

SH73 CHIPSEAL NOISE TRIAL

Construction Monitoring

1 FEBRUARY 2022

PREPARED BY JOHN BULL

Seal designs and materials

The seal designs were completed by the North Canterbury maintenance contractor, Downer New Zealand.

All sections utilise the same Road Science emulsion binder (product code: 72/B130 K0, base binder: 130/150, % binder: 72).

The target binder application rates for each trial section are listed below. The actual application rates are listed in the QA documentation for the site.

Aggregate was sourced from the Isaacs quarry in Christchurch. Samples of each grade of aggregate were taken from the project stockpile located at Aylesbury corner.

Table 1 Target bitumen application rates.

| Section | Surface Type | Target application rate [litres/m ²] | | | 2 nd coat applied |
|---------------------|---------------------------|--|----------------------------|----------------------------|------------------------------|
| | | <i>Pre-spray</i> | <i>1st coat</i> | <i>2nd coat</i> | |
| 1 | Single coat grade 3 | 1.0 | 2.6 | - | n/a |
| <i>Intersection</i> | <i>Two-coat grade 3/5</i> | <i>0.5</i> | <i>1.1</i> | <i>1.1</i> | <i>After grade 3 applied</i> |
| 2 | Two-coat grade 3/5 | 0.5 | 1.1 | 1.1 | After grade 3 applied |
| 3 | Single-coat grade 2 | 1.0 | 2.7 | - | n/a |
| 4 | Racked-in grade 2/4 | 0.5 | 2.7 | - | n/a |
| 5 | Two-coat grade 2/4 | 0.5 | 1.2 | 1.2 | After grade 2 applied |
| 6 | Multi-coat grade 2/4/6 | - | 1.7 | 1.0 | After grade 4 applied |

Sealing operation

The physical works were performed by Downer and took place over three daytime shifts between 17 January and 19 January 2022.

Sealing began at the western end of the site and progressed east. All spraying and chipping tasks began at the western side of the section and progressed east.

The extents of each section are the same as originally planned (see Table 2). The intersection changed from a single-coat grade 3 to a two-coat grade 3/5 after discussions around its susceptibility to wear, although this area will not form part of any future surface noise investigations.

Table 2 As-built trial section extents.

| Section | Surface Type | Start [m] | End [m] | Length [m] |
|---------------------|---------------------------|---------------|---------------|------------|
| 1 | Single coat grade 3 | 15,317 | 15,880 | 563* |
| <i>Intersection</i> | <i>Two-coat grade 3/5</i> | <i>15,880</i> | <i>15,980</i> | <i>100</i> |
| 2 | Two-coat grade 3/5 | 15,980 | 16,250 | 270 |
| 3 | Single-coat grade 2 | 16,250 | 16,520 | 270 |
| 4 | Racked-in grade 2/4 | 16,520 | 16,790 | 270 |
| 5 | Two-coat grade 2/4 | 16,790 | 17,060 | 270 |
| 6 | Multi-coat grade 2/4/6 | 17,060 | 17,330 | 270 |

* Section 1 extends past the house and trees to the east and only approx. 250 metres of the section is expected to form part of future surface noise investigations.

Table 3 contains the start and end times of the sealing operation for each trial section. Full details of the timing of each construction task are included in Appendix A.

Table 3 Summary of trial section construction times.

| Shift no. | Date | Section | Lane / direction | Start time | End time |
|-----------|------------|---------------------|------------------------|---------------------------------------|--------------|
| 1 | 17/01/2022 | 6 | WB (increasing) | 1030h | 1245h |
| | | | EB (decreasing) | 1450h | 1620h |
| | | 5 | WB (increasing) | 1050h | 1245h |
| | | | EB (decreasing) | 1506h | 1620h |
| 2 | 18/01/2022 | 4 | WB (increasing) | 0845h | 1030h |
| | | | EB (decreasing) | 1054h | 1220h |
| | | 3 | WB (increasing) | 0914h | 1030h |
| | | | EB (decreasing) | 1127h | 1220h |
| | | 2 | WB (increasing) | 1330h | 1503h |
| | | | EB (decreasing) | 1643h | 1753h |
| | | <i>Intersection</i> | <i>WB (increasing)</i> | <i>1530h</i> | <i>1630h</i> |
| | | | <i>EB (decreasing)</i> | <i>completed as part of section 2</i> | |
| 3 | 19/01/2022 | 1 | WB (increasing) | 0850h | 1438h |
| | | | EB (decreasing) | 1243h | 1438h |

The spray truck used was the Secmair Edensprayer, which has a telescopic spray bar and individual nozzle control (on/off). The sprayer was able to spray the full lane width in one pass.

The roller used was a Caterpillar CW-16 11-wheel roller with an operating weight of 5,300 kg to 14,900 kg. The exact ballast weight used is not known.

Three chip trucks were used to spread the aggregate. Each truck was fitted with a manually operated roller-spreader unit. Two passes were required to apply the aggregate as the roller spreader units were not wide enough to complete the task in one pass. Sometimes the second pass was performed by a different truck and roller-spreader operator. There was noticeable variability in the aggregate spread rate both along and across a lane.

Figure 1 Secmair Edensprayer and Caterpillar CW-16 11-wheel roller.



Temporary traffic management

Traffic management was performed by one of the local Downer traffic management crews.

A static closure (stop/go, with a 30 km/h speed reduction) was put in place for each sealing shift. Traffic was moved between the lanes several times during the shift to allow sealing to take place and to relieve a newly sealed section if it was at risk of being damaged by the constrained traffic.

At the end of each sealing shift the road was opened to two-way traffic with a 50 km/h speed restriction. Following the first sealing shift the centreline cones were left in-place overnight; the cones were moved several times during the night to force the traffic to wander. No centreline cones were in-place following the second and third sealing shifts.

The 50 km/h speed restriction remained in-place until road sweeping and line marking could be performed (approximately one week after sealing).

The following table contains details of the temporary traffic management put in place during sealing and in the days shortly after the sealing operation.

Table 4 Temporary traffic management details.

| Shift no. | Date | Time | Details |
|---------------|---------------------------------|---------------|--|
| 1 | 17/01/2022 | 0900h | Static closure installed (stop-go, 30 km/h) between Rp 16,600 and Rp 17,400 (sections 5 & 6). Traffic on EB lane to allow WB lane to be sealed. |
| | | 1245h | Traffic moved to WB lane to allow section 5 & 6 (EB) to be sealed. |
| | | 1620h | Traffic moved to EB lane after new seal in WB lane begins to blacken. |
| | | 1715h* | Opened to traffic in both directions |
| | | 1730h | Speed increased to 50 km/h, centreline cones in-place. |
| | | 1730h – 0730h | Actively managed: centreline cones moved to force traffic to wander. |
| 2 | 18/01/2022 | 0730h | Static closure installed (stop-go, 30 km/h) between Rp 16,100 and Rp 16,900 (sections 3 & 4). Traffic on EB lane to allow WB lane to be sealed. 50 km/h elsewhere. |
| | | 1030h | Traffic moved to WB lane to allow section 3 & 4 (EB) to be sealed. |
| | | 1220h | Opened to traffic both directions |
| | | 1220h | Static closure moved to between Rp 15,800 and Rp 16,770 (section 2 and intersection). Traffic on both lanes while moving cones and signs. |
| | | 1320h | WB lane closed. |
| | | 1630h | Traffic moved to WB lane to allow section 2 and intersection (EB) to be sealed. |
| | | 1753h | Opened to traffic both directions. |
| | | 1830h | Speed increased to 50 km/h, centreline cones removed. |
| 1830h – 0700h | Not actively managed. | | |
| 3 | 19/01/2022 | 0700h | Static closure installed (stop-go, 30 km/h) between Rp 15,260 and Rp 16,100 (section 1 and intersection). Traffic on EB lane to allow WB lane to be sealed. 50 km/h elsewhere. |
| | | 1230h | WB lane opened to traffic (30 km/h) |
| | | 1345h | Traffic moved to EB lane after new seal in WB lane begins to blacken. |
| | | 1438h | Opened to traffic both directions. |
| | | 1530h | Speed increased to 50 km/h, centreline cones removed. |
| | | 1530h – 1700h | Traffic management crew on-site. |
| 1700h onwards | Not actively managed. (50 km/h) | | |
| - | 20/01/2022 | All day | 50 km/h |
| | | 1130h | Road swept between Rp 15,950 and Rp 17,330 (sections 2–6). |

| Shift no. | Date | Time | Details |
|-----------|------------|---------------|--|
| - | 21/01/2022 | All day | 50 km/h |
| | | 1230h – 1330h | Lane marking between Rp 15,950 and Rp 17,330 (sections 2–6). |
| - | 22/01/2022 | All day | 50 km/h |
| - | 23/01/2022 | All day | 50 km/h |
| - | 24/01/2022 | All day | 50 km/h |
| | | 1130h | Road swept between Rp 15,317 and Rp 15,950 (section 1). |
| - | 25/01/2022 | 0000h-1300h* | 50 km/h |
| | | 1200h* | Lane marking between Rp 15,317 and Rp 15,950 (section 1). |
| | | 1300h* | Speed increased to 100 km/h. |

* estimated time – line marking was delayed due to poor weather.

Weather conditions

The following manual temperature readings were taken during construction. Additional weather information has been downloaded from the MetConnect website and is included in Appendix B.

Table 5 Manual temperature readings taken during the sealing shifts.

| Shift no. | Date | Time | Wind | Temperature [°C] | |
|-----------|------------|-------|-------------------------|------------------|-----|
| | | | | Surface | Air |
| 1 | 17/01/2022 | 1100h | light | 32 | 21 |
| | | 0856h | light | 23 | 18 |
| | | 1100h | light | 36 | 23 |
| | | 1200h | light | 37 | |
| 2 | 18/01/2022 | 1240h | light | 40 | |
| | | 1330h | light | 45 | 28 |
| | | 1610h | moderate | 42 | 27 |
| | | 1645h | moderate | 38 | 28 |
| | | 0845h | moderate | 26 | 22 |
| | | 0941h | moderate | 30 | 24 |
| 3 | 19/01/2022 | 1242h | moderate | 43 | 31 |
| | | 1342h | moderate | 48 | 32 |
| | | 1450h | moderate (SW change) | - | - |

Additional data

Additional data has been collected and stored on the CAPTIF network store under *../Projects/_cpx_data/2021_chipseal_trials/construction*. This includes:

- Downer seal design (one per trial section).
- Downer QA sheets (one per trial section).
- Photographs and videos of the construction process.
- Drive-by videos taken at various times during and in the first week following construction.
- GPS logger data for the spray truck and roller (2 second interval).
- Raw MetConnect weather data.

Samples of the five grades of aggregate used were taken and stored in the environmental equipment store at CAPTIF.

APPENDIX A

Sealing operation details

Section 6 – WB lane (increasing)

| | |
|--------------------|---|
| Surface | Multi-coat grade 2/4/6 (grade 2/4 racked-in with wetlock grade 6) |
| Date | 17/01/2022 |
| Weather conditions | Fine. Sunny. Light wind. 21°C (air), 32°C (surface) at 1100h. |

| Time | Event |
|---------------------|--|
| 1030h ⁺ | Spray 1 st coat |
| 1032h ⁺ | 1 st coat complete |
| 1040h* | Apply grade 2 chip |
| 1047h | Apply grade 2 chip – completed |
| 1134h | Apply grade 4 chip to left half of lane |
| 1139h | Apply grade 4 chip to left half of lane – complete |
| 1142h | Apply grade 4 chip to right half of lane |
| 1145h | Apply grade 4 chip to right half of lane – complete |
| 1202h ⁺ | Spray 2 nd coat |
| 1204h ⁺ | 2 nd coat complete |
| 1208h | Apply grade 6 chip to left half of lane |
| 1212h | Apply grade 6 chip to left half of lane – complete |
| 1212h ⁺ | Rolling started |
| 1217h | Apply grade 6 chip to right half of lane |
| 1220h* | Apply grade 6 chip to right half of lane – complete |
| 1240h ^{**} | Rolling complete |
| 1245h | Traffic moved to WB lane (30 km/h), pushed left |
| 1620h | Traffic moved back to EB lane after surface begins to blacken with constrained traffic |
| 1715h* | Opened to traffic (again) (30 km/h, both directions) |
| 1730h* | Speed increased to 50 km/h |

* estimated time.

+ to be confirmed from GPS loggers.

Observations

- No pre-spray (as per seal design).
- Traffic was moved to the EB lane at 1620h after the surface began to blacken with constrained traffic.

Photographs



1st coat of emulsion complete, applying grade 6 chip to left half of lane.



Grade 2 applied to left half of lane. Taken at 1045h.



Grade 2 applied to right half of lane. Taken at 1047h.



Grade 6 applied to left half of lane. Taken at 1216h.

Section 6 – EB lane (decreasing)

| | |
|--------------------|---|
| Surface | Multi-coat grade 2/4/6 (grade 2/4 racked-in with wetlock grade 6) |
| Date | 17/01/2022 |
| Weather conditions | Fine. Sunny. Light wind. |

| Time | Event |
|---------------------|---|
| 1450h ⁺ | Spray 1 st coat |
| 1452h | Apply grade 2 chip to left half of lane |
| 1454h ⁺ | 1 st coat complete |
| 1456h | Apply grade 2 chip to left half of lane – complete |
| 1458h | Apply grade 2 chip to right half of lane |
| 1501h | Apply grade 2 chip to right half of lane – complete |
| 1502h | Apply grade 4 chip to left half of lane |
| 1506h | Apply grade 4 chip to right half of lane |
| 1508h | Apply grade 4 chip to left half of lane – complete |
| 1512h [*] | Apply grade 4 chip to right half of lane – complete |
| 1604h ⁺ | Spray 2 nd coat |
| 1605h | Apply grade 6 chip to left half of lane |
| 1607h | Apply grade 6 chip to left half of lane – complete |
| 1610h | Apply grade 6 chip to right half of lane |
| 1612h [*] | Apply grade 6 chip to right half of lane – complete |
| 1610h ^{**} | Rolling started |
| 1620h ^{**} | Rolling complete |
| 1620h | Opened to traffic (30 km/h, WB lane closed after surface began to blacken from constrained traffic) |
| 1715h [*] | WB lane opened to traffic |
| 1730h [*] | Speed increased to 50 km/h |

* estimated time.

+ to be confirmed from GPS loggers.

Observations

- No pre-spray (as per seal design).
- Rolling performed after application of the grade 6 chip only.

Photographs



Applying 1st coat of emulsion. Taken at 1453h.



After application of grade 2 chip. Taken 1456h.



After application of grade 2 chip.



After application of grade 4 chip.



After application of grade 6 chip.

Section 5 – WB lane (increasing)

| | |
|--------------------|---|
| Surface | Two-coat grade 2/4 |
| Date | 17/01/2022 |
| Weather conditions | Fine. Sunny. Light wind. 21°C (air), 32°C (surface) at 1100h. |

| Time | Event |
|---------------------|--|
| 1050h ⁺ | Pre-spray applied |
| 1102h ⁺ | Spray 1 st coat |
| 1130h [*] | Apply grade 2 to left half of lane |
| 1135h [*] | Apply grade 2 to left half of lane – complete |
| 1130h [*] | Apply grade 2 to right half of lane |
| 1135h [*] | Apply grade 2 to right half of lane – complete |
| 1136h ^{**} | Spray 2 nd coat |
| 1149h | Apply grade 4 |
| 1212h ⁺ | Rolling started |
| 1240h ^{**} | Rolling complete |
| 1245h | Traffic moved to WB lane (30 km/h), pushed left. |
| 1620h | Traffic moved back to EB lane after surface begins to blacken with constrained traffic |
| 1715h [*] | Opened to traffic (again) (30 km/h, both directions) |
| 1730h [*] | Speed increased to 50 km/h |

* estimated time.

+ to be confirmed from GPS loggers.

Observations

- The pre-spray was relatively wide and left only narrow wheel paths.
- Traffic was moved to the EB lane at 1620h after the surface began to blacken with constrained traffic.
- There appears to be some minor chip loss along the edge and mid-lane where the traffic was constrained.

Photographs



After application of 2nd coat of emulsion.



After application of 2nd coat of emulsion. Taken at 1141h.

Section 5 – EB lane (decreasing)

| | |
|--------------------|--------------------------|
| Surface | Two-coat grade 2/4 |
| Date | 17/01/2022 |
| Weather conditions | Fine. Sunny. Light wind. |

| Time | Event |
|---------------------|---|
| 1506h ⁺ | Pre-spray applied |
| 1521h ⁺ | Spray 1 st coat |
| 1524h ⁺ | 1 st coat complete |
| 1527h | Apply grade 2 to left half of lane |
| 1531h | Apply grade 2 to left half of lane – complete |
| 1535h | Apply grade 2 to right half of lane |
| 1537h | Apply grade 2 to right half of lane – complete |
| 1542h ⁺ | Spray 2 nd coat |
| 1545h ⁺⁺ | 2 nd coat complete |
| 1543h | Apply grade 4 to right half of lane |
| 1546h [*] | Apply grade 4 to right half of lane – complete |
| 1549h | Apply grade 4 to left half of lane |
| 1551h | Apply grade 4 to left half of lane – complete |
| 1550h ⁺⁺ | Rolling started |
| 1620h ⁺ | Rolling complete |
| 1620h | Opened to traffic (30 km/h, WB lane closed after surface began to blacken from constrained traffic) |
| 1715h [*] | WB lane opened to traffic |
| 1730h [*] | Speed increased to 50 km/h |

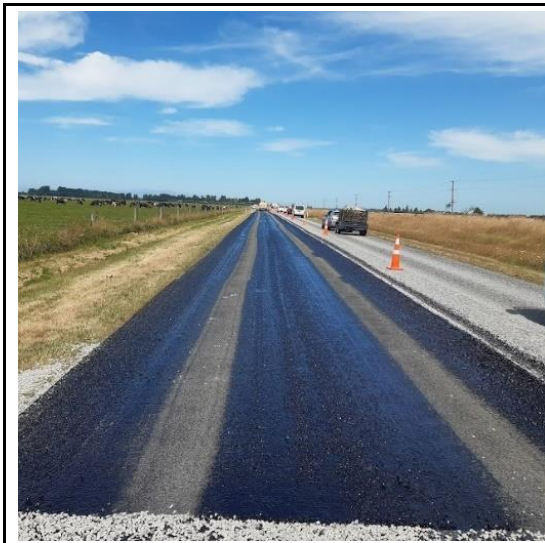
* estimated time.

+ to be confirmed from GPS loggers.

Observations

- The pre-spray was relatively wide and left only narrow wheel paths.
- Rolling performed after application of the grade 4 chip.
- The roller spreader has introduced corrugations in the right wheel path during application of the grade 4 chip (see photos below).
- On the morning of day two (during sealing of section 3 & 4) section 5 (EB) had stationary traffic due to the location of the stop/go threshold.

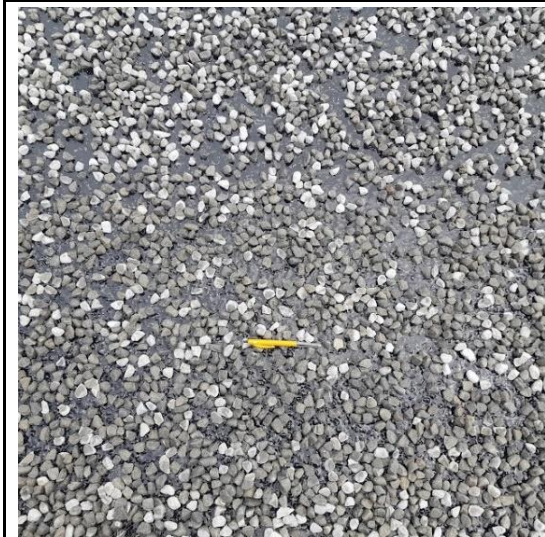
Photographs



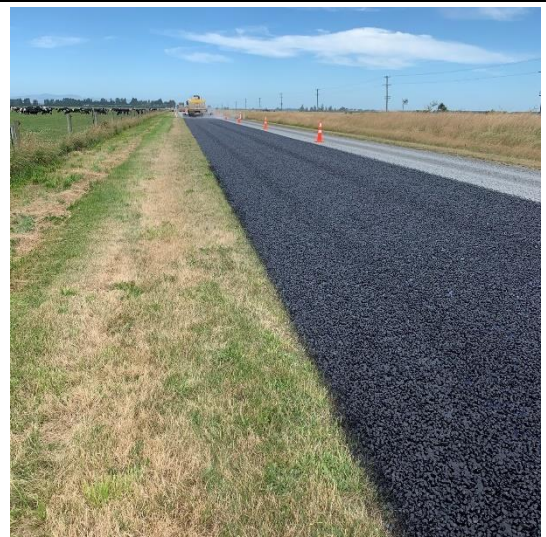
Pre-spray.



Application of 1st emulsion coat.



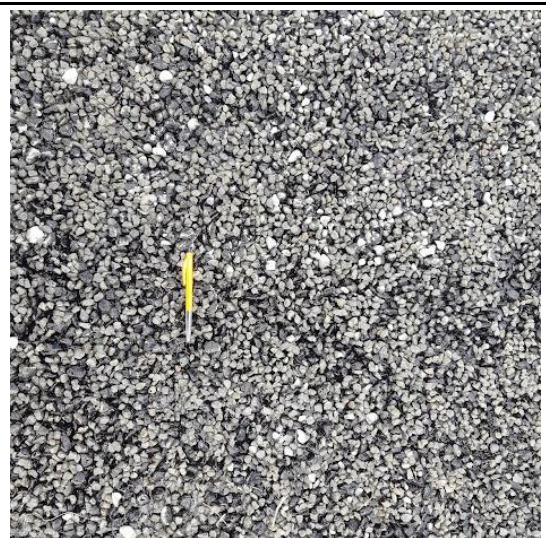
After application of grade 2 chip.



Application of 2nd emulsion coat. Taken at 1543h.



Application of grade 4 chip. Taken at 1550h.



After application of grade 4 chip.



Corrugations in the right half of the lane after application of the grade 4 chip. Taken at 1620h.

Section 4 – WB lane (increasing)

| | |
|--------------------|--|
| Surface | Racked-in grade 2/4 |
| Date | 18/01/2022 |
| Weather conditions | Overcast. Light wind. 18°C (air), 23°C (surface) at 0856h. |

| Time | Event |
|---------|--|
| 0845h** | Pre-spray applied |
| 0855h+ | Spray 1 st coat |
| 0857h | Apply grade 2 to left half of lane |
| 0902h+ | 1 st coat complete |
| 0902h | Apply grade 2 to left half of lane – complete |
| 0904h | Apply grade 2 to right half of lane |
| 0908h | Apply grade 2 to right half of lane – complete |
| 0915h | Apply grade 4 to left half of lane |
| 0918h | Apply grade 4 to left half of lane – complete |
| 0918h | Apply grade 4 to right half of lane |
| 0919h | Apply grade 4 to right half of lane – complete |
| 0944h+ | Rolling started |
| 1000h** | Rolling complete |
| 1030h | Traffic moved to WB lane (30 km/h), pushed left |
| 1220h | EB lane opened to traffic |
| 1830h | Speed increased to 50 km/h, centreline cones removed |

* estimated time.

+ to be confirmed from GPS loggers.

Observations

- The pre-spray width was reduced compared to day 1.

Photographs



Pre-spray.



Application of grade 2 chip. Taken at 0905h.



After application of grade 2 chip.



After application of grade 4 chip.

Section 4 – EB lane (decreasing)

| | |
|--------------------|---|
| Surface | Racked-in grade 2/4 |
| Date | 18/01/2022 |
| Weather conditions | Fine. Sunny. Light wind. 23°C (air), 36°C (surface) at 1100h. 37°C (surface) at 1200h. 28°C (air) at 1330h. |

| Time | Event |
|---------------------|--|
| 1054h ⁺ | Pre-spray applied |
| 1103h ⁺ | Spray 1 st coat |
| 1104h | Apply grade 2 to left half of lane |
| 1106h | Apply grade 2 to left half of lane – paused for sprayer |
| 1108h | Apply grade 2 to left half of lane – resumed for sprayer |
| 1109h ⁺ | 1 st coat complete |
| 1110h | Apply grade 2 to right half of lane |
| 1111h | Apply grade 4 to left half of lane |
| 1112h | Apply grade 2 to right half of lane – complete |
| 1114h | Apply grade 4 to left half of lane – complete |
| 1114h ⁺ | Rolling started |
| 1115h | Apply grade 4 to right half of lane |
| 1118h | Apply grade 4 to right half of lane – complete |
| 1130h ^{**} | Rolling started |
| 1200h ^{**} | Rolling complete |
| 1220h | Opened to traffic (30 km/h, both directions) |
| 1830h | Speed increased to 50 km/h, centreline cones removed |

* estimated time.

+ to be confirmed from GPS loggers.

Observations

- The pre-spray width was reduced compared to day 1.

Photographs



Pre-spray. Taken at 1101h.



After application of 1st coat of emulsion.



After application of grade 2 chip.



After application of grade 4 chip.

Section 3 – WB lane (increasing)

| | |
|--------------------|--|
| Surface | Single-coat grade 2 |
| Date | 18/01/2022 |
| Weather conditions | Overcast. Light wind. 18°C (air), 23°C (surface) at 0856h. |

| Time | Event |
|---------------------|--|
| 0914h ⁺ | Pre-spray applied |
| 0916h ⁺ | Pre-spray complete |
| 0925h ⁺ | Spray 1 st coat |
| 0929h | Apply grade 2 to left half of lane |
| 0929h ^{**} | 1 st coat complete |
| 0934h | Apply grade 2 to left half of lane – complete |
| 0936h | Apply grade 2 to right half of lane |
| 0940h | Apply grade 2 to right half of lane – complete |
| 0944h ⁺ | Rolling started |
| 1015h ^{**} | Rolling complete |
| 1030h | Traffic moved to WB lane (30 km/h), pushed left |
| 1220h | EB lane opened to traffic |
| 1830h | Speed increased to 50 km/h, centreline cones removed |

* estimated time.

+ to be confirmed from GPS loggers.

Observations

- The pre-spray width was reduced compared to day 1.

Photographs



Pre-spray.



After application of 1st coat of emulsion.



After application of grade 2 chip.

Section 3 – EB lane (decreasing)

| | |
|--------------------|---|
| Surface | Single-coat grade 2 |
| Date | 18/01/2022 |
| Weather conditions | Fine. Sunny. Light wind. 23°C (air), 36°C (surface) at 1100h. 37°C (surface) at 1200h. 28°C (air) at 1330h. |

| Time | Event |
|---------------------|--|
| 1127h ⁺ | Pre-spray applied |
| 1130h ^{**} | Pre-spray complete |
| 1134h ⁺ | Spray 1 st coat |
| 1139h | Apply grade 2 to left half of lane |
| 1140h ⁺ | 1 st coat complete |
| 1140h | Apply grade 2 to right half of lane |
| 1146h [*] | Apply grade 2 to left half of lane – complete |
| 1146h [*] | Apply grade 2 to right half of lane – complete |
| 1146h ⁺ | Rolling started |
| 1215h ^{**} | Rolling complete |
| 1220h | Opened to traffic (30 km/h, both directions) |
| 1830h | Speed increased to 50 km/h, centreline cones removed |

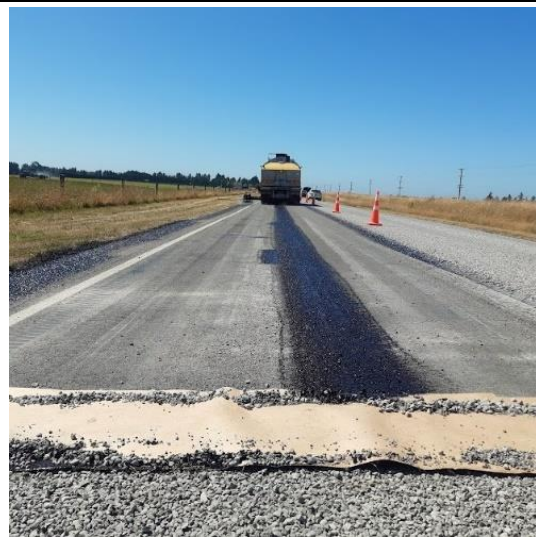
* estimated time.

+ to be confirmed from GPS loggers.

Observations

- The pre-spray width was reduced compared to day 1.
- During sealing of section 2 and the intersection, section 3 (EB) had stationary traffic due to the location of the stop/go threshold. This stationary traffic was on the section between 1320h and 1750h. Some minor damage has occurred to the surface.

Photographs



Pre-spray.



1st coat of emulsion.



After application of grade 2 chip.

Section 2 – WB lane (increasing)

| | |
|--------------------|---|
| Surface | Two-coat grade 3/5 |
| Date | 18/01/2022 |
| Weather conditions | Fine. Sunny. Light wind. 40°C (surface) at 1240h. 28°C (air), 45°C (surface) at 1330h. 27°C (air), 42°C (surface) at 1610h. |

| Time | Event |
|---------------------|---|
| 1330h ⁺ | Pre-spray applied |
| 1333h ^{**} | Pre-spray complete |
| 1336h ⁺ | Spray 1 st coat |
| 1340h | Apply grade 3 to right half of lane |
| 1339h ^{**} | 1 st coat complete |
| 1346h | Apply grade 3 to left half of lane |
| 1349h | Apply grade 3 to right half of lane – complete |
| 1349h | Apply grade 3 to left half of lane – complete |
| 1353h ⁺ | Rolling started (1 st coat) |
| 1401h ⁺ | Rolling complete (1 st coat) |
| 1418h ⁺ | Spray 2 nd coat |
| 1421h ⁺ | 2 nd coat – complete |
| 1421h | Apply grade 5 to right half of lane |
| 1427h | Apply grade 5 to left half of lane |
| 1427h [*] | Apply grade 5 to right half of lane – complete |
| 1433h [*] | Apply grade 5 to left half of lane – complete |
| 1436h ⁺ | Rolling started (2 nd coat) |
| 1503h ⁺ | Rolling complete (2 nd coat) |
| 1530h [*] | <i>Intersection sealed (before moving to EB lane)</i> |
| 1630h | Traffic moved to WB lane (30 km/h), pushed left |
| 1753h | EB lane opened to traffic |
| 1830h | Speed increased to 50 km/h, centreline cones removed |

* estimated time.

+ to be confirmed from GPS loggers.

Observations

- The pre-spray width was reduced compared to day 1.
- Section 2 (WB lane) was sealed separately to the intersection.

Photographs



Pre-spray.



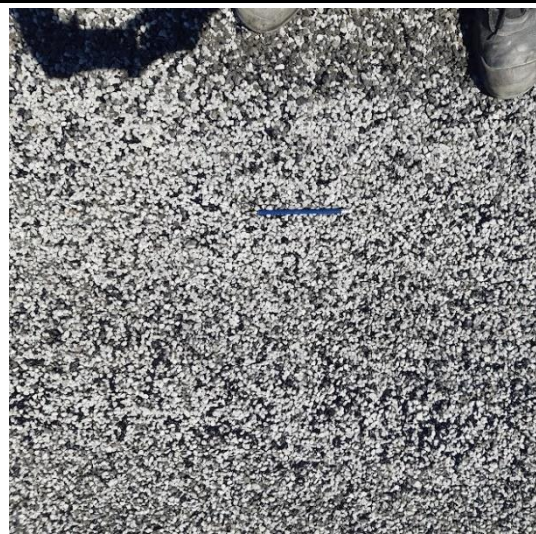
After 1st coat of emulsion.



After application of grade 3 chip.



After 2nd coat of emulsion.



After application of grade 5 chip.



Rolling the grade 5 chip. Taken at 1614h.

Section 2 – EB lane (decreasing)

| | |
|--------------------|---|
| Surface | Two-coat grade 3/5 (includes intersection sealing) |
| Date | 18/01/2022 |
| Weather conditions | Fine. Sunny. Light wind. 28°C (air), 38°C (surface) at 1645h. |

| Time | Event |
|---------------------|--|
| 1643h ⁺ | Pre-spray edge |
| 1647h ⁺ | Pre-spray mid-lane |
| 1654h ⁺ | Spray 1 st coat |
| 1655h | Apply grade 3 to left half of lane |
| 1656h | Apply grade 3 to right half of lane |
| 1701h [*] | Apply grade 3 to left half of lane – complete |
| 1702h [*] | Apply grade 3 to right half of lane – complete |
| 1704h ⁺ | Rolling started (1 st coat) |
| 1712h ^{**} | Rolling complete (1 st coat) |
| 1713h ⁺ | Spray 2 nd coat |
| 1714h | Apply grade 5 to right half of lane |
| 1720h [*] | Apply grade 5 to right half of lane – complete |
| 1729h | Apply grade 5 to left half of lane |
| 1735h [*] | Apply grade 5 to left half of lane – complete |
| 1729h ⁺ | Rolling started (2 nd coat) |
| 1742h ⁺ | Rolling complete (2 nd coat) |
| 1753h | Opened to traffic (30km/h, both directions) |
| 1830h | Speed increased to 50 km/h, centreline cones removed |

* estimated time.

+ to be confirmed from GPS loggers.

Observations

- The pre-spray width was reduced compared to day 1.
- Both the intersection and section 2 (EB lane) were sealed together.

Photographs



After application of grade 3 chip. Taken at 1704h.



After application of grade 3 chip. Taken at 1705h.



After application of grade 5 chip. Taken at 1800h.

Section 1 – WB lane (increasing)

| | |
|--------------------|---|
| Surface | Single-coat grade 3 |
| Date | 19/01/2022 |
| Weather conditions | Fine. Sunny. Light wind. 22°C (air), 26°C (surface) at 0845h. 31°C (air), 43°C (surface) at 1242h. 32°C (air), 48°C (surface) at 1342h. |

| Time | Event |
|---------------------|---|
| 0850h ⁺ | Pre-spray centreline |
| 0910h ⁺ | Pre-spray edge and mid-lane |
| 0912h ⁺ | Pre-spray edge and mid-lane – complete |
| 0916h ⁺ | Spray 1 st coat |
| 0922h ^{**} | 1 st coat complete |
| 0925h | Apply grade 3 to both sides of lane |
| 0930h | Apply grade 3 to both sides of lane – complete |
| 0938h ⁺ | Rolling started (1 st coat) |
| 1010h ^{**} | Rolling complete (1 st coat) |
| 1230h | WB lane opened to traffic (30 km/h) |
| 1345h | Traffic moved to EB lane after surface begins to blacken due to constrained traffic and heat. |
| 1415h | Apply grade 5 to wheel paths |
| 1416h | Rolling started (no GPS logging) |
| 1423h | Apply grade 5 along lane edge |
| 1424h | Watercart (1 pass) |
| 1430h | Rolling complete (~1 pass, no GPS logging) |
| 1438h | Opened to traffic (30 km/h, both lanes) |
| 1530h | Speed increased to 50 km/h, centreline cones removed |

* estimated time.

+ to be confirmed from GPS loggers.

Observations

- The pre-spray width was reduced compared to day 1.
- All traffic was moved to the WB lane at 1230h for sealing of the EB lane. The seal remained soft with the high surface temperatures and began to blacken as the traffic moved the chip around. The traffic was moved onto the EB lane at 1345h and grade 5 chip spread on the WB lane to cover up the blacked surface in preparation for opening to traffic at the end of the shift. One pass of the watercart was used to cool down the surface.

Photographs



1st coat of emulsion. Taken at 0918h.



After application of grade 3 chip. Taken at 0924h.

Section 1 – EB lane (decreasing)

| | |
|--------------------|---|
| Surface | Single-coat grade 3 |
| Date | 19/01/2022 |
| Weather conditions | Fine. Sunny. Moderate wind. 31°C (air), 43°C (surface) at 1242h. 32°C (air), 48°C (surface) at 1342h. |

| Time | Event |
|---------------------|---|
| 1243h ⁺ | Pre-spray applied |
| 1250h ^{**} | Pre-spray complete |
| 1254h ⁺ | Spray 1 st coat |
| 1258h | Apply grade 3 to left half of lane |
| 1259h | Apply grade 3 to right half of lane |
| 1306h ⁺ | 1 st coat complete |
| 1313h | Apply grade 3 to left half of lane – complete |
| 1313h | Apply grade 3 to right half of lane – complete |
| 1315h ⁺ | Rolling started |
| 1345h ^{**} | Rolling complete |
| 1345h | Traffic moved to EB lane (30 km/h) after WB lane surface begins to blacken due to constrained traffic and heat. |
| 1424h | Watercart (1 pass) |
| 1438h | Opened to traffic (30 km/h, both lanes) |
| 1530h | Speed increased to 50 km/h, centreline cones removed |

* estimated time.

+ to be confirmed from GPS loggers.

Observations

- The pre-spray width was reduced compared to day 1.
- Note the longitudinal variability in chip spread rate in the photos below. This was fairly typical across all trial sections.
- There was heavy rain between 1730h and 0900h the following morning sealing. The bitumen still appeared soft in the morning following the rain event and the surface appeared to have suffered some chip loss as a result. This is generally limited to the area around the house and trees.

Photographs



Pre-spray. Taken at 1242h.



1st coat of emulsion.



After application of grade 3 chip. Taken at 1306h.



After application of grade 3 chip. Taken at 1306h.

APPENDIX B

Weather data

MetConnect platform

The MetConnect platform (operated by Metservice) provides predicted weather data for short (approx. 4 km) segments of the State highway network. The platform also includes actual weather data collected at several monitoring stations around New Zealand (see Table 6 below).

The data is presented on an hourly basis on the web interface, while the underlying database contains 10-minute observations.

Table 6 Weather data available through the MetConnect platform.

| Parameter | State highway segments | Weather stations | |
|--------------------------|------------------------|------------------|-----------------|
| | <i>Predicted</i> | <i>Predicted</i> | <i>Observed</i> |
| Road temperature | ✓ | ✓ | ✓ |
| Air temperature | ✓ | ✓ | ✓ |
| Dew point temperature | ✓ | ✓ | ✓ |
| Rainfall (previous hour) | ✓ | ✓ | |
| Cloud cover percentage | ✓ | ✓ | |

State highway data

The predicted weather data for the section of road between Highfield Rd and Kirwee town has been downloaded from MetConnect covering the period from 0000h 17 January to 0000h 27 January 2022. Summary values are given in Table 7 below. The full records are stored on the CAPTIF network store.

Table 7 Daily summary of predicted road weather data from the MetConnect platform.

| Date | Air temperature [°C] | | Road temperature [°C] | | Total rainfall [mm] |
|------------|----------------------|------------------|-----------------------|------------------|---------------------|
| | min | max | min | max | |
| | <i>Predicted</i> | <i>Predicted</i> | <i>Predicted</i> | <i>Predicted</i> | <i>Predicted</i> |
| 17/01/2022 | 12 | 25 | 18 | 48 | 0 |
| 18/01/2022 | 13 | 24 | 18 | 46 | 0 |
| 19/01/2022 | 13 | 28 | 17 | 46 | 19 |
| 20/01/2022 | 10 | 16 | 12 | 36 | 10 |
| 21/01/2022 | 10 | 19 | 16 | 40 | 0 |
| 22/01/2022 | 12 | 24 | 18 | 49 | 0 |
| 23/01/2022 | 14 | 17 | 20 | 32 | 2 |
| 24/01/2022 | 13 | 18 | 17 | 29 | 1 |
| 25/01/2022 | 12 | 23 | 18 | 48 | 0 |
| 26/01/2022 | 12 | 24 | 16 | 46 | 5 |

Weather station data

The nearest weather stations to the trial site are at Springfield, Methven and Cooptown (Banks Peninsula). The locations of the weather stations and distances to the trial site are listed in the table below.

Table 8 MetConnect weather station locations and distance to trial site.

| Weather station | Station ID | Location | | Distance to trial site |
|-----------------|------------|-----------------|------------------|------------------------|
| | | <i>Latitude</i> | <i>Longitude</i> | |
| Springfield | 93638 | -43.331 | 171.804 | 41 km |
| Methven | 93756 | -43.6027 | 171.644 | 49 km |
| Cooptown | 93778 | -43.7514 | 172.82 | 54 km |

Weather data has been downloaded from MetConnect covering the period from 0000h 17 January to 0000h 27 January 2022. Summary values are given in Table 9 below. The full records are stored on the CAPTIF network store.

Table 9 Daily summary of weather station data from the MetConnect platform.

| Date | Weather station | Air temperature [°C] | | | | Road temperature [°C] | | | | Total rainfall [mm] |
|------------|-----------------|----------------------|-----------------|------------------|-----------------|-----------------------|-----------------|------------------|-----------------|---------------------|
| | | min | | max | | min | | max | | |
| | | <i>Predicted</i> | <i>Observed</i> | <i>Predicted</i> | <i>Observed</i> | <i>Predicted</i> | <i>Observed</i> | <i>Predicted</i> | <i>Observed</i> | |
| 17/01/2022 | Springfield | 12 | 11 | 21 | 21 | 19 | 20 | 49 | 38 | 0 |
| | Methven | 13 | 9 | 24 | 24 | 16 | 15 | 52 | 54 | 0 |
| | Cooptown | 16 | 16 | 23 | 23 | 19 | 19 | 52 | 51 | 0 |
| 18/01/2022 | Springfield | 12 | 9 | 21 | 22 | 19 | 20 | 49 | 41 | 1 |
| | Methven | 13 | 9 | 23 | 24 | 17 | 17 | 51 | 55 | 0 |
| | Cooptown | 14 | 12 | 23 | 25 | 19 | 18 | 53 | 52 | 0 |
| 19/01/2022 | Springfield | 11 | 10 | 24 | 25 | 19 | 20 | 45 | 32 | 13 |
| | Methven | 11 | 10 | 25 | 26 | 17 | 15 | 45 | 43 | 26 |
| | Cooptown | 13 | 11 | 29 | 31 | 19 | 20 | 56 | 54 | 94 |
| 20/01/2022 | Springfield | 6 | 4 | 12 | 15 | 11 | 15 | 31 | 34 | 75 |
| | Methven | 7 | 6 | 14 | 17 | 10 | 9 | 37 | 48 | 62 |
| | Cooptown | 11 | 10 | 16 | 18 | 15 | 16 | 41 | 43 | 25 |
| 21/01/2022 | Springfield | 9 | 8 | 16 | 19 | 15 | 17 | 41 | 38 | 0 |
| | Methven | 10 | 9 | 19 | 21 | 14 | 14 | 47 | 52 | 0 |
| | Cooptown | 10 | 9 | 19 | 20 | 16 | 17 | 44 | 46 | 6 |
| 22/01/2022 | Springfield | 11 | 11 | 21 | 24 | 18 | 20 | 50 | 38 | 0 |
| | Methven | 11 | 10 | 22 | 22 | 14 | 16 | 52 | 47 | 0 |
| | Cooptown | 10 | 9 | 23 | 24 | 17 | 17 | 53 | 53 | 0 |

| Date | Weather station | Air temperature [°C] | | | | Road temperature [°C] | | | | Total rainfall [mm] |
|------------|-----------------|----------------------|----------|-----------|----------|-----------------------|----------|-----------|----------|---------------------|
| | | min | | max | | min | | max | | Predicted |
| | | Predicted | Observed | Predicted | Observed | Predicted | Observed | Predicted | Observed | |
| 23/01/2022 | Springfield | 11 | 10 | 13 | 14 | 16 | 17 | 29 | 24 | 6 |
| | Methven | 11 | 11 | 14 | 14 | 15 | 14 | 31 | 26 | 4 |
| | Cooptown | 13 | 13 | 16 | 17 | 19 | 21 | 38 | 31 | 1 |
| 24/01/2022 | Springfield | 10 | 10 | 15 | 14 | 14 | 16 | 26 | 20 | 7 |
| | Methven | 11 | 10 | 17 | 15 | 13 | 14 | 31 | 27 | 7 |
| | Cooptown | 12 | 12 | 18 | 18 | 17 | 18 | 30 | 30 | 2 |
| 25/01/2022 | Springfield | 12 | 9 | 20 | 20 | 14 | 14 | 47 | 33 | 0 |
| | Methven | 11 | 9 | 20 | 20 | 12 | 11 | 48 | 44 | 0 |
| | Cooptown | 13 | 10 | 22 | 23 | 17 | 15 | 49 | 48 | 0 |
| 26/01/2022 | Springfield | 9 | 9 | 22 | 24 | 17 | 18 | 49 | 36 | 12 |
| | Methven | 10 | 10 | 20 | 22 | 15 | 16 | 49 | 48 | 64 |
| | Cooptown | 12 | 12 | 21 | 23 | 19 | 17 | 43 | 37 | 65 |

