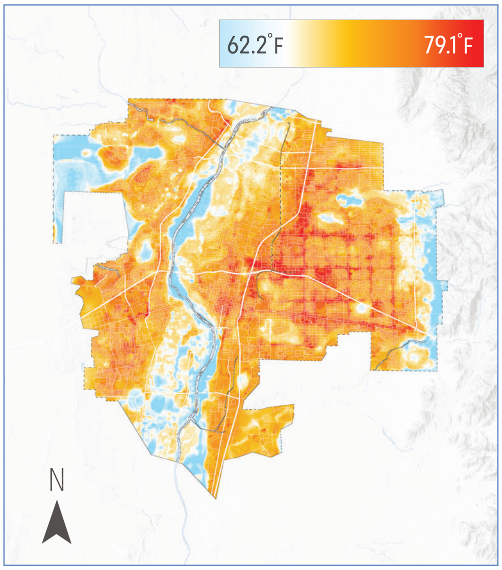
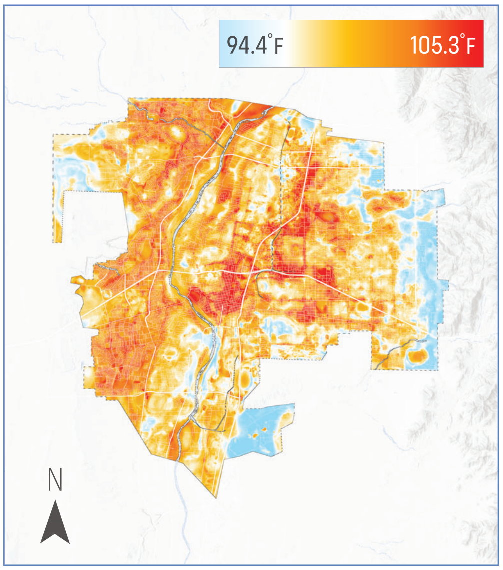
Executive Summary

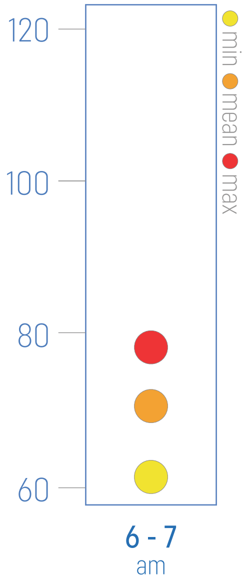
Major thanks to all of the participants and organizers of the Urban Heat Watch program in Albuquerque, New Mexico. After months of collaboration and coordination, local organizers and volunteers collected thousands of temperature and humidity data points in the morning, afternoon, and evening of a long, hot campaign day on July 9th, 2021.

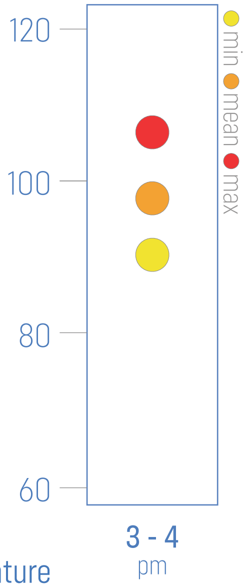
Morning Area-Wide Temperature (6 - 7 am)



Afternoon Area-Wide Temperature (3 - 4 pm)







Traverse Point Temperature

Study Date

July 9th, 2021

65
Volunteers

18
Routes

67,662
Measurements

105.9°
Max Temperature

16.9°
Temperature Differential

HEAT WATCH

Learn more about the background and goals of each Heat Watch 2021 campaign city at https://nihhis.cpo.noaa.gov/Urban-Heat-Islands/Mapping-Campaigns/Campaign-Cities

Purpose & Aims

We know that climate-induced weather events have the most profound impact on those who have the least access to financial resources, historically underserved communities, and those struggling with additional health conditions. Infrastructure is also at risk, which can further compromise a region's capacity to provide essential cooling resources.

CAPA Strategies offers an unparalleled approach to center communities and infrastructure facing the greatest threat from the impact of increasing intensity, duration, and frequency of extreme heat. This report summarizes the results of a field campaign that occurred on July 9th, 2021 and with it we have three aims:

1

Provide high resolution descriptions of the distribution of temperature and humidity (heat index) across an urban area

2

Engage local communities and create lasting partnerships to better understand and address the inequitable threat of extreme heat

3

Bridge innovations in sensor technology, spatial analytics, and community climate action to better understand the relationships between urban microclimates, infrastructure, ecosystems, and human well-being.

With a coordinated data-collection campaign over several periods on a hot summer day, the resulting data provide snapshots in time of how urban heat varies across neighborhoods and how local landscape features affect temperature and humidity.

Campaign Process

CAPA Strategies has developed the Heat Watch campaign process over several iterations, with methods well established through peer-reviewed publications[1], testing, and refinement.

The current campaign model requires leadership by local organizers, who engage community groups, new and existing partner organizations, and the media in generating a dialog about effective solutions for understanding and addressing extreme heat.

CAPA provides training, equipment, and support to the recruited community groups as they endeavor to collect primary temperature and humidity data across a metropolitan region.

The seven main steps of the campaign process are summarized to the right. An overview of the analytical modeling methodology is presented later in this report and described at full length in peer-reviewed publications.

1. Set Goals

Campaign organizers determine the extent of their mapping effort, prioritizing areas experiencing environmental and social justice inequities. CAPA then divides this study area into sub-areas ("polygons"), each containing a diverse set of land uses and land covers.

2. Establish

Organizers recruit volunteers, often via non-profits, universities, municipal staff, youth groups, friends, family, and peers. Meanwhile, CAPA designs the data collection routes by incorporating important points of interest such as schools, parks, and community centers.

3. Prepare

Volunteers attend an online training session to learn the why and how of the project, their roles as data collectors, and to share their personal interest in the project. Participants sign a liability and safety waiver, and organizers assign teams to each polygon and route.

4. Activate

With the help of local forecasters, organizers identify a high-heat, clear day (or as near to one as possible) and coordinate with their volunteer teams. Once confirmed, CAPA ships the sensor equipment and bumper magnets to be distributed to campaign participants.

5. Execute

Volunteer teams conduct the heat campaign by driving and/or bicycling sensor equipment along pre-planned traverse routes at coordinated hour intervals. Each second the sensors collect a measurement of ambient temperature, humidity, longitude, latitude, speed and course.

6. Analyze

Organizers collect and return the equipment, and CAPA analysts begin cleaning the data, as described in the Mapping Method section below, and utilize machine learning algorithms to create predictive area-wide models of temperature and heat index for each traverse.

7. Implement

Campaign organizers and participants review the Heat Watch outputs (datasets, maps, and report), and campaign teams meet with CAPA to discuss the results and next steps for addressing the distribution of extreme heat in their community.

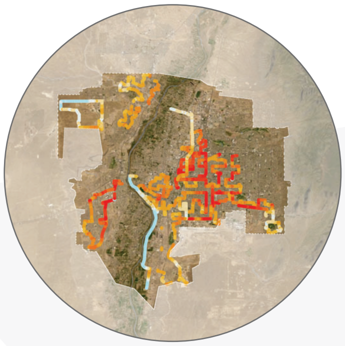
[1] The most relevant and recent publications to the Heat Watch campaign process include:

Shandas, V., Voelkel, J., Williams, J., & Hoffman, J., (2019). Integrating Satellite and Ground Measurements for Predicting Locations of Extreme Urban Heat. Climate, 7(1), 5. https://doi.org/10.3390/cli7010005

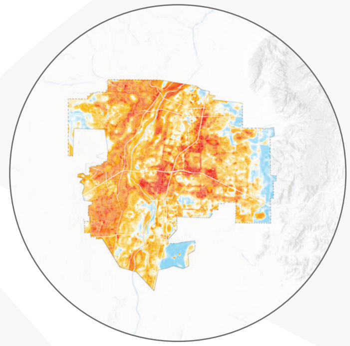
Voelkel, J., & Shandas, V. (2017). Towards Systematic Prediction of Urban Heat Islands: Grounding Measurements, Assessing Modeling Techniques. Climate, 5(2), 41. https://doi.org/10.3390/cli5020041

About The Maps

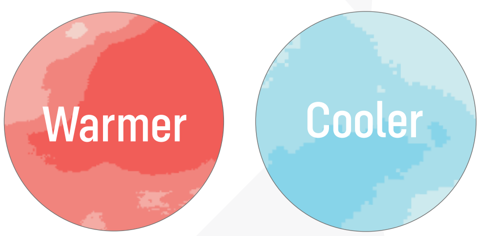
The following sections present map images from the Heat Watch campaign and modeling process. Two sets of maps comprise the final results from the campaign process, and they include:



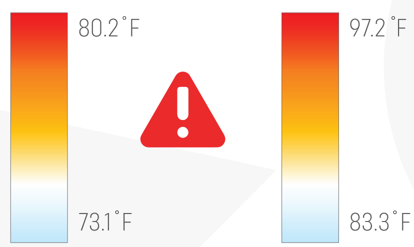
Point temperatures collected in each traverse period, filtered to usable data.



Area-wide heat maps, displaying either the modeled temperature or heat index across the entire study area at each traverse period.



The data are classified by natural breaks in order to clearly illustrate the variation between warmer (red) and cooler (blue) areas across the map.



Note that the scales are different between the traverse point and area-wide maps due to the predictive modeling process.

How does your own experience with heat in these areas align with the map?

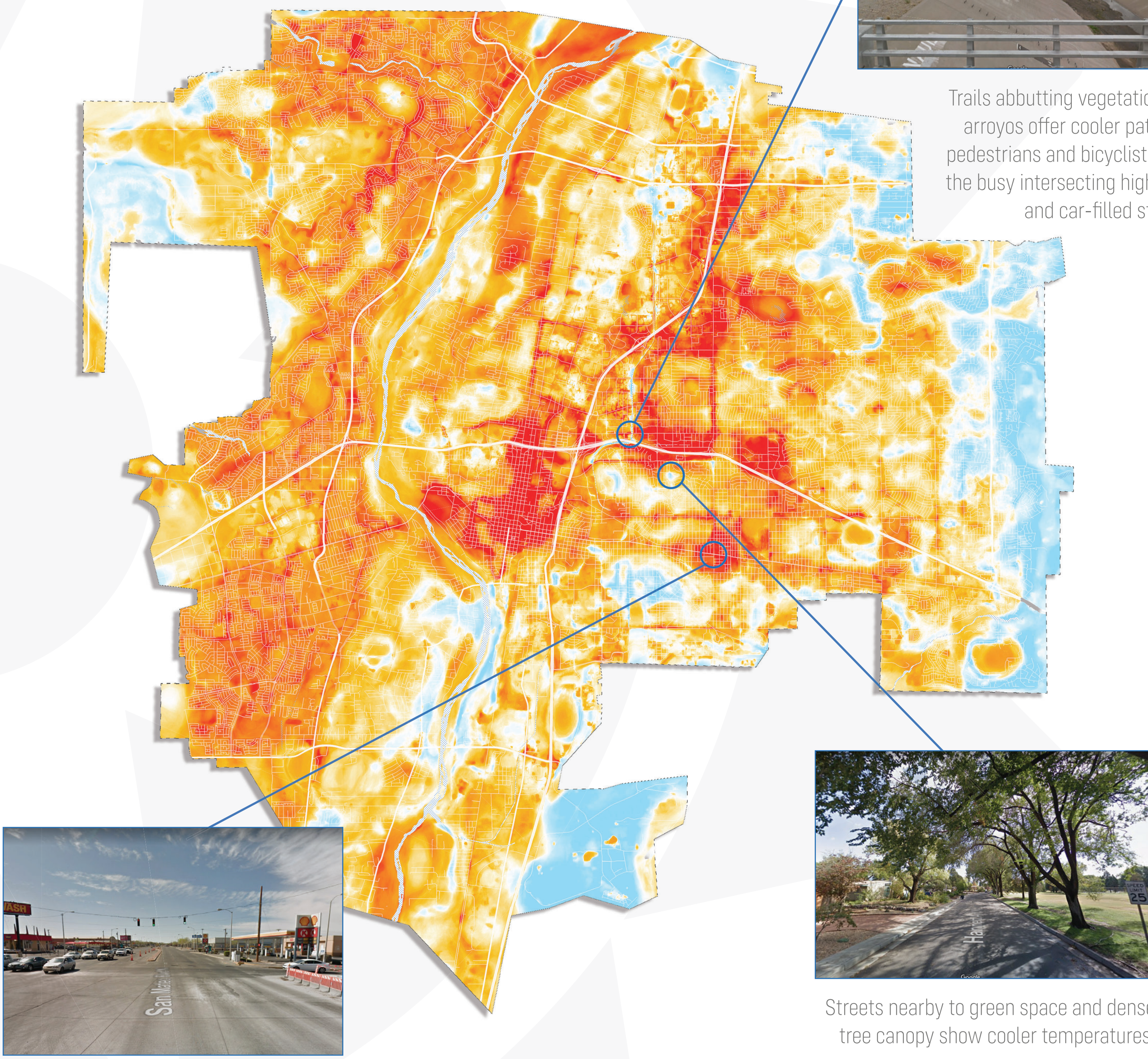
Find your home, place of work, or favorite park on the maps and compare the heat throughout the day to your personal experience.

What about the landscape (trees, concrete buildings, riverside walkway) do you think might be influencing the heat in this area?

Initial Observations

The distribution of heat across a region often varies by qualities of the land and its use. Here are several observations of how this phenomenon may be occurring in your region.

Trails abutting vegetation and arroyos offer cooler paths for pedestrians and bicyclists than the busy intersecting highways and car-filled streets.

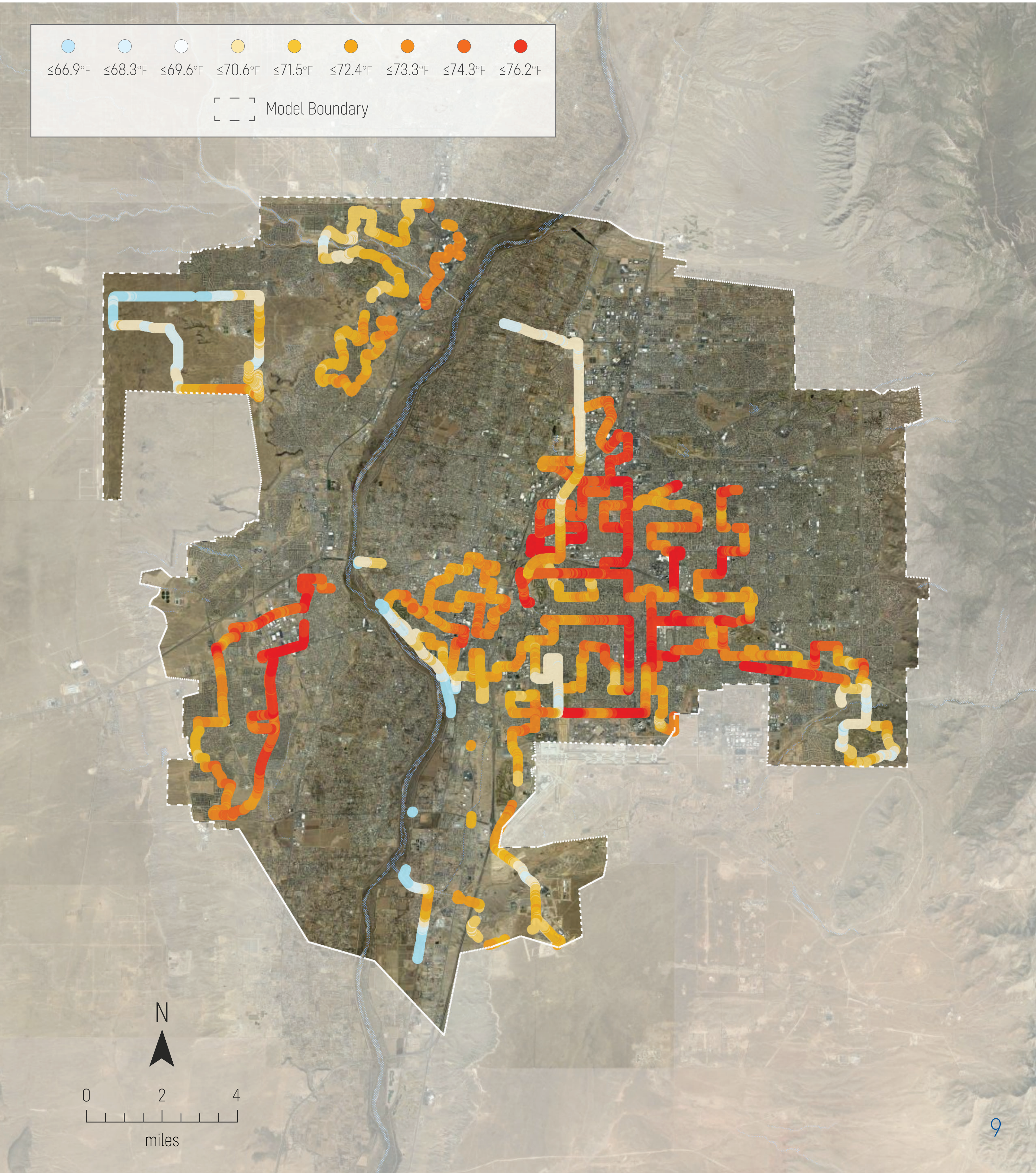


Wide asphalt intersections with little to no shade retain high temperatures and offer no refuge for pedestrians.

Streets nearby to green space and dense tree canopy show cooler temperatures.

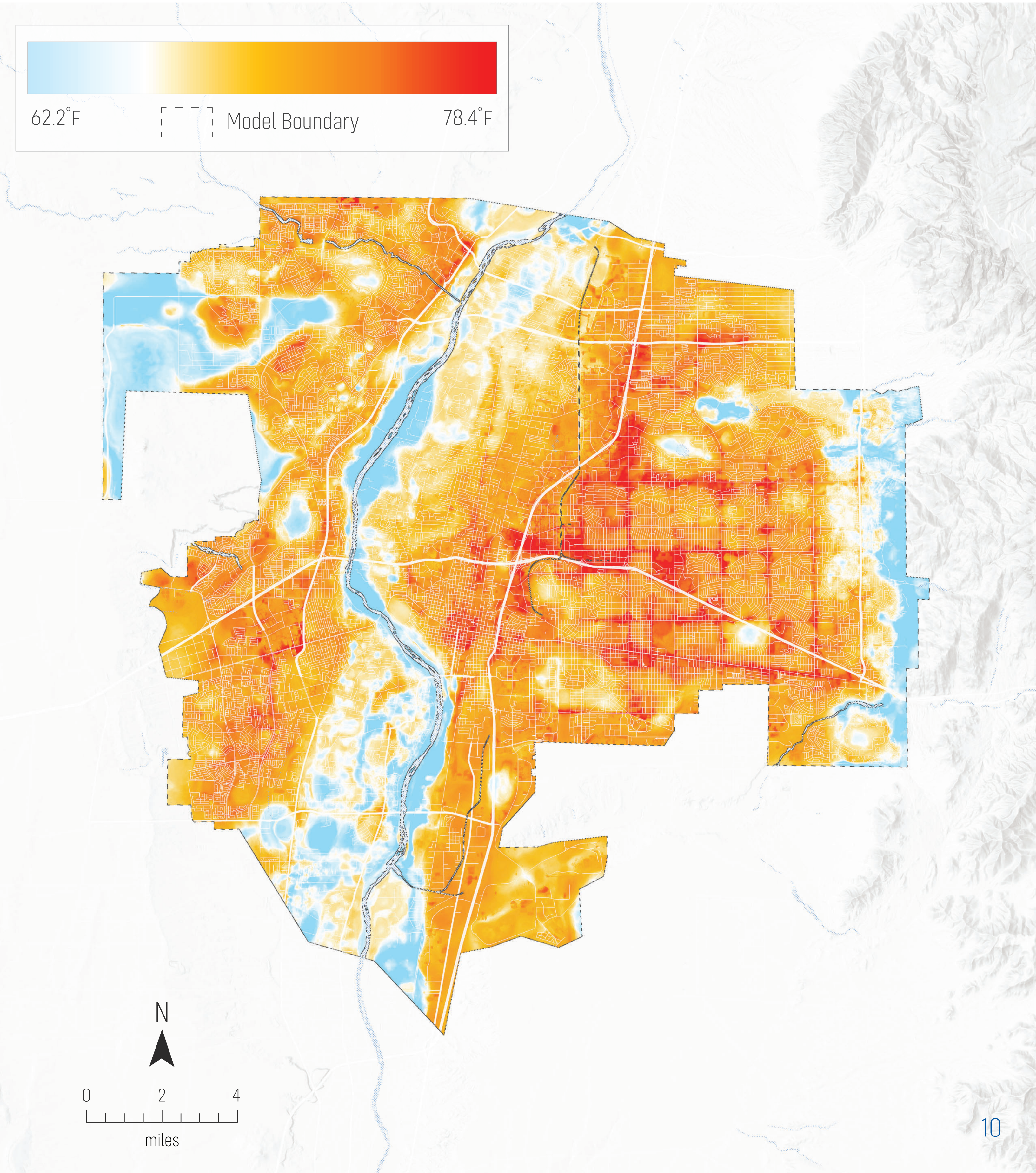
Morning Traverse Points

(6 - 7 am)



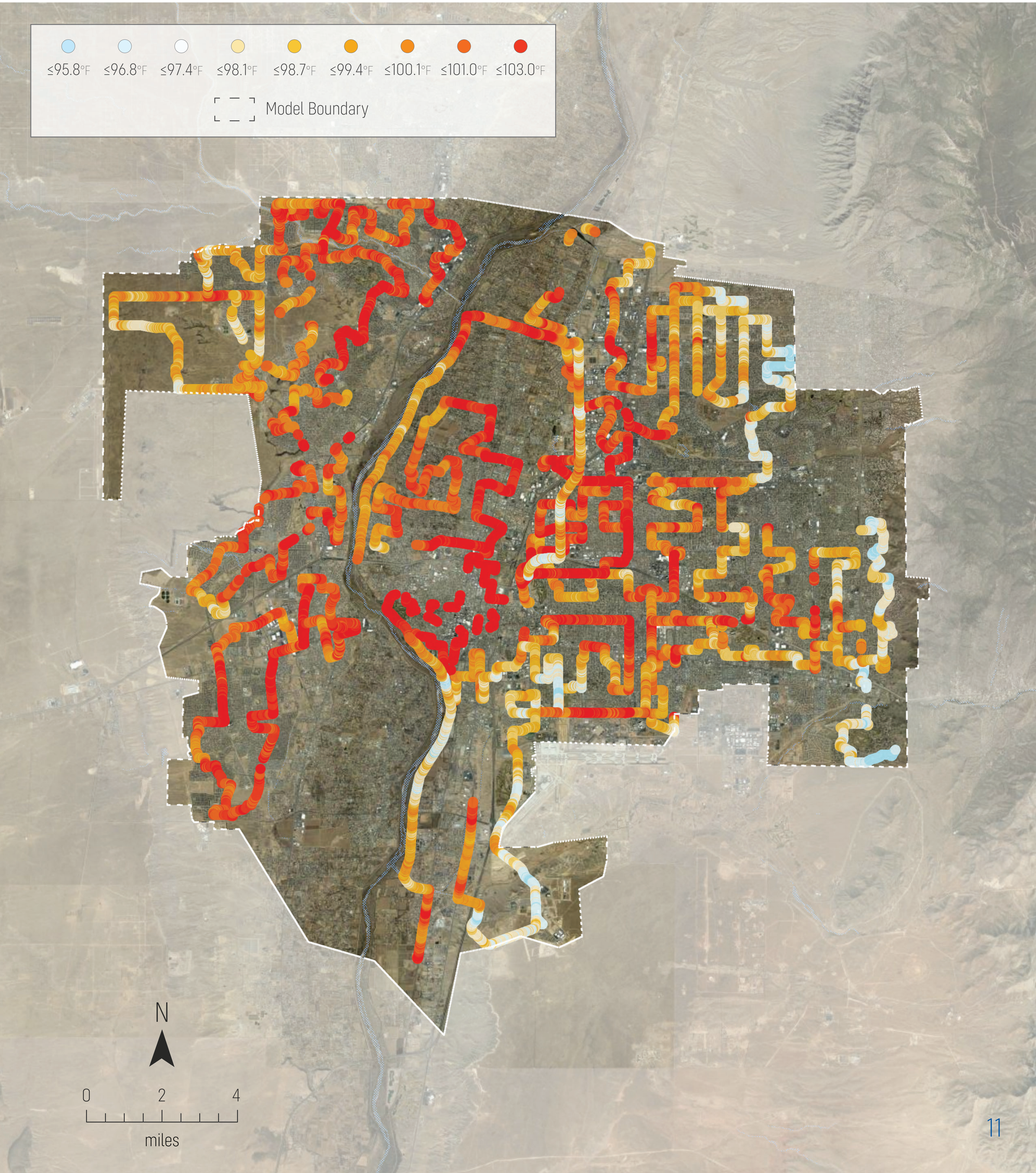
Morning Area-Wide Predictions

Temperature (6 - 7 am)



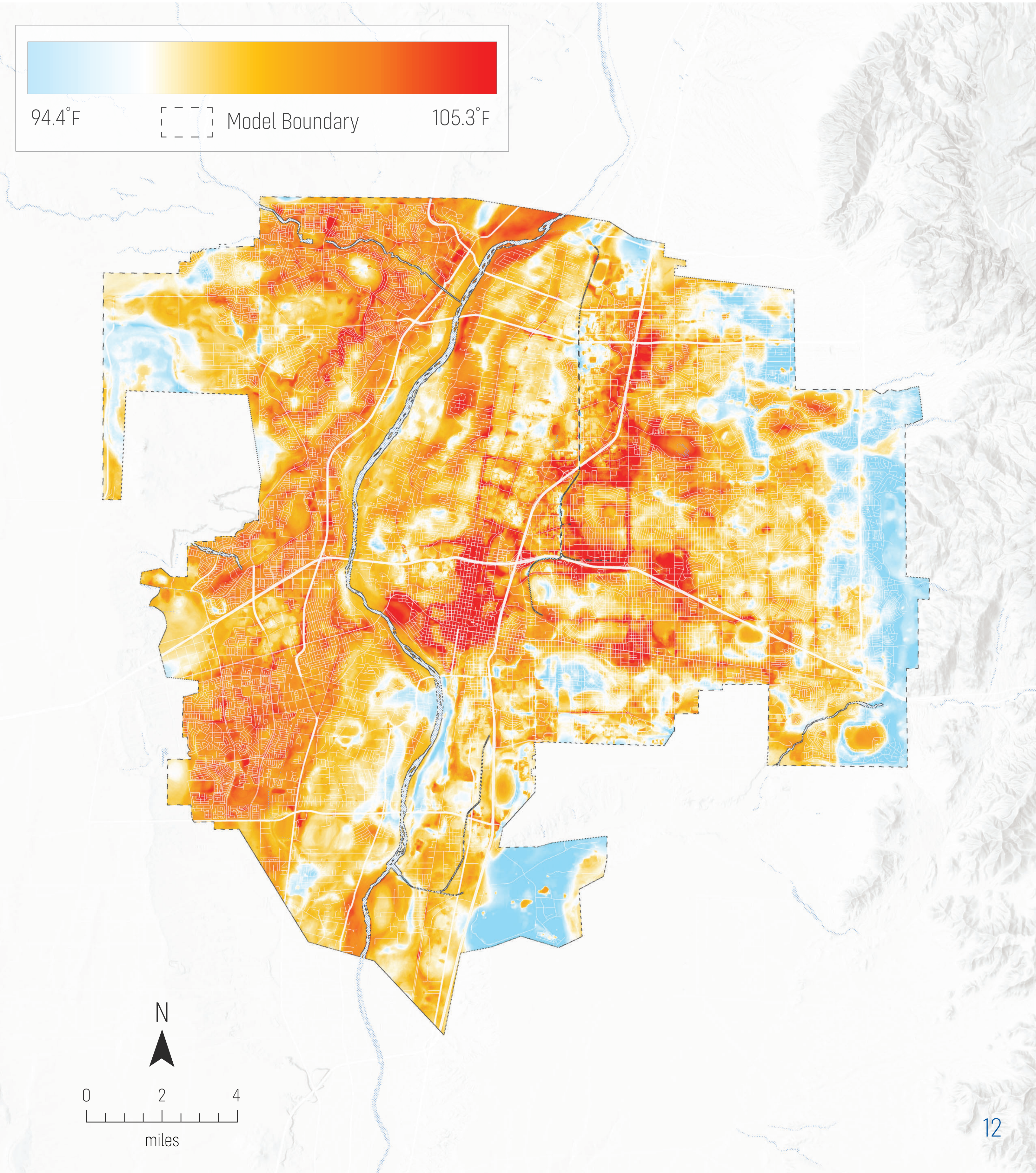
Afternoon Traverse Points

(3 - 4 pm)



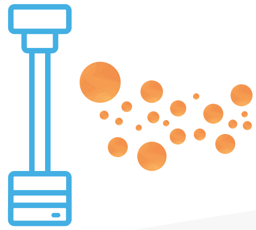
Afternoon Area-Wide Predictions

Temperature (3 - 4 pm)



Mapping Method

1 Download & Filter

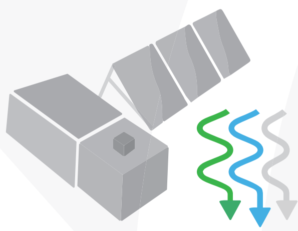


Download raw heat data from sensor SD cards

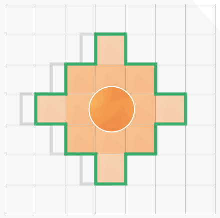
Compare data with field notes and debrief interview

Trim data to proper time window, speed, and study area

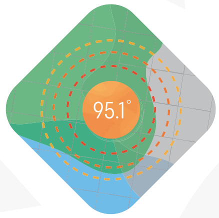
2 Integrate & Analyze



Download multi-band land cover rasters from Sentinel-2 satellite

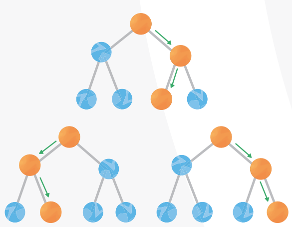


Transform land cover rasters using a moving window analysis

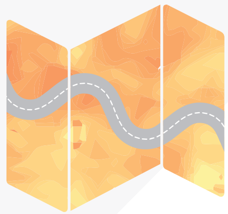


Calculate statistics of each land cover band across multiple radii

3 Predict & Validate



Combine heat and land cover data in Machine Learning model



Create predictive raster surface models of each period

Perform cross validation using 70:30 holdout method

The most relevant and recent publications include:

Shandas, V., Voelkel, J., Williams, J., & Hoffman, J., (2019). Integrating Satellite and Ground Measurements for Predicting Locations of Extreme Urban Heat. Climate, 7(1), 5. https://doi.org/10.3390/cli7010005

Voelkel, J., & Shandas, V. (2017). Towards Systematic Prediction of Urban Heat Islands: Grounding Measurements, Assessing Modeling Techniques. Climate, 5(2), 41. https://doi.org/10.3390/cli5020041

CAPA

Credit: Gino Barasa

Accuracy Assessment*	
Traverse	R-Squared
6 - 7 am 3 - 4 pm	0.98 0.95

Field Data

Like all field campaigns, the collection of temperature and humidity data requires carefully following provided instructions. In the event that user error is introduced during the data collection process, outputs may be compromised in quality. While our team has a developed a multi-stage process for assessing and reviewing the datasets, some errors cannot be identified or detected, and therefore can inadvertently compromise the results. Some examples of such outputs may include temperature predictions that do not match expectations for an associated landcover (e.g. a forested area showing relatively warmer temperatures). We suggest interpreting the results in that context.

Prediction Areas

The traverse points used to generate the areas wide maps do not cover every square of the studied area. Due to the large number of data collected, however, our predictive models support the extension of prediction to places beyond the traversed areas. We suggest caution when interpreting area wide values that extend far beyond the traversed areas

*Accuracy Assessment: To assess the strength of our predictive temperature models, we used a 70:30 "holdout cross-validation method," which consists of predicting 30% of the data with the remaining 70%, selected randomly. An 'Adjusted R-Squared' value of 1.0 is perfect predictability, and 0 is total lack of prediction. Additional information on this technique can be found at the following reference: Voelkel, J., and V Shandas, 2017. Towards Systematic Prediction of Urban Heat Islands: Grounding measurements, assessing modeling techniques. Climate 5(2): 41.

Next Steps

Now that you have completed a Heat Watch campaign, you have a better understanding of where urban heat is occurring in your region, and who is at risk of exposure. You may be wondering what to do next: how to mitigate that exposure, or help your region adapt to a hotter future. If you would like to take the next steps in preparing for climate change, CAPA's *Growing Capacity* services can help.

GROWING CAPACITY

Growing Capacity is an arm of CAPA Strategies which emphasizes place-based solutions, substantive community engagement, and the translation of data into action. These services ask not only "where do climate risks exist?," but "what can we do about them?" *Growing Capacity* services offer a systematic way to integrate data and accelerate climate adaptation in your area. We do this by reducing common barriers that limit action; making climate adaptation accessible to your colleagues and communities; and facilitating opportunities for collaboration, learning, and problem solving.

Growing Capacity services reflect a holistic approach to climate change mitigation and adaption. Our process is rooted in social scientific thinking, interdisciplinarity, and a mission of equity. This adds up to capacity-building solutions which are actionable, tailored to your region, and promote climate resilience for all.

We offer a range of services to support you in your climate adaption efforts, no matter how big or small. Choose from our offerings below to create a *Growing Capacity* package that fits your needs and budget.

Whether your climate adaption goals require increased community-based research, data synthesis, public outreach, network-building, or novel interventions, the *Growing Capacity* team is here to assist you.

Jurisdictional Scan

Comprehensive Report

Capacity Assessment

Comprehensive Report, Analysis

Community Knowledge Assessment

Workshops, Surveys, Focus Groups, Interviews

Resource Development

Strategic plans, Handbooks, Policy language, Tools for education/outreach

Want to start a conversation about Growing Capacity in your region? Contact us at *info@capastrategies.com*

Media

ALBUQUERQUE JOURNAL

Charting ABQ's urban heat islands

BY ELISE KAPLAN / JOURNAL STAFF WRITER

PUBLISHED: TUESDAY, JULY 13TH, 2021 AT 9:00PM

UPDATED: TUESDAY, JULY 13TH, 2021 AT 9:07PM

Maggie Fitzgerald who is a liaison with the city's environmental health department attaches a sensor on her vehicle to record temperatures throughout parts of the city. This is a way to map out the hottest parts of the city as a way to protect the most vulnerable residents. (Roberto E. Rosales/Albuquerque Journal.)

CAPA strategies

HEAT WATCH