City of Phoenix

Cool Pavement Program

May 17, 2022
Nevada Transportation Conference

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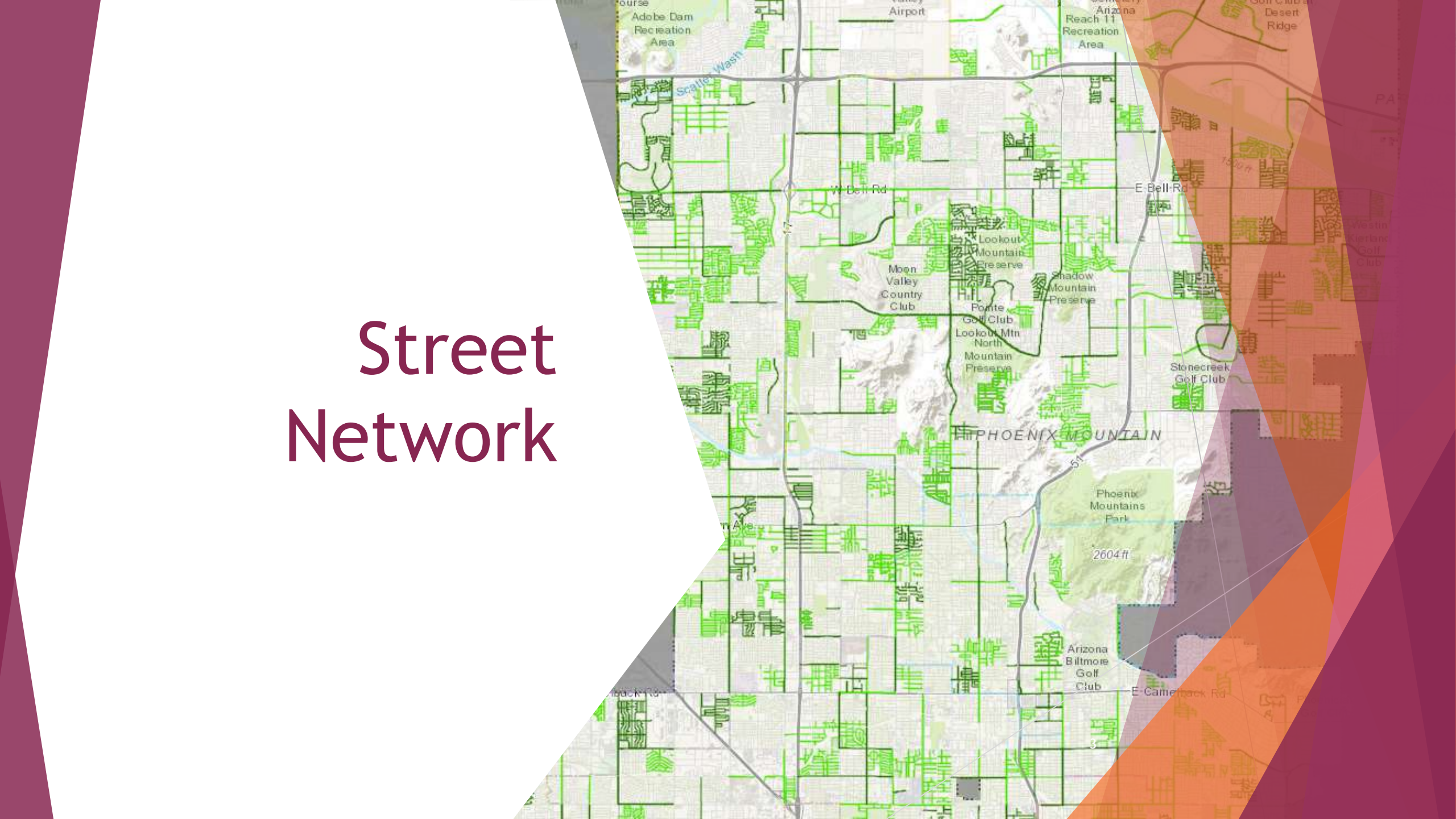
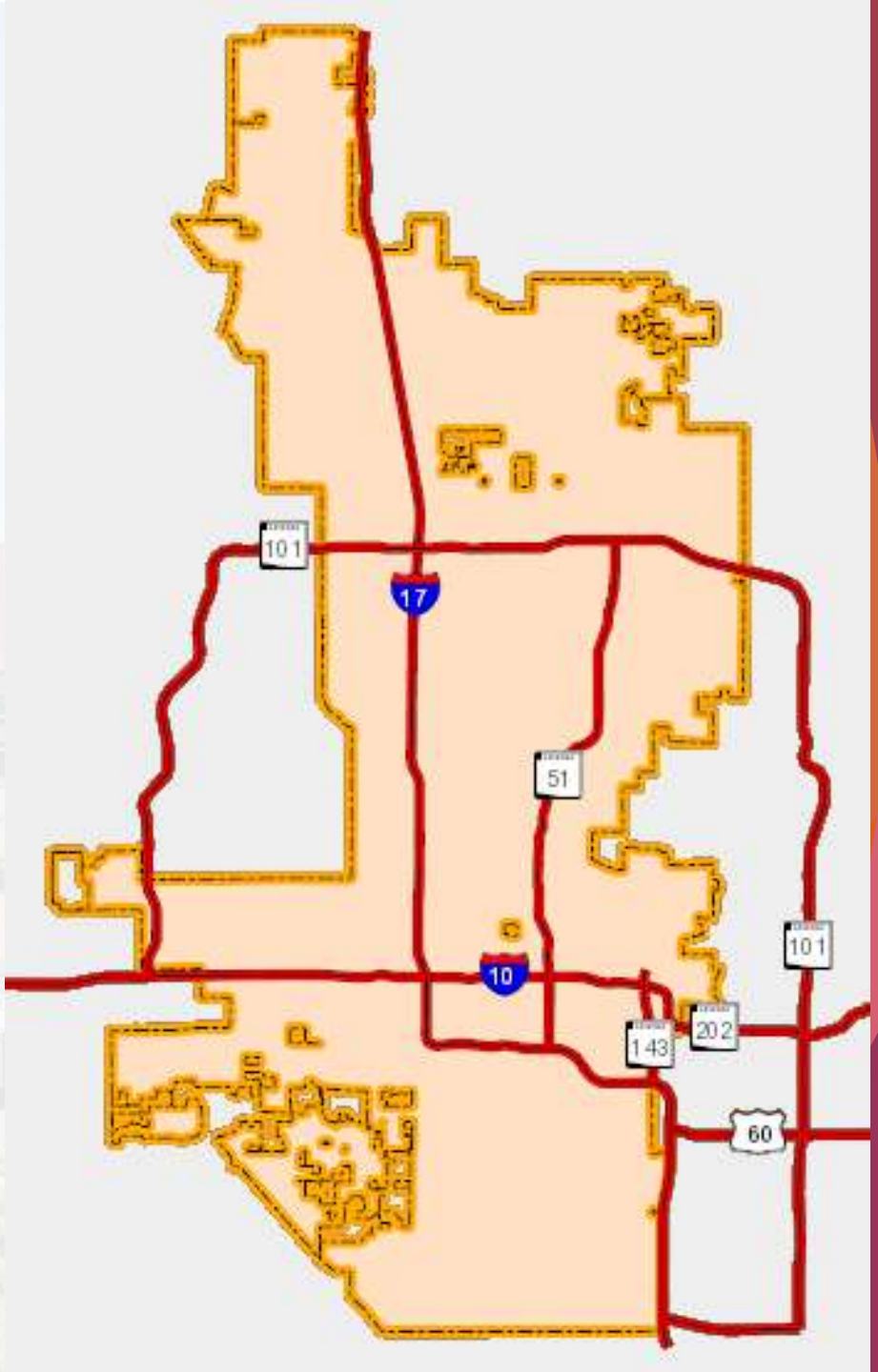
Outline

- City of Phoenix Street Network
- Cool Pavement Program
- Questions

Street Network



- 5th Largest City in the United States
- 1.6 Million residents
- 520 square mile land area
  - More than the top 3 Cities in the U.S. by population
    - New York City, Los Angeles, Chicago
- 8 Council districts



City of Phoenix Street Network

Arterial Street Network

- 900 centerline miles
- 14,900 Lane Miles
- Arterial and Major Collector
- 1-mile segments

Local Street Network

- 3,900 centerline miles
- 8,700 Lanes miles
- Residential, Industrial, Minor Collector
- Quarter Sections
  - ½ mile by ½ mile grid

PHOENIX'S PAVEMENT ISSUES

Challenges

- Aging network
- Limited Budgets

Goals

- Maintain network in best condition possible for as long as possible
- Cost effectiveness

Solutions

- ✓ Improve preservative toolbox
- ✓ Better performing paving technologies

Streets PHX
STREET TRANSPORTATION DEPARTMENT

PHOENIX COOL PAVEMENT PILOT PROJECT

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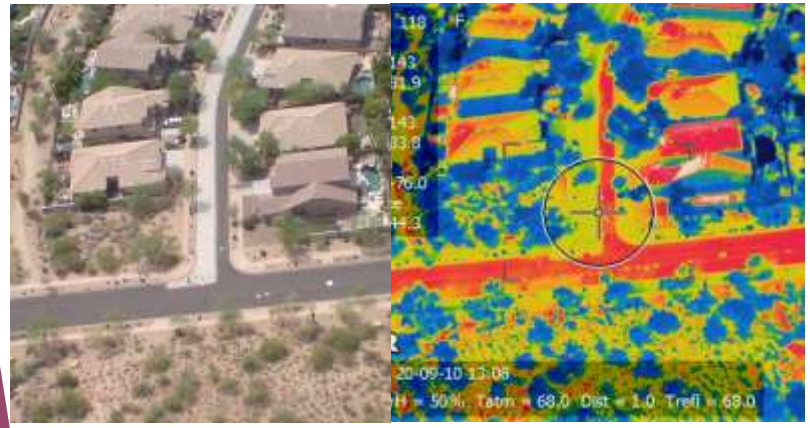
2020 Pilot Project

- Collaboration
- Why would Phoenix apply cool seal?
- Why is this a pilot project?
- What benefit does Phoenix expect?



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City of Phoenix
Office of Sustainability

ASU Arizona State University

CoolSeal by GuardTop

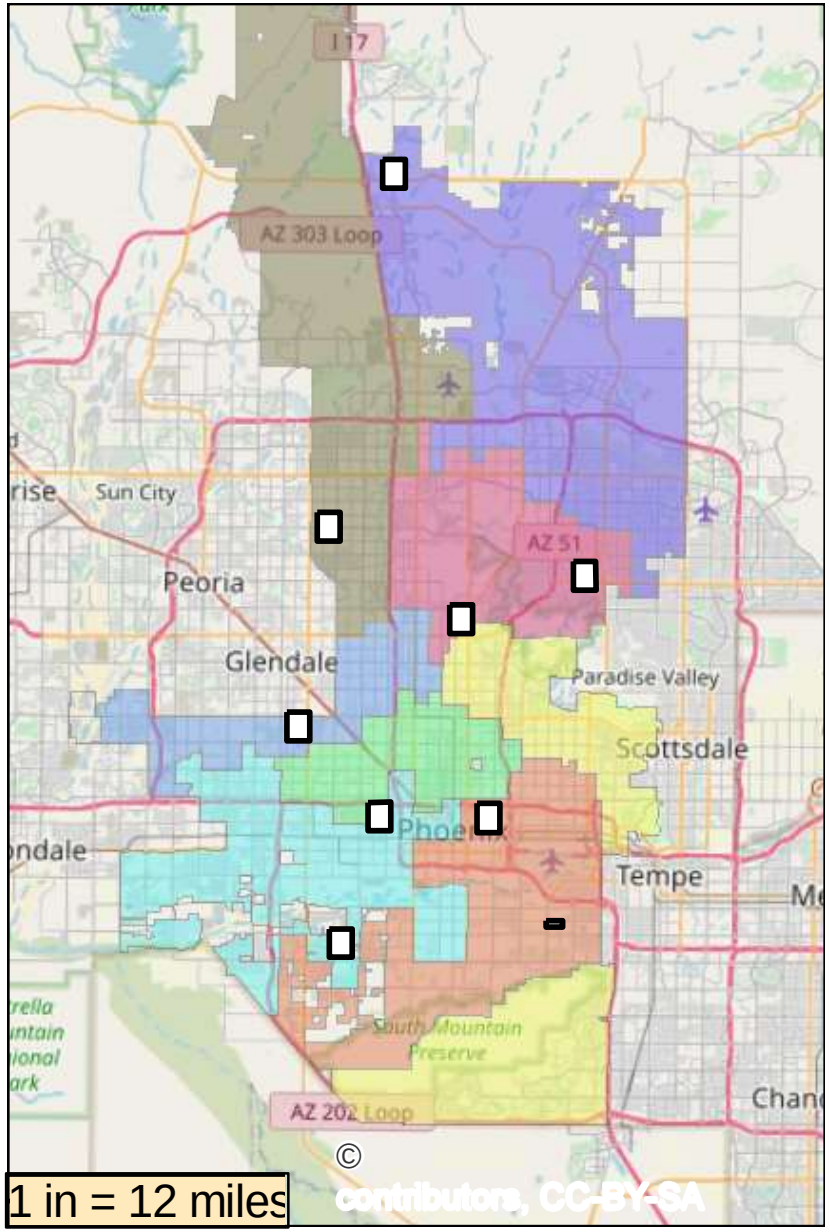
ViaSun corporation

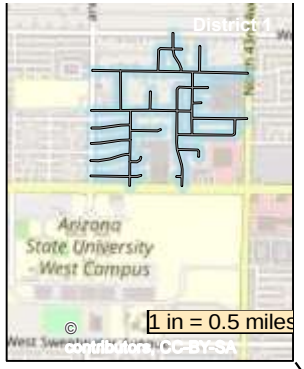
General Project Timeline

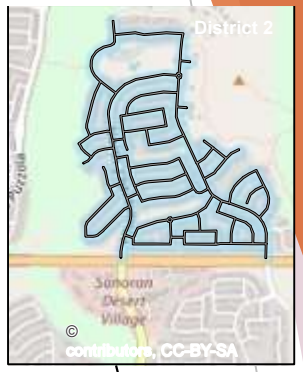
- October 2019 – Visit to City of LA to evaluate project outcomes
- November 2019 – Selected probable location for vetting by council districts
- April 2020 – Council Districts approve locations
- April 2020 – Contract procurement and Agreement with ASU for study, trial installation in a park.
- June 30, 2020 – Virtual public notification
- August to November 2020 – Installation
- September 2021 – Year 1 Study Results
- October 2021 – Phase 1b Installation
- May 2022 – ‘Phase 2’ Installations

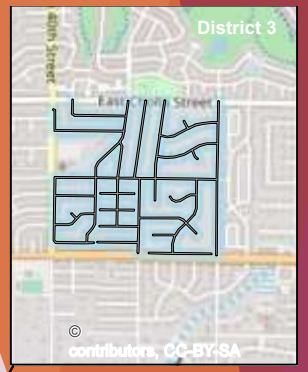
Project Location

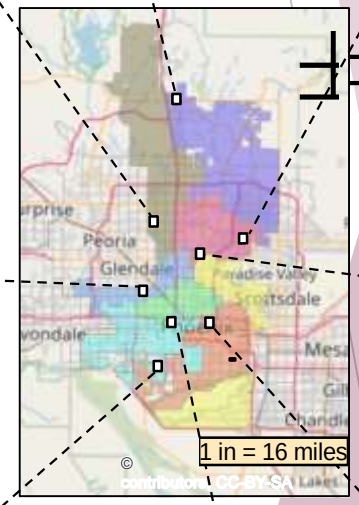
- Locations throughout the city
- One Council District
- 8 neighborhood locations and 1 park street/parking
- 36 miles (58km) of residential roads
- Selection based pavement condition
- Installed between August and November of 2020

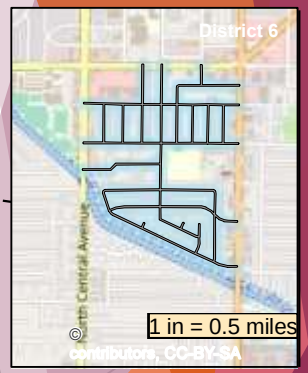


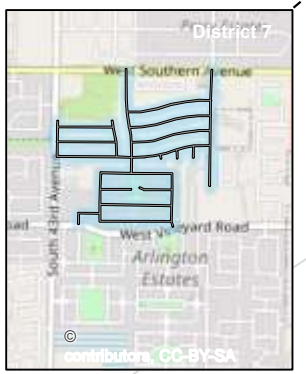












Product Used

CoolSeal by GuardTop used in LA

- Asphalt Seal Coat
  - Asphalt, water, emulsifiers, polymers
- Safe, non-toxic, suitable for typical activities on a road
- Light in Color,
- Enhances reflectivity
- Applied by spraying or with a squeegee
- Compatible with existing asphalt surfaces
- Durable like a regular seal coat, not paint.

Evolution of Application Process

Spray Application in Phoenix

Project Challenges and Mitigation

During Construction

Residents driving on wet material

Extra Police officers to enforce closures

Additional traffic control notification of resident and closure of Driveways

After Construction

Product getting dirty with tire marks

Monitor effectiveness as part of study

Cool Pavement Evaluation By ASU

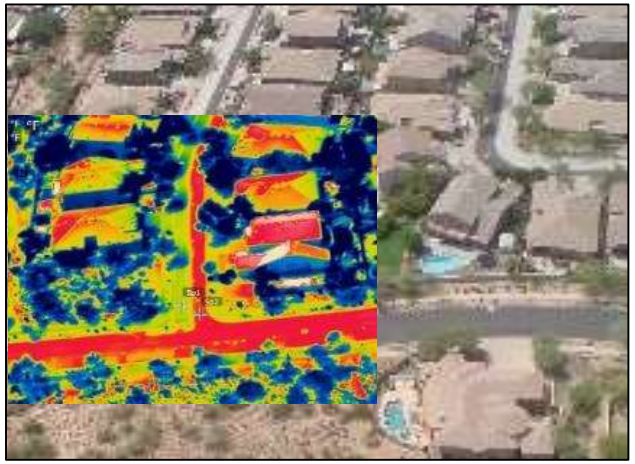
What is the impact of cool (highly reflective) pavement on urban heat?

Holistic assessment of “Cool Seal” in City of Phoenix residential neighborhoods

1. Air temperature & Surface Temperature:
Thermocouples / vehicle traverse

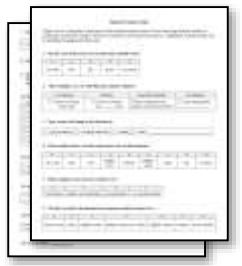
2. Mean Radiant Temperature:
MaRTy

3. Surface Temperature:
Helicopter overflight/thermal photography



4. Subsurface Temperature:
iButtons

5. Reflectivity:
Spectrometer



6. Neighborhood Survey:
Residents’ perceptions

Phoenix neighborhood, half-coated with CoolSeal
September 10, 2020, 13:08 h
Air temperature: 32°C
Difference in surface temperature: ~7.5°C

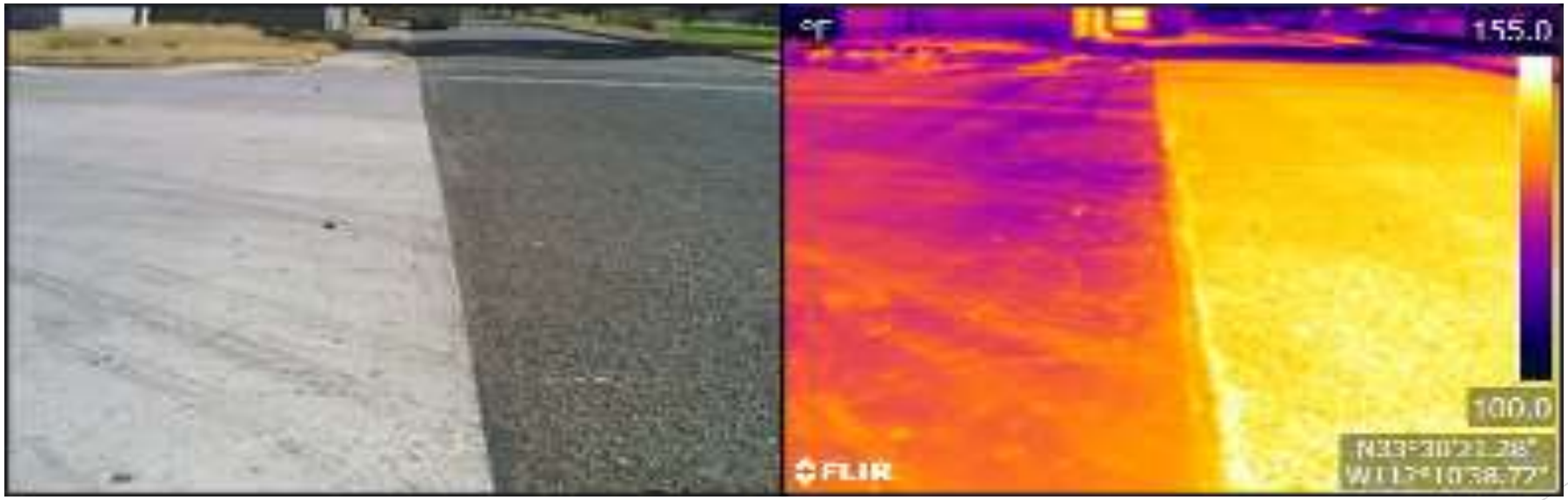
Urban Climate Research Center
Arizona State University

Results

Results: Surface Temperature

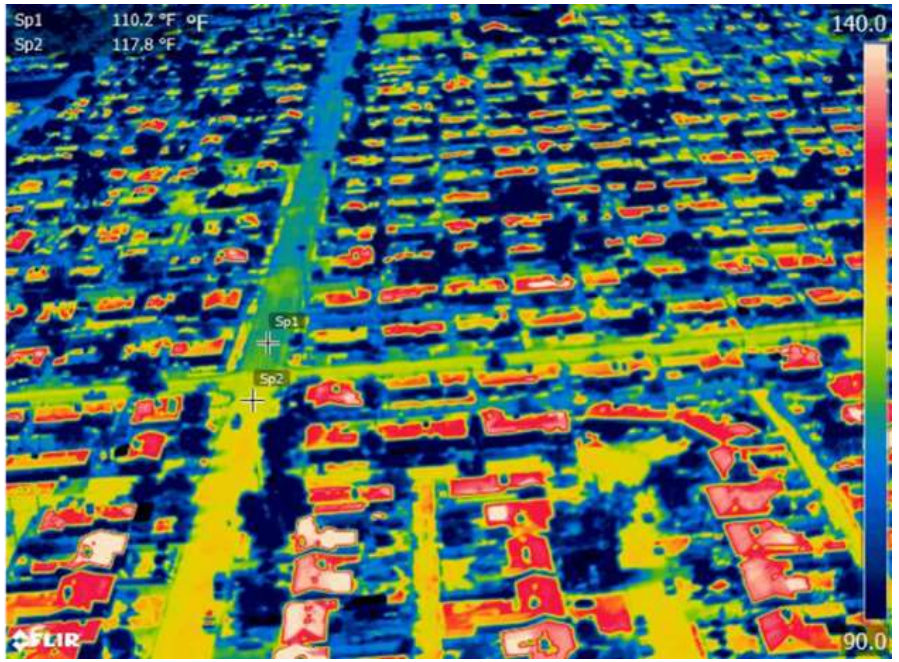
Surface Temperature
On average, CP was cooler than asphalt concrete by:

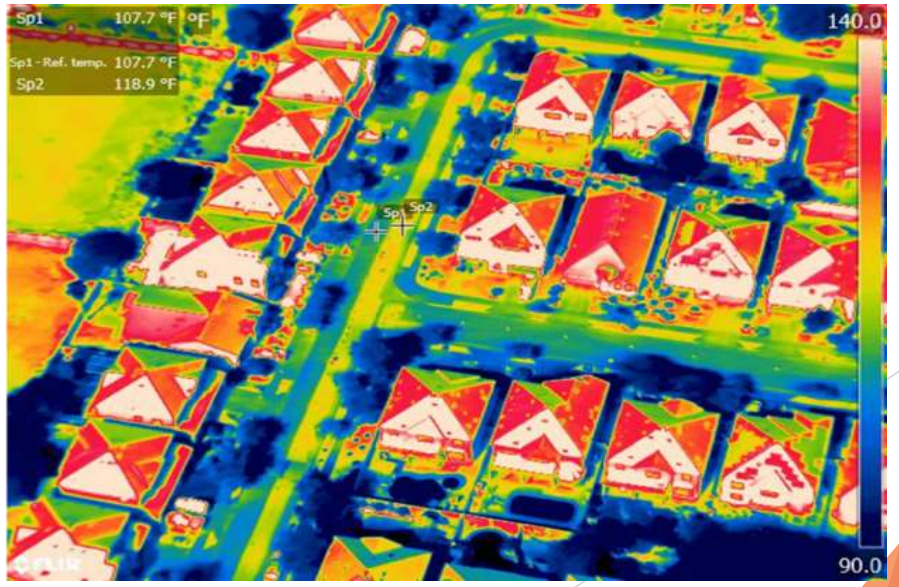
- **12.0°F** and **10.5°F** at noon and afternoon hours (range: 9–16°F lower)
- **2.4°F** lower at sunrise (range: 1.6–3.0°F lower)
- **4.8°F** lower after sunset (range: 3.8–5.7°F lower)



Side-by-side visible and infrared images of a junction between Cool Pavement and untreated asphalt concrete, taken Sept. 9, 2020 at 1:30pm.

Helicopter Overflights





Urban Climate Research Center
Arizona State University

Results: Air Temperature

- lower above the CP than the non-treated surface in the evening by approximately **0.5°F** (ranging from 0.9°F lower to 0.1°F higher)

- daytime differences averaged **0.3°F** lower above the CP (ranging from 1.2°F lower to 0.2°F higher).

  - Small neighborhoods
  - **Mixing of air**
  - Shading variability
  - Vegetation patterns
  - Watering lawns
  - Lawns versus xeriscape
  - Other factors…

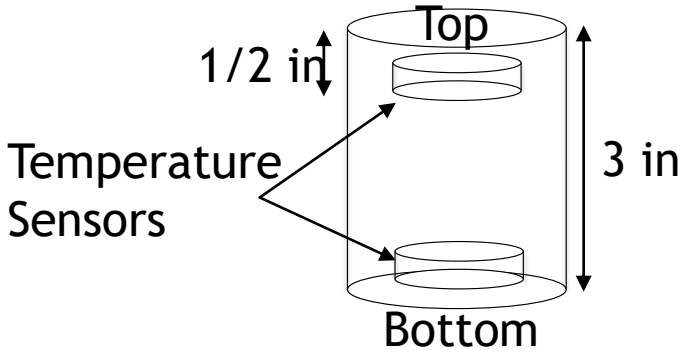
Results: Mean Radiant Temperature (MRT)

- Human's total radiant heat exposure walking on the surfaces
- CP MRTs were **higher** than the traditional asphalt concrete at noon and afternoon hours by ~**5.5°F**, on average (ranging from **2.6 to 9.2**°F higher) due to higher surface reflectivity.
- Lower at sunrise and sunset (~**0.5°F** lower)
- Similar to that experienced if walking over a concrete road
- Higher values may be a necessary tradeoff to reduce surface temperatures using a reflective surface

Results: Subsurface Temperatures & Preliminary Performance Tests

Subsurface Temperatures

- **5.1°F** reduction in top temperature compared to control
- **4.6°F** reduction in bottom temperature compared to control
- Temperature differential between the top and bottom is on average 2.1°F lower beneath cool seal pavements
- potential reduction in thermal stresses



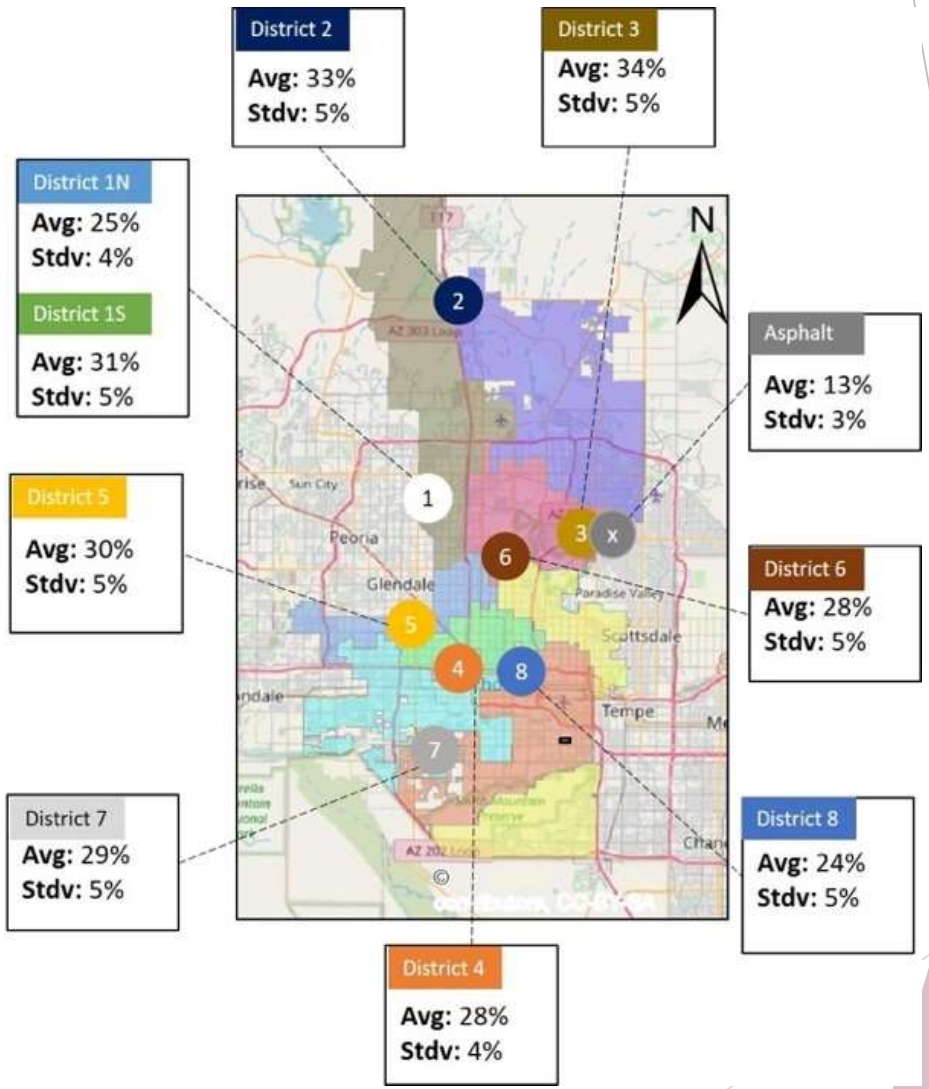
Preliminary Performance

- CP has a higher specific heat capacity than asphalt concrete*
- CP is significantly less conductive than conventional asphalt concrete
- Bond strength test shows significant less bonding strength of the CoolSeal compared to conventional asphalt binders, with an average strength of 34 psi compared to 230 to 276 psi.

**Since the CP layer is very thin compared to the typical asphalt concrete layer, the higher heat capacity will have minimal impact.*

Results: Surface Reflectivity – Nov–May

- **33–38%** reflectivity when installed; declined over time
- ranged from **19–30%** across the eight neighborhoods 10 months after installation
- Control: untreated asphalt concrete surface had a consistent reflectivity of **12%**



Results: Resident Survey

- **Satisfaction** with communication from the City about the CP pilot program and **interest** in learning more
- **Divergent opinions** expressed among residents concerning visual appeal and aesthetics, impacts on property values, the longevity of the coating, and surface friction.
- **Collectively, the interview and preliminary survey results point to opportunities for additional resident engagement and education concerning CP.**

Visual appeal and aesthetics:

Positive Comments:

"If the pavement lasts, it will bring value to the neighborhood."
"Makes the neighborhood look nicer and thinks that it is a point of interest for home buyers."
"People have not said much in the way of negative comments. The glaring effect is not as big of an issue."

Negative Comments:

"At first it was very glaring it had a lot of tire marks, but the glaring effect has toned down."
"I've tried to avoid the streets that have the pavement because it is blinding."
"Tire tracks and oil tend to show up more, and that looks bad over time."
"Tire marks and oil stains are obvious."

Summary

- Holistic assessment of numerous physical and social indicators of pavement at various timescales provides critical insight for future work, as well as useful information for the City of Phoenix and cities globally with similar goals.

- **Opportunities:**
  - Longer-term performance testing
  - Additional resident engagement and education
  - High-end air temperature tests
  - New types or colors of CP
  - **Optimal location selection***

- *Open lots, not shaded* ☑
- *Low-rise residential*

- *Not in playgrounds or parks*
- *Not in places people would spend time midday*
- *Not in already-shaded locations*
- *Not in high-rise downtown areas*

Phase 2

- CoolSeal Phoenix Gray
- 5M sf planned began May 1st

- Additional product trials of
  - SolarPave by SealMaster (this week)
  - Durashield by GAF (next week)