Local Government Association of South Australia

City of Charles Sturt

COOLING ROADS IN HENDON

An assessment of the 2019 CoolSeal trial



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1. What is the urban heat island effect?

Urban heat islands are areas of land that retain more heat than other parts of the landscape. They can be caused where land surfaces like asphalt roads, dark colored pavements and roofs, and artificial turf result in higher surface temperatures. In contrast, trees, irrigated grass and light colored roofs tend to have lower surface temperatures.

Urban heat islands are a key concern for Local Government because extreme heat leads to greater mortality and disease in our community than any other natural hazard. This is especially so for vulnerable members of the community.

In 2017, the Western Adelaide Heat Mapping Study identified urban heat islands as well as the types of materials that contribute to higher surface temperatures. The results highlighted that asphalt roads contribute greatly to heat islands across the region. They are one of the hottest land surface types during the day and also retain this heat into the evening.

Reducing the build-up of heat on roads can help to encourage their use for cycling, reduce heat loads on cars and properties and contribute to cooler neighbourhoods. While trees offer shade and are often an option for cooling the road surface, they are not always practical in verges and along road sides where there is a narrow carriage way, low hanging powerlines or where there are water, gas, electricity and telecommunications services in the footpath. Furthermore, new established trees can take 2-3 decades to deliver the full benefit of shading.



2. What is CoolSeal and how is it applied?

A different approach to reducing road surface temperatures is to change the road surface. Understanding the growing challenges posed by urban heat build-up, the City of Charles Sturt undertook a trial application of a “CoolSeal” treatment to selected roads in the suburb of Hendon.

CoolSeal is an asphalt sealcoat that is manufactured by USA based GuardTop® and designed to reduce surface temperatures through its lighter color and higher reflectivity by 5.5 to 16.7 °C (10 to 30 °F).

CoolSeal is applied like conventional sealcoats to asphalt surfaces to protect and maintain the quality and longevity of the surface. Compared with other cool pavements that are polymer based, CoolSeal is a water-based, asphalt emulsion. CoolSeal is marketed as also achieving other benefits such as increasing night-time visibility and reducing lighting requirements which saves on energy.

CoolSeal was imported under licence to Australian based company SuperSealing, who was engaged by the City of Charles Sturt to apply the treatment. This was done in two applications: the first was between 19 and 21 January 2019 and the second between 11 and 30 March 2019.

3. How was the community engaged?

Due to the expected change in the look of the road once CoolSeal was applied engagement with business owners in the Hendon Business Precinct and adjacent local residents was undertaken prior to its application. This involved a community meeting on site in Gordon Street Reserve and a letter box drop. Signage was also placed in residential streets to explain the purpose of the trial. The community and business response was generally positive with no significant concerns raised in relation to the Cool Seal application.

After the treatment was applied, residents who live in the study area were invited to participate in voluntary face-to-face surveys to share their views on the new surface. Surveys were undertaken 6 to 9 weeks after the CoolSeal was applied with a small number of participants aged between 25-65+ years.

The majority of respondents provided positive feedback about the trial. Key findings from the survey were that:

- 86% of respondents said that the road surface looked cooler;
- 57% perceived it to be cooler;
- 43% feel it is more comfortable to walk along compared to a street without Cool Seal;

[1] https://guardtop.com/coolseal

- 67% of respondents believed that the CoolSeal had visually improved the street.

70% of residents who responded to the survey said that Council should consider applying CoolSeal in other areas subject to the findings of the cooling assessment and effectiveness of CoolSeal compared to other options such as planting more trees.

4. What was the impact of the road treatment?

How was the impact of CoolSeal assessed?

Temperature and heat in the city can be measured in a range of ways. To understand how CoolSeal might have helped with cooling in Hendon, land surface temperature, air temperature and thermal comfort were assessed. Of these, thermal comfort provides the most comprehensive understanding of heat impacts on people and combines air temperature, relative humidity, wind speed and solar radiation. It is often described as the "feels like" temperature.

Measurements were taken before and after CoolSeal was applied to the roads in Hendon and on treated and untreated roads. This was done to understand whether the cooling impact could be directly linked to the CoolSeal application. Data was also collected under the canopy of trees to help understand whether tree shade or CoolSeal was better at cooling.

Surface temperatures from before the treatment were taken from urban heat island data collected in 2017, whereas air temperature and thermal comfort data were recorded on 5 December 2018. All data collected from after the treatment were recorded on 24 February 2019.

Surface temperature was assessed over 9,152 m^2 of roads after the application of CoolSeal using a thermal camera mounted on an industrial octocopter UAV (drone) platform operated by a licenced pilot. This produced 55,000 measurements of surface temperature from treated roads and 128,020 measurements of untreated roads. All air temperature and thermal comfort data were collected using mobile weather stations.

What was the impact of the CoolSeal on heat?

Surface temperature

Treated roads were, on average, 6.1°C cooler than un-treated roads. This can be directly attributable to CoolSeal. The average measured cooling influence for the entire treated area was therefore on the low end of the advertised range for the product which is 5.5 °C to 16.7 °C. Some spot measurements of surface temperature using a hand held infrared red gun did find some temperature reductions to be at the upper end of this range. The difference in spot measurements compared with average could be due to underlying surface materials contributing to additional heat retention or if the surface has been exposed to differing levels of shade leading into the time that data was collected.



In the 2017 Western Adelaide Heat Mapping Study asphalt roads measured 3.0°C above the regional average temperature and were identified as a "hot spot" surface. Therefore, in a broader heat island context, the 6.1 °C cooling provided by the CoolSeal treatment should be capable of transforming the road surface from a heating source into a cooling surface. This is important for the Hendon precinct, which was shown in the 2017 study to have several large heat islands.

Air temperature and thermal comfort

Although some cooling of air temperatures over the CoolSeal area was measured, due to the variability of results across sites, it was not possible to directly attribute the air temperature reduction to the CoolSeal application for this assessment. The variability in the results is most likely to have been caused by wind mixing the air column adjacent to the weather stations. Reassessing air temperature under still conditions is likely to provide clearer results.

[2] Zitera, C.D., Pedersenb, E.J., Kucharikc, C.J. and Turnera, M.G. (2018). Scale-dependent interactions between tree canopy cover and impervious surfaces reduce daytime urban heat during summer. Proceedings of the National Academy of Sciences of the United States of America. 116 (15) 7575-7580. www.pnas.org/cgi/doi/10.1073/pnas.1817561116.

As for air temperature, the differences in thermal comfort could not be directly attributed to CoolSeal and was most likely due to the conditions on the day of data collection. However, the thermal comfort results confirm the effectiveness of trees in reducing the experience of heat, with the "feels like" temperature being 10°C lower under trees compared to exposed road surfaces. In addition, comparing air temperature data with and without trees suggests that trees provide a cooling influence of 1.3°C and are more effective at reducing heat than the CoolSeal.

A recent study from the USA (Ziter et al. 2019[2]) found that while tree canopy can reduce temperatures during the day, impervious surfaces like roads contribute much more to night time urban heat islands. This is supported by the 2017 Western Adelaide Heat Mapping Study results. Conducting this assessment again at night would help to better understand whether the CoolSeal is more effective at reducing air temperature and thermal comfort during the night.

Key messages

- CoolSeal reduces the average surface temperature of the road but at the lower end of its advertised range.
- Surface temperature reductions are likely to be enough to mitigate hot spots and urban heat islands caused by asphalt roads.
- Trees proved to be better overall at reducing surface and temperature and improving thermal comfort, however, CoolSeal may provide an important alternative in areas where trees cannot be planted or where canopy will take a long time to develop.

5. Cost comparison for seal coat road surface preservation treatment

The traditional approach to road seal preservation by the City of Charles Sturt is to use a polymer modified binder treatment. This is sprayed on the road surface using a truck mounted tank at an application rate of 1 litre per m^2. In contrast, CoolSeal is manually applied to the road surface using a truck mounted tank at an application rate of 1.5 – 1.7 litres per m^2. Due to its thicker application it takes longer to cure.

The standard life and cost range for both products is:

	Standard Seal Coat	Cool Seal Coat
Standard Life	5 - 7 years	7 - 10 years
Cost range	$\$6/m^2$ to $\$8/m^2$	$\$13/m^2$ to $\$15/m^2$

The unit rate of the cost range for both treatments is based on an area less than 10,000 square metres and includes initial road sweeping, surface priming, customer notification, line marking and standard traffic management. Not included in the unit rate are ad hoc maintenance costs such as reapplying the CoolSeal coat after road or utility repairs. The difference in unit cost is due to CoolSeal containing additional high-performance materials and a greater quantity of material per unit area, the importing costs and potentially its application being more labour intensive dependent on additional surface preparation that may be required for the treatment road surface based on its condition prior to priming.

However, the trial does indicate that the higher upfront project cost of applying the CoolSeal coat rather than a standard seal coat is likely to be offset by the benefits of a longer asset life. In addition, a cool road surface will assist in reducing urban heat islands, which the standard seal coat does not provide.

6. Applicability of results elsewhere

This trial of CoolSeal in Hendon produces strong evidence that CoolSeal can reduce the surface temperature of asphalt roads.

The observation from past urban heat island analyses in Western Adelaide, and Eastern and Northern Adelaide, that asphalt roads measure 3 to 4 °C above baseline temperature means that even at the lower end of its marketed surface temperature reduction range, CoolSeal could transform a road surface from a heating source into a cooling surface. While the benefits from daytime cooling compared with trees is not as great, further testing is needed to understand the night-time benefits.

The results from this study also suggest that given the change in the appearance of the road surface, small trial areas supported by strong community engagement before and after the application of the treatment are warranted.

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The City of Charles Sturt

COOLSEAL TRIAL

CoolSeal Road Treatment

THE PRODUCT

COOLSEAL IS AN ASPHALT SEAL COAT DESIGNED TO REDUCE ROAD SURFACE TEMPERATURE

THE TEST SITE

IT WAS APPLIED TO ROADS IN THE SUBURB OF HENDON IN SOUTH AUSTRALIA AS A TRIAL

DATA COLLECTION

1.9 KM OF ROADS SURVEYED FOR:

SURFACE TEMPERATURE
AIR TEMPERATURE
THERMAL COMFORT

OUTCOME

TREES ARE BETTER AT COOLING

BUT... COOLSEAL IS A GOOD ALTERNATIVE WHERE TREES CAN'T BE PLANTED

OR... WHILE TREES ARE MATURING

BENEFITS

REDUCES ROAD SURFACE TEMPERATURE
COULD INCREASE CYCLING AND WALKING
CONTRIBUTES TO COOLER NEIGHBOURHOODS

COST

COSTS MORE BUT LASTS LONGER (LIKELY TO BE COST NEUTRAL)



70% OF RESIDENTS SURVEYED SAID COOLSEAL SHOULD BE APPLIED IN OTHER AREAS

6+ DEGREE SURFACE TEMPERATURE REDUCTION