



Sydney CoolSeal Trial Outcomes

Summary of Western Sydney University Report

July 2021

Western Sydney University Report

Highlights

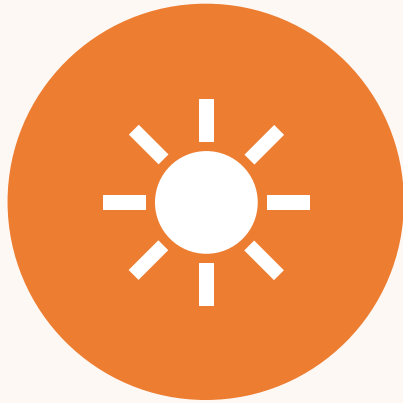
- The longest, field-based environmental monitoring program of such a product in Australia. The monitoring program was designed to document cooling benefits of a reflective surface coat beyond reduced surface temperatures.
- It was found that CoolSeal is a viable option to help mitigate the UHIE in Western Sydney addressing the contribution of pavements to local heat.
- **Increasing albedo of roads and carparks will help reduce surface Urban Heat Island Effects due to lower surface temperatures.**
- **Evidence that CoolSeal positively influenced site microclimate.**
- The Cool Roads Trial collected unequivocal evidence that application of a highly reflective surface coat to roads and carparks in Western Sydney reduced surface temperatures. Maximum surface temperature reductions on unshaded roads and carparks were up to 11.5°C.
- **The Cool Roads Trial assessed microclimatic effects. Applying these technologies at larger scales might produce more uniform cooling outcomes and modelling studies have indicated this is the case**

The Problem

- Increasing heat is recognised as the largest risk to local populations and economies. Mitigating the negative impacts of heat is essential.
- Stories of melting roads have become a staple of the local news in Sydney's west in recent years as high temperatures raised mortality. As the volume of hard surface increases (roads), so does the temperature.
- Without adapting the built environment, some places are going to be too hot to live in. That's coming sooner than we know.

The Solution:

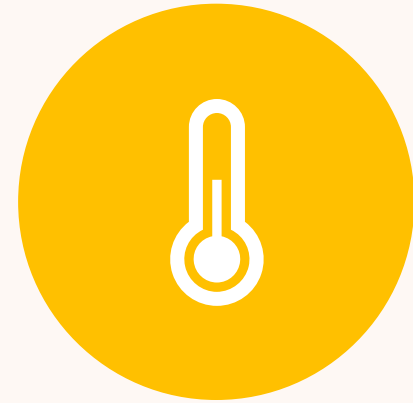
“CoolSeal is a viable option to help mitigate the Urban Heat in Western Sydney and beyond”



COOL ROADS ADDRESSES THE CONTRIBUTION OF UNSHADED ROAD AND CARPARK SURFACES TO LOCAL HEAT ISLAND EFFECTS. COOLSEAL ADDRESSES THE CONTRIBUTION OF PAVEMENTS TO LOCAL HEAT.



THE COOL ROADS TRIAL ESTABLISHED IMPORTANT INFORMATION FOR THE MANAGEMENT OF HEAT IN WESTERN SYDNEY AND BEYOND.

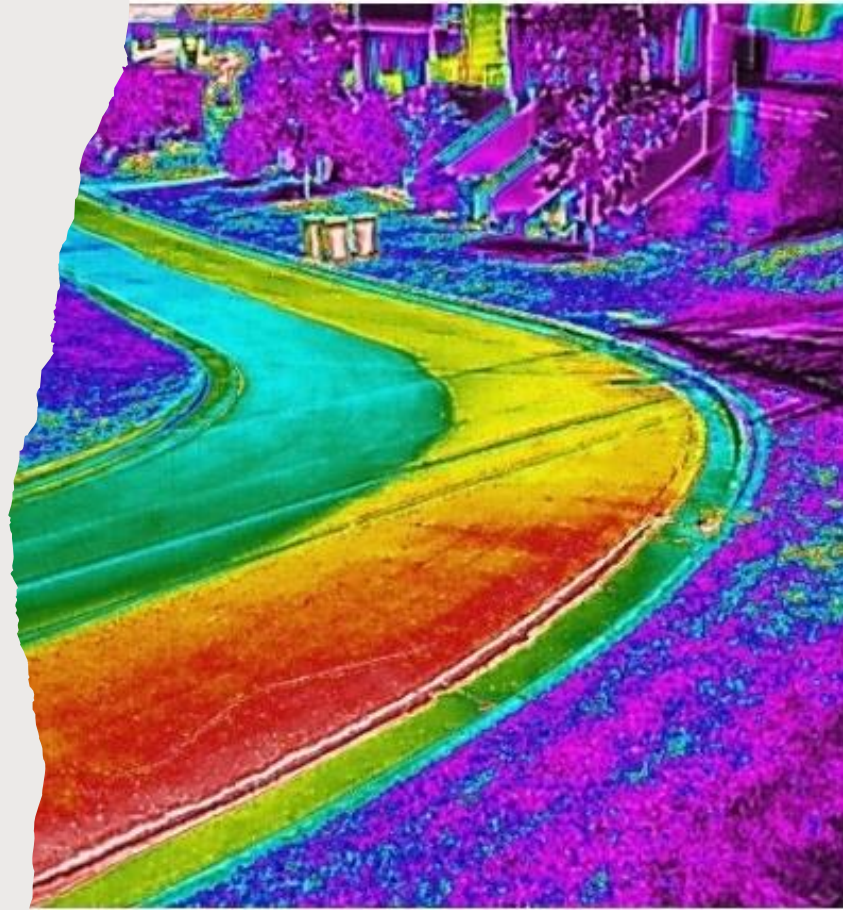


INCREASING ALBEDO OF ROADS AND CARPARKS WILL HELP REDUCE SURFACE URBAN HEAT ISLAND EFFECTS DUE TO LOWER SURFACE TEMPERATURES.

What was used in the trial?

INFRARED THERMOGRAPHY

- The effect of CoolSeal on surface temperature was quantified using radiometric infrared cameras and radiometers.
- Ground-based infrared images were collected at all sites before and after the application of CoolSeal, resulting in more than 700 images.



This residential street in Parramatta is covered with CoolSeal, which reflects solar radiation, keeping it at least 10C cooler than the uncoated section on a normal summer's day.

Pfautsch

Results showed highly significant benefits of CoolSeal

After the application of CoolSeal, **highly significant differences were observed between coated and uncoated sites** ($p<0.001$). These differences were the result of lower surface temperatures in the sun at sites coated with CoolSeal.

CoolSeal did not add cooling benefits when surfaces were shaded. CoolSeal made the unshaded roads the same temperature as the shaded areas.

TABLE 3: Mean surface temperatures of unshaded and shaded road surfaces before and after they were coated with CoolSeal. Uncoated core sites were Raymond Avenue, Mackey Circuit and the staff carpark at the HJ Daley Library in Campbelltown, coated core sites were Roslyn Avenue, Kobe Street and the public carpark at the HJ Daley Library in Campbelltown. A total of 180 individual surface temperature measurements were used to calculate these means. ‘Before’ data was collected between 24 February and 18 March 2020. ‘After’ data was collected between 19 March 2020 and 12 January 2021. All measurements were extracted from radiometric infrared images.

TIME INTERVAL	TREATMENT	SITE TYPE	SURFACE TEMPERATURE IN SUNLIGHT (°C)	SURFACE TEMPERATURE IN SHADE (°C)	SURFACE TEMPERATURE REDUCTION FROM SHADING (°C)
Before application of CoolSeal	uncoated	core	53.9	34.0	-19.9
	coated	core	52.5	34.1	-18.4
After application of CoolSeal	uncoated	core	42.6	23.1	-19.5
	coated	core	35.2	21.6	-13.5

Predicting Surface Temperature Decreases due to CoolSeal

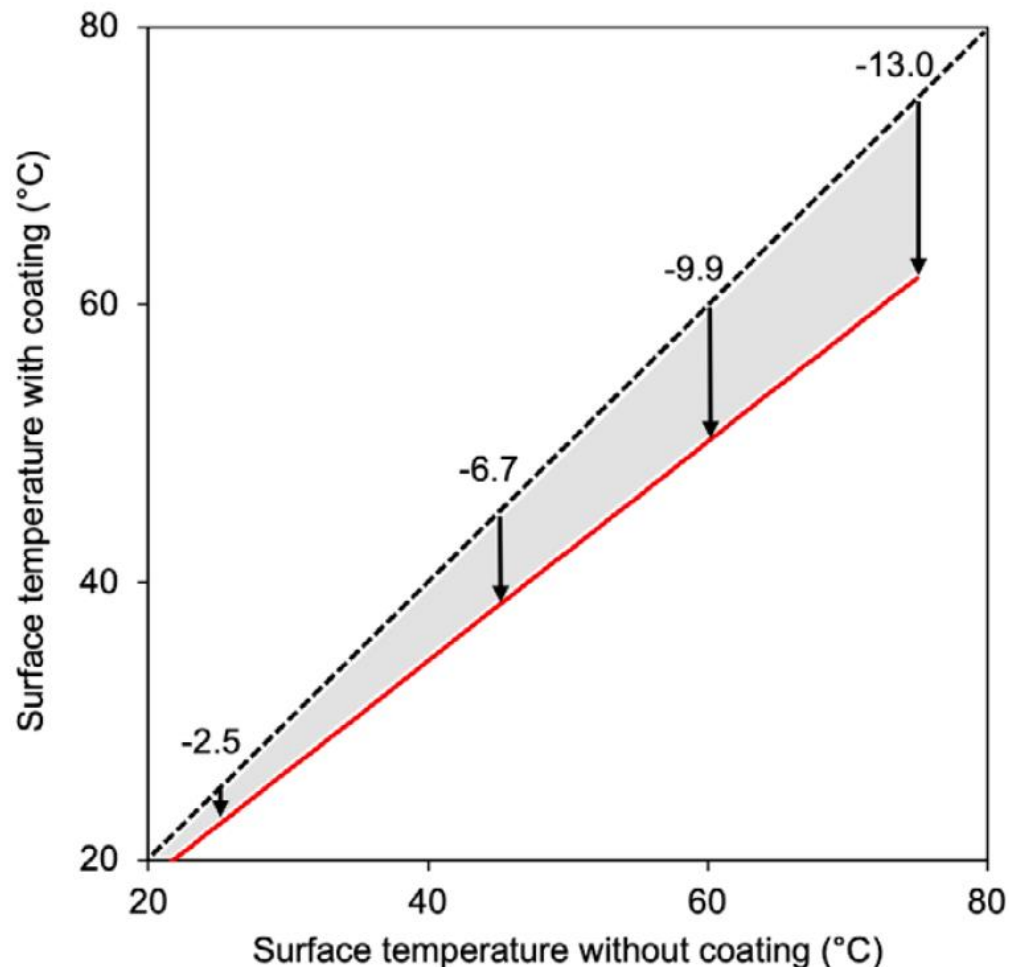


FIGURE 9: Predicted surface cooling benefits from CoolSeal at increasing surface temperatures. Temperature reductions are shown for coated surfaces when uncoated surfaces are 25, 45, 60 and 75°C hot. The dashed black line indicates the 1:1 line; the solid red line shows the linear relationship between the two parameters based on data shown in Figure 8. Here we show a truncated relationship covering a range of 55°C (20-75°C). The linear relationship was established using 450 individual measurements of surface temperatures.

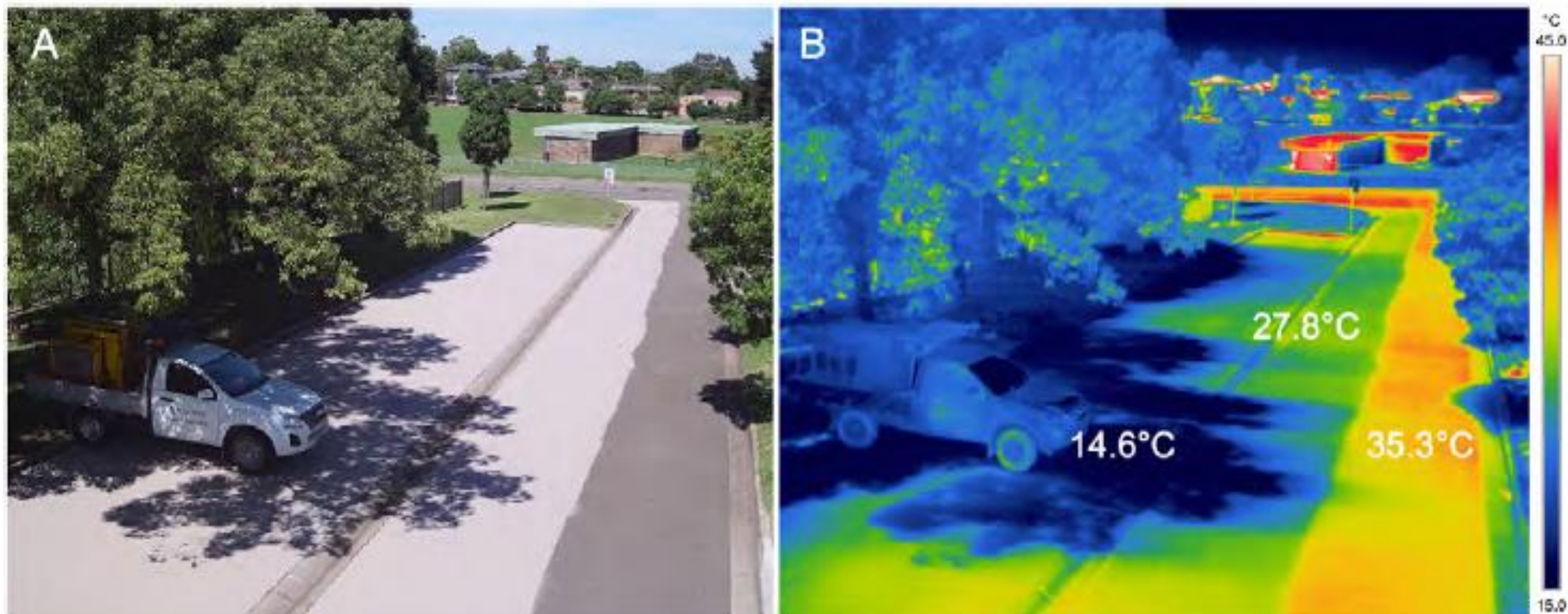


FIGURE 11: Effect of CoolSeal on surface temperature during a sunny afternoon at Corry Court, North Parramatta, Parramatta LGA. The image was taken at 12:40 on 19 March 2020 when air temperature was 31°C. At that time, only half of the road surface was coated, allowing a side-by-side comparison of resulting surface temperatures. Panel A shows the normal view, panel B shows the infrared view where different colours represent different surface temperatures (see scale on right side).

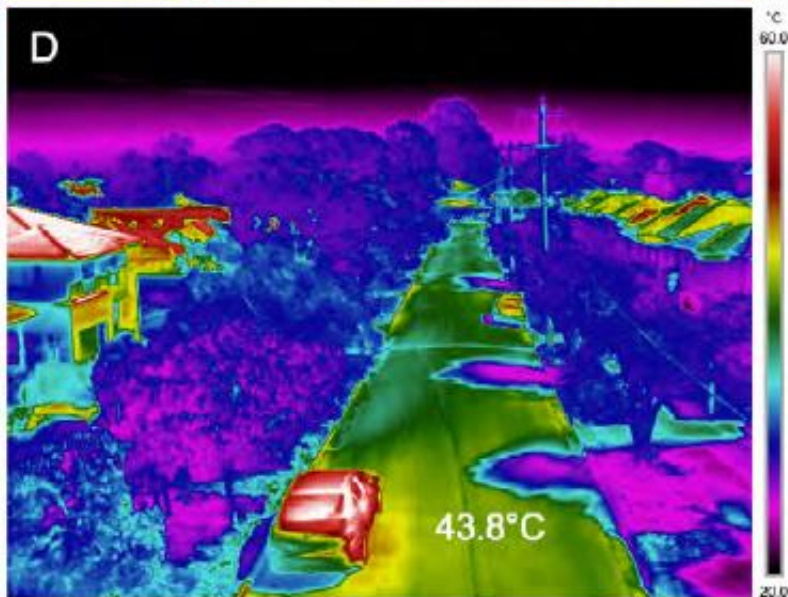
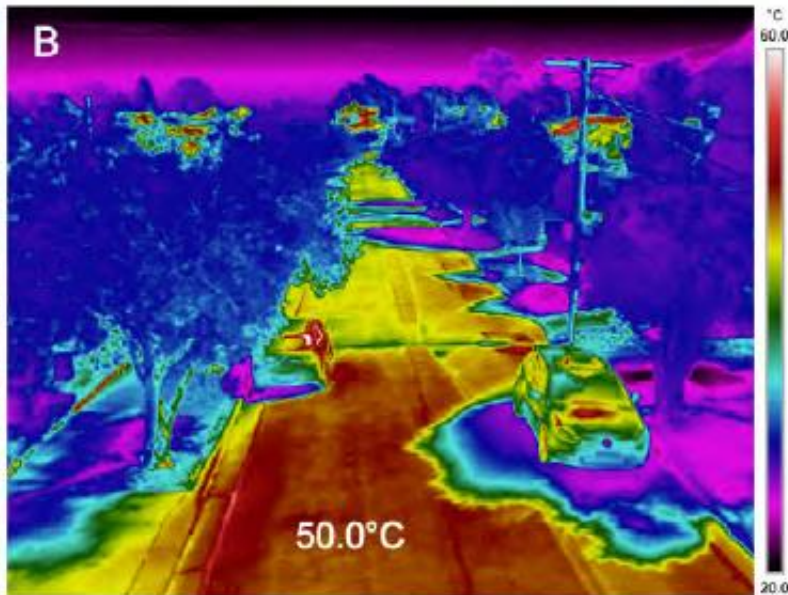


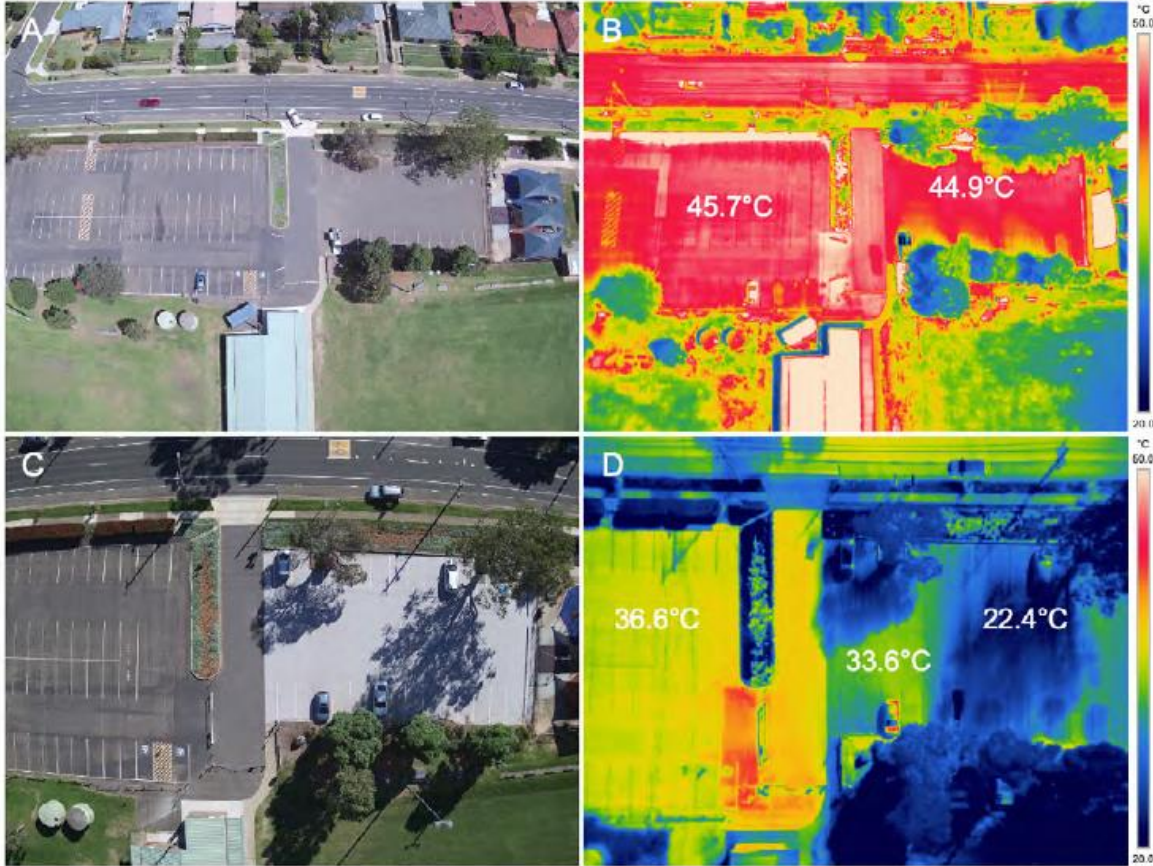
FIGURE 13: High-definition infrared image of Raymond Avenue (A, B; unpaved street) and Roslyn Avenue (C, D; paved street) in Northmead, Parramatta LGA. The images were taken under clear sky on 19 March 2020. Air temperature in Raymond Avenue and Roslyn Avenue was 34°C. Surface temperature of the paved road was about 6°C cooler compared to the unpaved road. Panels A and C show normal views, panels B and D show infrared views where different colours represent different surface temperatures (see scale on right side).



FIGURE 14: Surface temperature during overcast conditions. The images were taken on 2 December 2020 at Mackey Circuit (A, B) and Kobe Street (C, D) in Ropes Crossing, Blacktown LGA. Panels A and C show normal views, panels B and D show infrared views where different colours represent different surface temperatures (see scale on right side).

- In late February 2020, the uncoated surface of a cul-de-sac in Ropes Crossing (Burnette Court) had a temperature of around **57°C**. On that day, ambient air temperature was 31°C and the sky was clear. A couple of weeks later, air temperatures were even higher with 35°C. In the meantime, the road surface had been coated and although it was a hotter day, surface temperatures were below **47°C**.

Evidence that CoolSeal positively influenced site microclimate.



- A graphic example of the **magnitude of surface cooling by CoolSeal** and tree shade was documented in the carpark at Binalong Park (Fig. 15).
- Prior to the application of the CoolSeal, both sections of the carpark were displaying similar surface temperatures during clear, sunny summer days (Fig. 15 A, B).
- Shade provided by trees in the top right section of the carpark reduced surface temperatures from 45°C to 30°C.
- The magnitude of that cooling effect remained the same once CoolSeal was applied, reducing the carpark surface temperature from 37°C (uncoated) to 22°C (coated and shaded) (Fig.15 C, D).
- At the carparks in Campbelltown significant differences in mean daily air temperatures were detected for all effects, providing evidence that the application of CoolSeal had influenced site microclimate.

AIR COOLING BENEFITS

- Mean daytime air temperature at Roslyn Avenue was 1°C cooler compared to the nearby uncoated Raymond Avenue.
- Mean night-time air temperature at Roslyn Avenue was also 0.3°C cooler compared to Raymond Avenue.
- Especially during warm nights, this cooling benefit of coated residential streets seemed apparent at all monitoring sites.

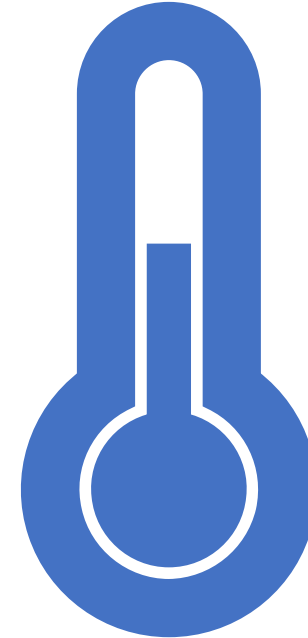


SUPPLEMENTARY IMAGE 2: Cool Roads Trial site at Renoir Street, Old Toongabbie. Image was taken on 15 April 2021. © Nearmap.

Report Recommendations

SURFACE COOLING BENEFITS

- The Cool Roads Trial collected unequivocal evidence that application of a highly reflective surface coat to roads and carparks in Western Sydney reduced surface temperatures.
- Maximum surface temperature reductions on unshaded roads and carparks were up to 11.5°C. It was evident that the hotter surfaces became in the sun, the greater were the surface temperature reductions provided by CoolSeal. Moreover, surface cooling benefits were not only apparent during sunny days but were also detected during overcast conditions. CoolSeal also lowered surface temperatures by 1°C-2°C during the night.
- These results clearly document the effectiveness of the tested product to reduce surface temperatures of roads and carparks under a range of environmental conditions and different local climate zones.
- The Cool Roads Trial assessed microclimatic effects. **Applying these technologies at larger scales might produce more uniform cooling outcomes and modelling studies have indicated this is the case** (e.g., Mohegh et al. 2017).





Some of the References used within the Report.

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