RTA Sponsored Trials

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CONTENT

1. Introduction

The State of New South Wales' Roads and Traffic Authority (RTA) has been very progressive in their quest to improve road safety. Potters has had a long history of partnering with the RTA in pavement marking trials and development of improved pavement marking systems. The following list presents some of the RTA's initiatives and field trial research and development, in partnership with Potters, to improve road safety

Chronology of RTA Initiatives and Road Safety Improvements

a) September 1994 - RTA and Potters partner in a large scale field trial to test various waterborne paints, different sized glass beads and combinations of both on the Pacific Highway at Kundabung. As a consequence of this the RTA changed their pavement marking specification from solvent based paint to waterborne paint.

b) November 1995 - RTA convenes a Value Management Study to improve the visibility of markings in all conditions, including wet nights. As a consequence, RTA Specifies large sized glass beads to AS2009 Type D.

c) March 1997 - RTA proves that bigger brighter beads (AS2009 Type D-HR) last longer. RTA Report No 1841.2 Performance of Class A and Class B beads (RTA Class A are Type B and Class B are Type D).

d) July 1998 - Potters approaches RTA to field test new large brighter beads (D-HR)

e) November 1998 - RTA / Potters conducts large scale trial at Lithgow. The results established that greater control of the glass beads during application is required if greater retroreflectivity measurements are to be achieved.

f) December 1998 - RTA / Potters conducts medium scale trial at Goulburn. The results of this trial provided marginal improvements in retroreflectivity by adjustments made to the Visigun's position, a reduction in application speed, and a slight increase in the targeted retained rate of beads.

g) January 1999 - The RTA's Dr John Kemp, of Scientific Services, suggests a method of firing the beads in a reverse direction to that of application, to minimise the bead activity during application.

h) March 1999 - RTA / Potters conducts a small scale trial at Blacktown. A slide system was developed for the delivery of beads as suggested by John Kemp. The intention of the slide was to provide an environment that may provide similar high retro measurements to those achieved in the lab. By accelerating the beads in a reverse direction to that of application and at a pace to match the forward road speed of the truck, it was anticipated that a 'static

drop' environment could be created. The delivery method was acclaimed as successful. However the paint target applications were not achieved. The poor bead embedment contributed to the anticipated high retroreflectivity not being realised.

i) April 1999 - RTA / Potters conducts a mini sized trial at Grafton. This trial went a step further in proving that if a 'static drop' environment could be created for the placement of the beads, a much higher retro measurement would be provided. The SLOPE (Static Longitudinal Optimum Placement Environment) method was fine tuned and further developed on a section of road that is closed to the public. This mini-trial provided confirmation of the potential success of an upcoming trial due in Canberra.

j) April 1999 - Totalcare Industries, for the ACT's Department of Urban Services, conducted an eight kilometre trial of edgelines applied to a new asphalt surface on the Barton Highway. Potters and RTA participated with Totalcare and assisted to improve the application method. There were many adjustments made to the application techniques throughout the day. Permanent testing stations were established where each adjustment had been made. The end result, measured with a Mirolux 12, provided a low result of 497mcd/lux/m², and a high result of 744, providing an average initial measure of 564mcd/lux/m². We had optimised the bead performance. An unexpected spin-off was the equalising of retroreflectivity in both the direction of application, and the reverse direction

k) October 1999 - Totalcare Industries is awarded a three year performance contract on the Tuggeranong Parkway. The road surface was of a coarse chipseal. Both the RTA and Potters were there during the first two days to assist with developing the application method further. We had already observed what effect that a textured road surface could have on retroreflectivity. The trial on the Barton Highway provided higher measures on the dense grade asphalt than on the textured open grade asphalt. The initial measures were around 15% lower. The first application attempts were less than satisfactory. Average measures were around 380mcd/lux/m² (Mirolux 12), and 230mcd/lux/m² (MX30). The RTA's Ross Walsh, suggested a method of adjusting two gun so that the paint streams intersect at the pavement to reduce the velocity on contact with the irregular road surface. This method was successful. The entire 44km length of edgelines were applied using this paint and bead application method. Permanent testing stations were established at each 200m. The initial average result was 524mcd/lux/m² (MX30). The performance of the markings over the coming years proved the benefit of improved method of application.

l) October 1999 to August 2000 - Potters developed a mechanised version of the static bead application system, identified as the Speedbeader. (R&D in excess of $300,000+).

m) October 1999 to August 2000 - Potters develops their research and development application testing vehicles, the DART (Delineation Application, Roadmarking Technology). (Initial commissioning cost of $400,000+). As manufacturers and suppliers of road safety products, we believed it would be valuable to learn more about how our products interact with other road marking products and how we may be able to optimise road safety performance by considering road-markings as collective 'systems'.

n) August 2000 - Potters Partners with the RTA's Scientific Services to set up testing of various material and systems in the ACT to test improved linemarking performance. Potters / RTA 'AU' series of road field trial were expanded to include AU010, AU011, AU012, AU014 and AU016. (Over the past six years or so, Potters and the RTA have demonstrated that better marking systems *[Thermoplastic, PMMA and HD21A and 3427 polymer Waterborne paint]* are available and can be sustained over long periods, with exposure to stressful traffic conditions.)

o) November 2003 - RTA partners with Potters in a second round of field trials in Canberra. Trial AU017 has been established and continues to be monitored.

It is the last trial mentioned above at (o) that is the focus in this paper

2. Background

Late in 2003 the State of New South Wales' Roads and Traffic Authority (RTA) approached Potters to put together a partnered road marking trial. The RTA designed the road marking systems that they wanted to trial, and Potters organized the application equipment and road marking materials. Both RTA staff and Potters staff agreed to form a measurement and reporting team and to revisit the site at approximately 3 monthly intervals.

The aim of this trial was:

a) To improve the retroreflectivity (wet and dry) of roadmarkings.
b) To improve and maintain adequate skid resistance levels.
c) To gauge whether any test markings show improved durability compared to current RTA Spec R141 markings.

The trial is largely built around the Visibead product lines, with the intention to generate accelerated wear data, (by location of line placement position - left line on left curve), in the measure-able performance areas of dry retroreflectivity, wet retroreflectivity and skid resistance.

3. Location

The City of Canberra, in the Australian Capital Territory (ACT), was chosen for this round of field trial. Canberra was chosen for a variety of reasons. The first is because of its meteorological pattern. An annual weather summary shows extremes, including a minimum air temperature of minus 6°C, a maximum air temperature 40°C, and an average precipitation of 547.2mm falling over 86 days.

ACT Roads (the Road Authority for the ACT) have been very cooperative over past years, with road entry approval for road marking trials readily granted. It can be very difficult to get the same cooperation on NSW roads, even for in-house RTA Scientific Services staff.

Traffic volumes are high, with most traffic using these arterials during peak hours. This allows a good window for lane closures to allow applications and follow up testing without causing any traffic problems.

Two sites were chosen for this trial. The first was on the Tuggeranong Parkway, carrying 40,000 vehicles per day on a very coarse 14mm chipseal. The second was on Monaro highway, carrying 13,000 vehicles per day on a dense grade asphalt.

All trial markings were applied as left side edge lines on a left curved road alignment, to generate worst-case data. The following pictures show each road testing site.

Tuggeranong Parkway - 14mm chipseal.

South bound AADT 19,300, with 2.3% heavy vehicles.
Estimate 70% traveling in the left lane.

Monaro H'way - Dense Asphalt

South bound AADT 6,300, with 8% heavy vehicles.
Estimate 70% traveling in the left lane.

4. Test Regime

Monaro Highway - 11th November 2003

Weather conditions during application: Air Temp range 20 to 28 degrees C.

Humidity range RH40 to RH49. Air movement moderate NW.

Application Details			**Target**		**Target**		**Target**	
Applic Vehicle	**ID No**	**Binder Type**	**Binder Applic Dry Rate**	**Bead Type**	**Bead Rate g/m2**	**Quartz Size**	**Quartz Rate g/m2**	**Surface**
DART	**1**	WB 3427	300micron	T3	400	na		AC
	2	WB 3427	300	Max	400	na		AC
	3	WB 3427	300	Max	400	1.6 - 1.0	200	AC
	4	WB 3427	300	Max (lum)	400	1.6 - 1.0	200	AC
	36	WB 3427	300	UHR	400	1.6 - 1.0	200	AC
	5	WB 3427	300	UHR	na	na		AC
	6	WB 3427	300	UHR	400	2.36 - 0.5	200	AC
T'care	**7**	WB HD21	300	Max	400	nil		AC
	8	WB HD21	300	Max	400	1.6 - 1.0	200	AC
	35	WB HD21	450	Max	400	1.6 - 1.0	200	AC
TCP	**9**	PMMA	500	T3 & d/o	400/400	nil		AC
	10	PMMA	500	Max	400	nil		AC
	11	PMMA	500	Max	400	2 to 1	200	AC
	12	PMMA	500	UHR	400	2 to 1	200	AC
	13	PMMA	500	UHR	400	2.36 to	200	AC

L'ways						0.5		
control	**14**	Thermo	2.0mm	d/o	300	nil		AC
20% Int & 10% visimax	**15**	Thermo	2.0mm	Max	400	nil		AC
10% Int & 10% UHR	**16**	Thermo	2.0mm	UHR	400	nil		AC
20% Int & 10% visimax	**17**	Thermo	2.0mm	Max	400	2 to 1	200	AC
20% UHR	**18**	Thermo	2.0mm	UHR	400	2.36 to 0.5	200	AC
quartz int & 20% visimax	**19**	Thermo	2.0mm	Max	400	2.36 to 0.5	200	AC

Tuggeranong Parkway - 12th November 2003

Weather conditions during application: Air temp range 20 to 23 degrees C.
Humidity range RH41 to RH49. Air movement light NW.

Application Details								
Applic Vehicle	**ID No**	**Binder Type**	**Target Binder Applic Dry Rate**	**Bead Type**	**Target Bead Rate g/m2**	**Quartz Size**	**Target Quartz Rate g/m2**	**Surface**
DART	**20**	WB 3427	300micron	T3	400	na		Coarse 14mm
	21	WB 3427	300micron	Max	400	na		Coarse 14mm
	22	WB 3427	300micron	Max	600	na		Coarse 14mm
	23	WB 3427	300micron	Max	600	1.6 - 1.0	200	Coarse 14mm
	25	WB 3427	300micron	UHR	600	1.6 - 1.0	200	Coarse 14mm
	26	WB 3427	300micron	UHR	600	2.36 - 0.5	200	Coarse 14mm
T'care	**27**	WB HD21	300	Max	600	na		Coarse 14mm
	28	WB HD21	300	Max	600	1.6 - 1.0	200	Coarse 14mm
	37	WB HD21	450	Max	600	1.6 - 1.0	200	Coarse

								14mm
TCP	**29**	PMMA	500	T3 & d/o	400/400	nil		Coarse
								14mm
	30	PMMA	500	Max	400	nil		Coarse
								14mm
	31	PMMA	500	Max	600	nil		Coarse
								14mm
	32	PMMA	500	Max	600	2 to 1	200	Coarse
								14mm
	33	PMMA	500	UHR	600	2 to 1	200	Coarse
								14mm
	34	PMMA	500	UHR	600	2.36 to 0.5	200	Coarse
								14mm

NOTES: No 36 was added because of an error, which omitted quarrtz in No5.
No 35 was added at the request of R&H.
No 24 was removed because of lack of material.
No 37 was included at the request of R&H.

5. Trial Combinations

Above: Totalcare's application equipment, used to apply the Waterborne HD21A Fastrack markings.

Above: Potters application equipment, used to apply the waterborne 3427 Fastrack markings.

Above: TCP application equipment, used to apply the PMMA two-component cold applied plastic markings.

Above: Lineways application equipment, used to apply the thermoplastic markings.

6. Problems

There were some problems encountered both during the application of some of the trial markings, and also during the initial testing. These problems are listed below:

SPEED CONTROL

As there was no speed control available for the thermoplastic application equipment, nor for the PMMA application equipment, is was intended that Potters DART vehicle would be coupled to each to control the application speed. On the day, this system did not work for us, so application speed was controlled my manual timing.

THERMOPLASTIC

It appears that in some applications the temperature of the thermoplastic may not have been sufficiently hot. One week after application there has been massive loss of surface applied glass beads and angular material. It is obvious that the optimum embedment was not achieved due to the thermo temperature. Shallow stamped impressions of spherical and angular shapes demonstrate the poor embedment achieved.

WATER DRAINAGE

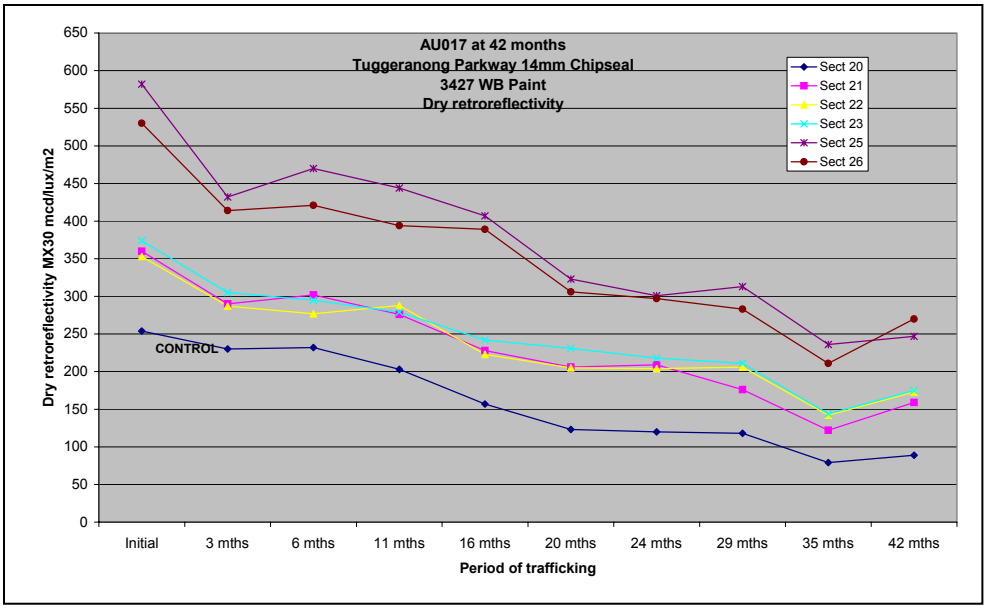
During the initial measuring of results (one week after application) it became obvious that the asphalt surface of the Monaro Highway was deformed, and would not allow water to flow across the pavement from the trafficked lane. Ponding occurred over the edgelines because of the road deformation. This did not allow proper drainage. The wet-retroreflectivity measure that were recorded were therefore, in most cases, lower than anticipated. Similarly on the coarse chipseal trial length of the Tuggeranong Parkway, deep ponding was also observed. But in this case the ponding areas were created by the macro texture of the pavement aggregates. The wet-retroreflectivity measures in this case were however, much higher.

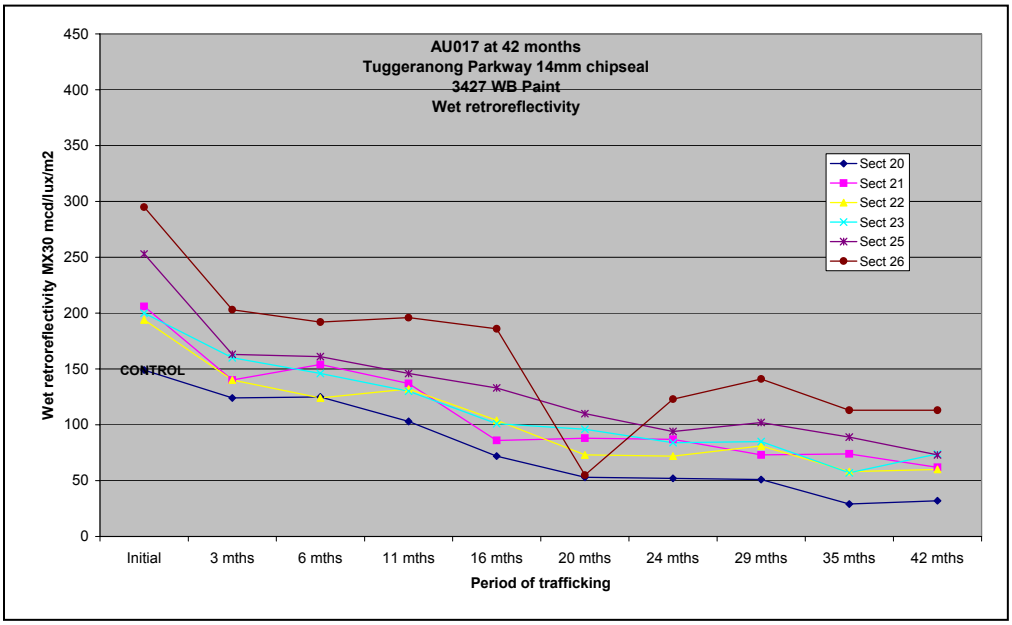
ANGULAR ENCAPSULATION

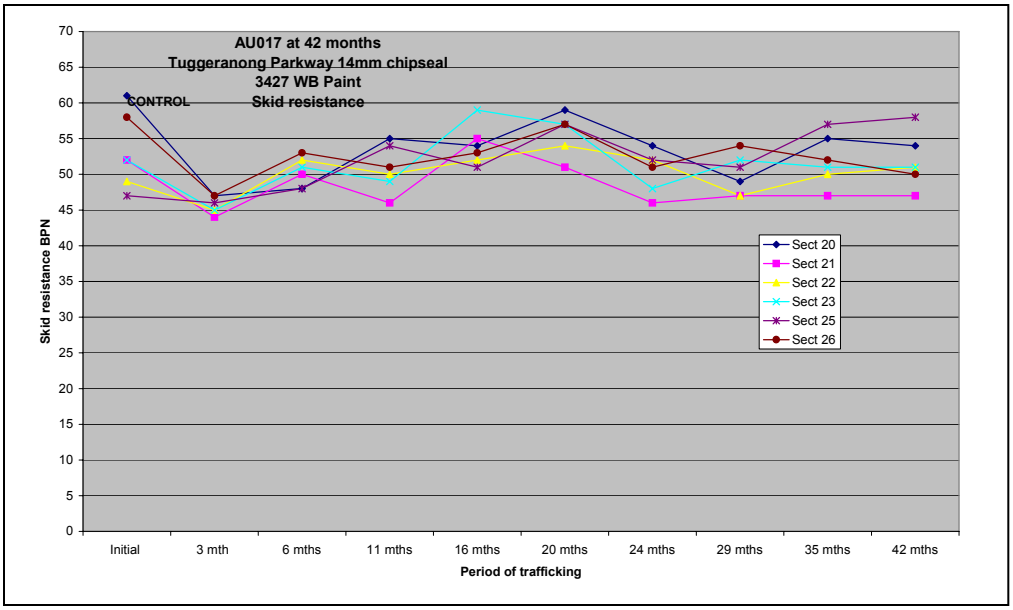
All of the 'sprayed' applications had the angular particles dropped between the two streams of paint (3427 and HD21A waterbornes, and PMMAs), with the intention to encapsulate the angular particles within the paint. Past testing, with angular particles surface applied, generally provided improved friction. Theoretically, the encapsulated method would improve the durability of the angular particles. In reality, to date, the encapsulation has, in most cases, provided little in improved skid resistance on the asphalt pavement sections. This may change with time.

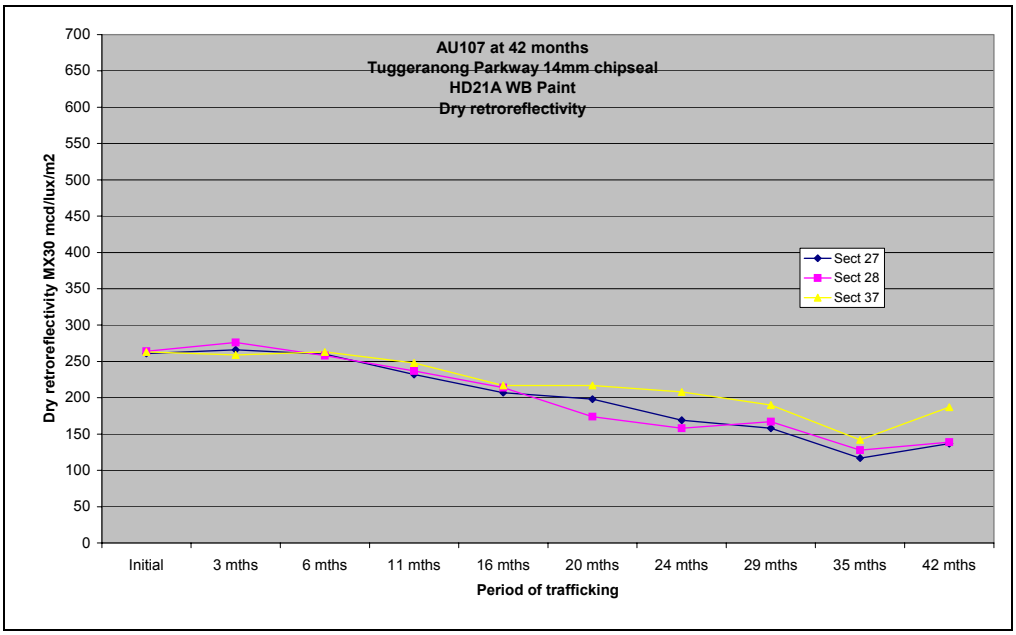
7. Results

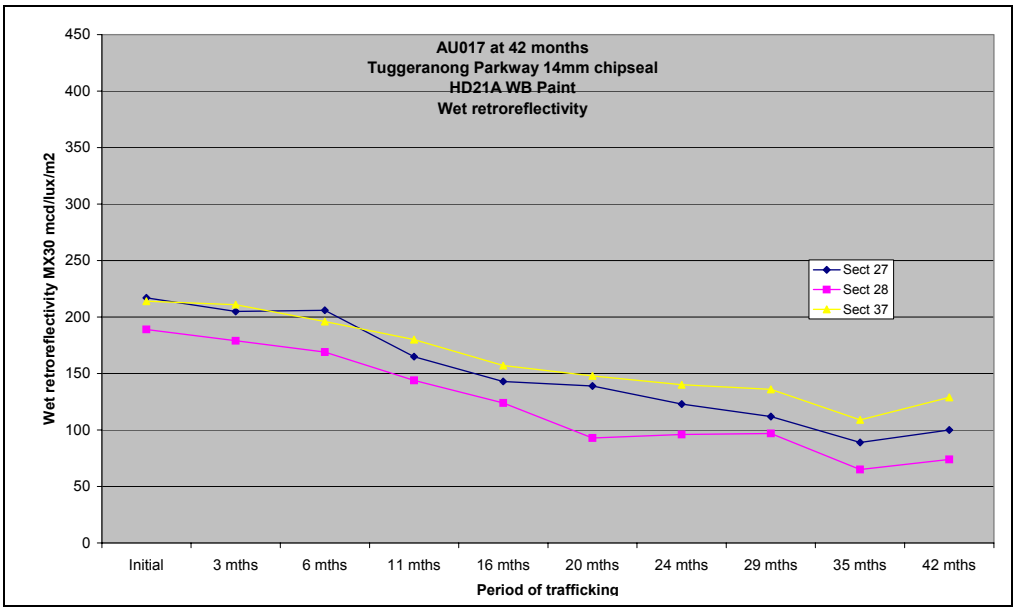
The results of these trial combinations have been quite variable. Some due to the initial road environment and lack of application control and some due to poor pavement marking system design. There are some combinations that have provided to perform better than anticipated. Graphed performance of the trial combinations at 42 months follow:

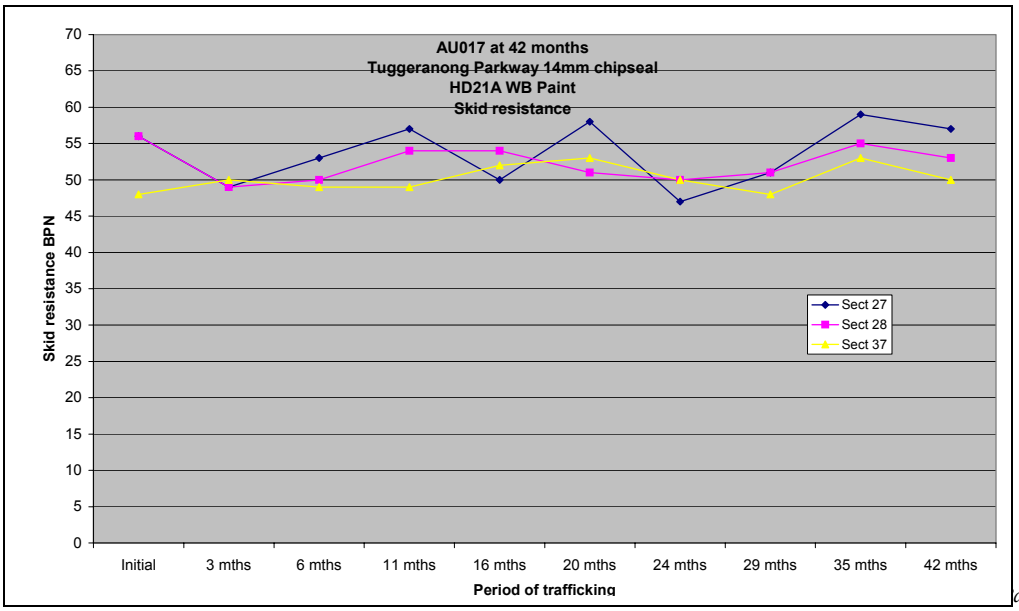

AU017 at 42 months
Tuggeranong Parkway 14mm Chipseal
3427 WB Paint
Dry retroreflectivity
Dry retroreflectivity MX30 mcd/lux/m2
Period of trafficking
Initial
3 mths
6 mths
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths
Sect 20
Sect 21
Sect 22
Sect 23
Sect 25
Sect 26
CONTROL

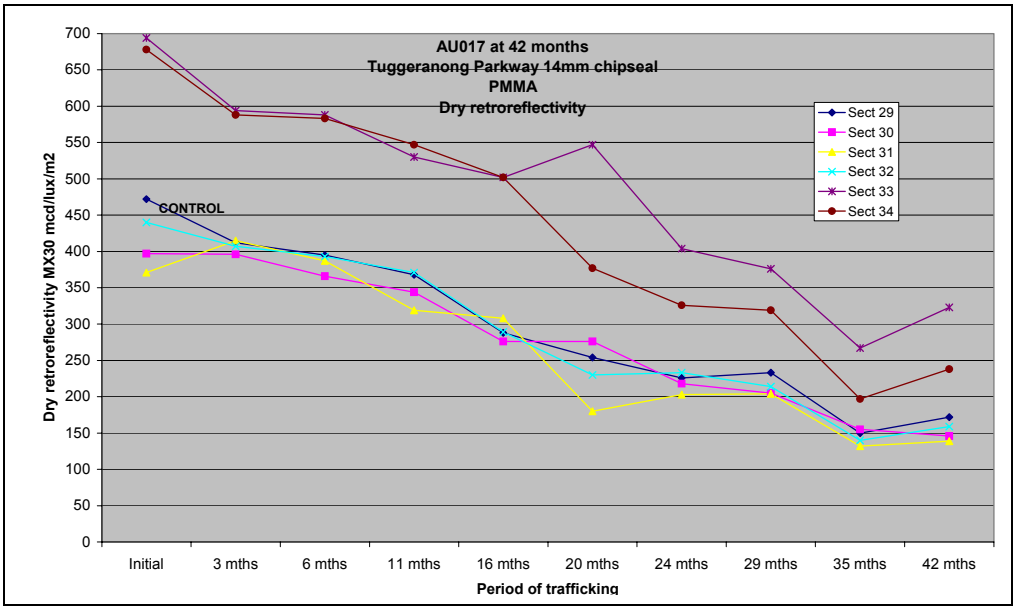

AU017 at 42 months
Tuggeranong Parkway 14mm chipseal
3427 WB Paint
Wet retroreflectivity
Wet retroreflectivity MX30 mcd/lux/m2
Period of trafficking
Initial
3 mths
6 mths
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths
Sect 20
Sect 21
Sect 22
Sect 23
Sect 25
Sect 26
CONTROL

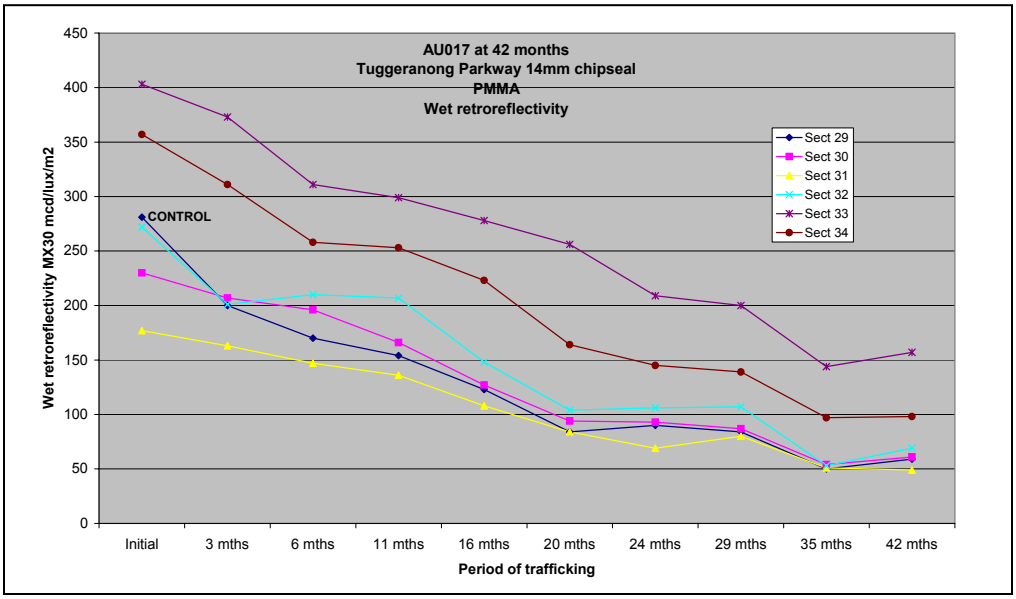

AU017 at 42 months
Tuggeranong Parkway 14mm chipseal
3427 WB Paint
Skid resistance
CONTROL
Skid resistance BPN
Period of trafficking
Initial
3 mth
6 mths
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths
Sect 20
Sect 21
Sect 22
Sect 23
Sect 25
Sect 26


AU107 at 42 months
Tuggeranong Parkway 14mm chipseal
HD21A WB Paint
Dry retroreflectivity
Dry retroreflectivity MX30 mcd/lux/m2
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
Initial
3 mths
6 mths
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths
Period of trafficking
Sect 27
Sect 28
Sect 37


AU017 at 42 months
Tuggeranong Parkway 14mm chipseal
HD21A WB Paint
Wet retroreflectivity
Wet retroreflectivity MX30 mcd/lux/m2
450
400
350
300
250
200
150
100
50
0
Initial
3 mths
6 mths
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths
Period of trafficking
Sect 27
Sect 28
Sect 37


AU017 at 42 months
Tuggeranong Parkway 14mm chipseal
HD21A WB Paint
Skid resistance
Skid resistance BPN
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Initial
3 mths
6 mths
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths
Period of trafficking
Sect 27
Sect 28
Sect 37


AU017 at 42 months
Tuggeranong Parkway 14mm chipseal
PMMA
Dry retroreflectivity
Dry retroreflectivity MX30 mcd/lux/m2
Period of trafficking
Initial
3 mths
6 mths
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths
CONTROL
Sect 29
Sect 30
Sect 31
Sect 32
Sect 33
Sect 34


AU017 at 42 months
Tuggeranong Parkway 14mm chipseal
PMMA
Wet retroreflectivity
Wet retroreflectivity MX30 mcd/lux/m2
Period of trafficking
Initial
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6 mths
11 mths
16 mths
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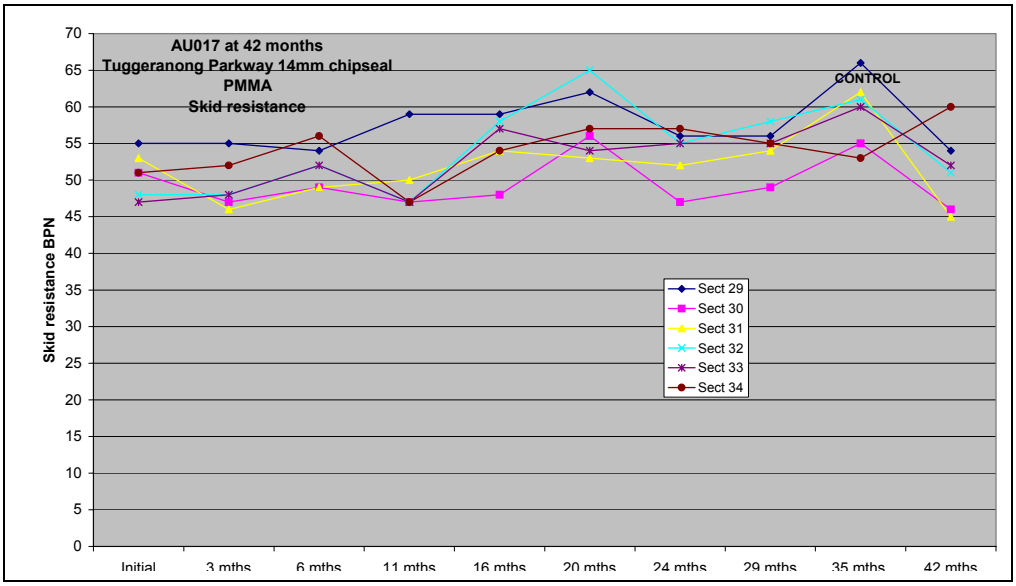
Sect 32
Sect 33
Sect 34


AU017 at 42 months
Tuggeranong Parkway 14mm chipseal
PMMA
Skid resistance
Skid resistance BPN
Initial
3 mths
6 mths
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths
CONTROL
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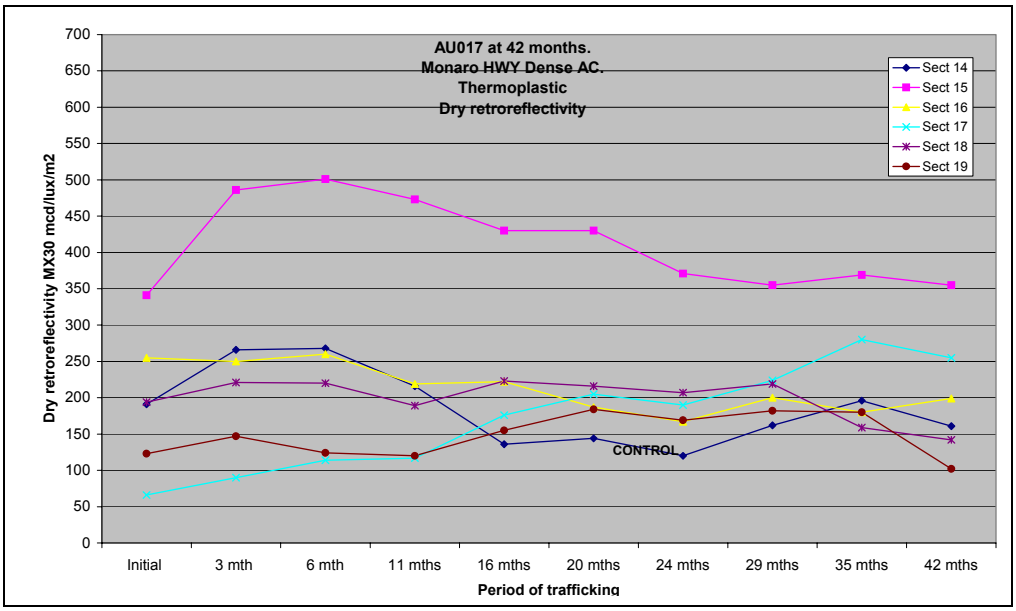
Sect 34


AU017 at 42 months.
Monaro HWY Dense AC.
Thermoplastic
Dry retroreflectivity
Dry retroreflectivity MX30 mcd/lux/m2
Period of trafficking
Initial
3 mth
6 mth
11 mths
16 mths
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Sect 14
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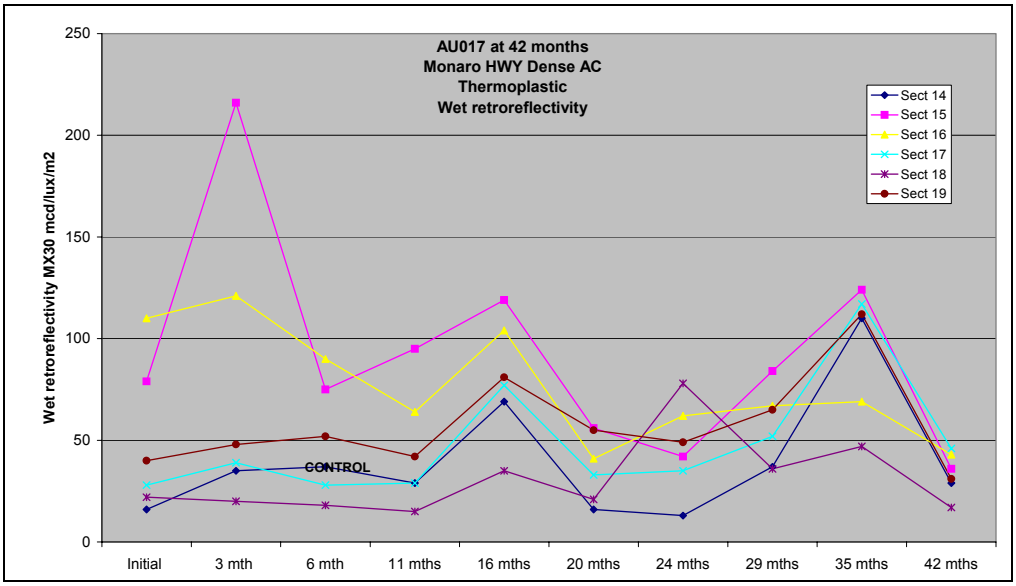
Sect 16
Sect 17
Sect 18
Sect 19
CONTROL


AU017 at 42 months
Monaro HWY Dense AC
Thermoplastic
Wet retroreflectivity
Wet retroreflectivity MX30 mcd/lux/m2
Initial
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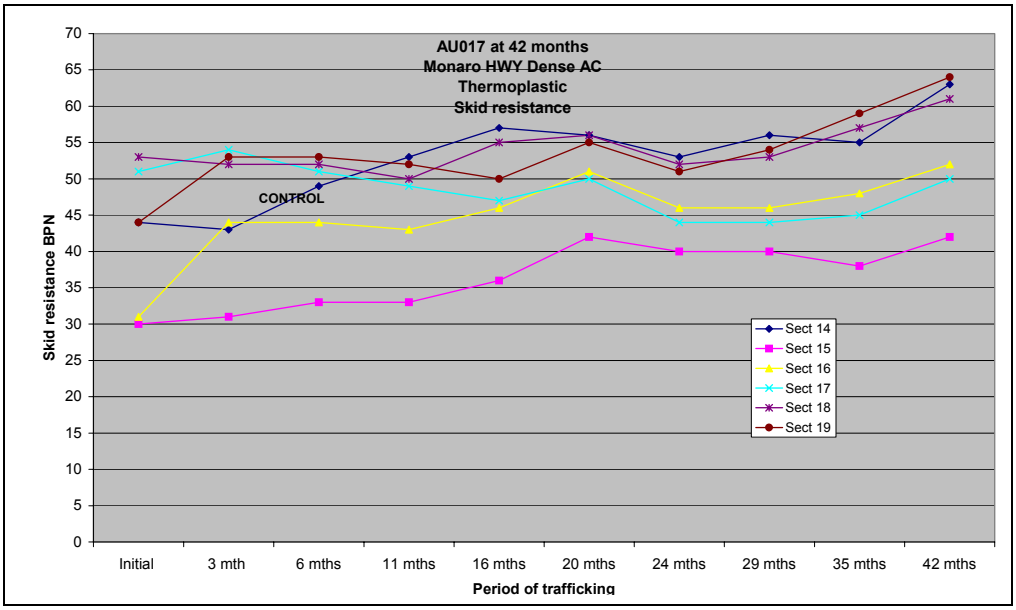
Sect 19
CONTROL


AU017 at 42 months
Monaro HWY Dense AC
Thermoplastic
Skid resistance
Skid resistance BPN
Initial
3 mth
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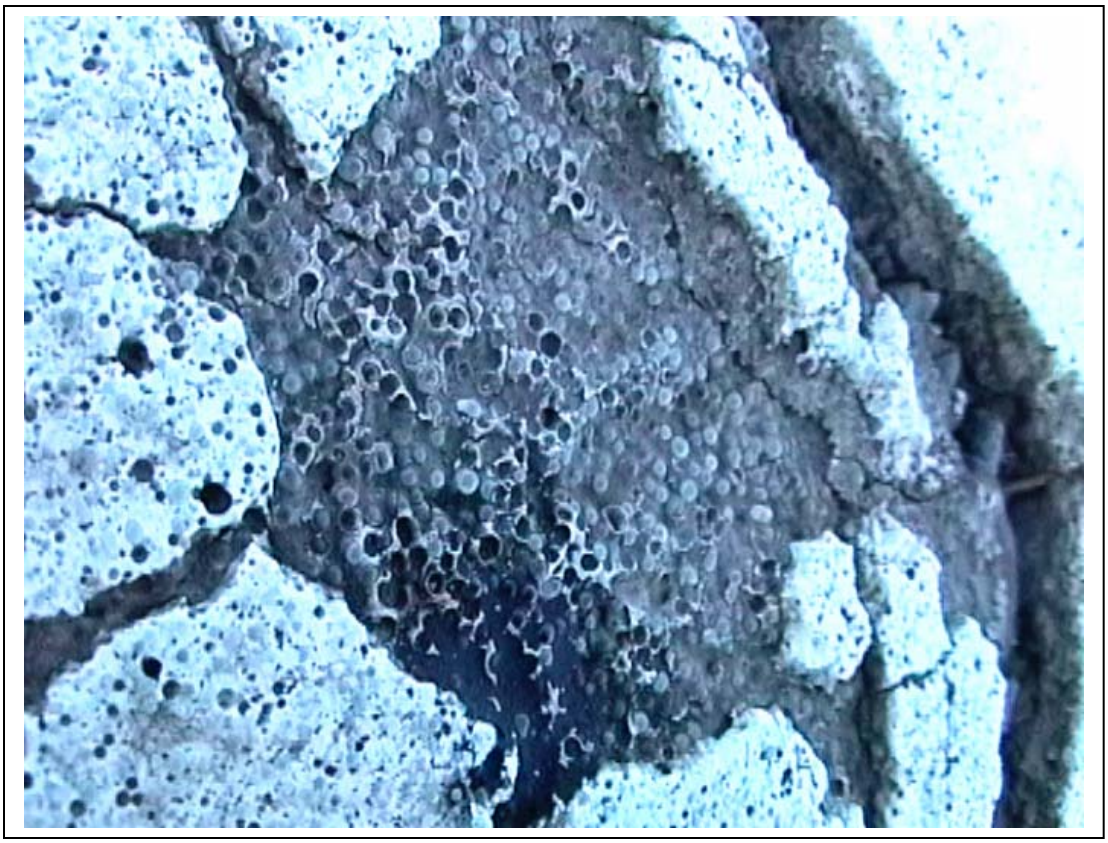
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths
Period of trafficking
Sect 14
Sect 15
Sect 16
Sect 17
Sect 18
Sect 19
CONTROL

It has been interesting recording the pavement markings performance through macro photography over time. Some of the thermoplastic markings that had initial failures in performance, due to premature loss of surface applied particles, have recovered through the erosion of itself.

Some of the thermoplastic trial combinations, such as the one pictured below, have provided measured performance values that have been misleading, as the thermoplastic has delaminated to reveal a sound waterborne and Visibead marking below. With the measurement being reported as that of the thermoplastic marking.



Pictured above: Thermoplastic marking has delaminated to reveal a sound waterborne and Visibead marking.

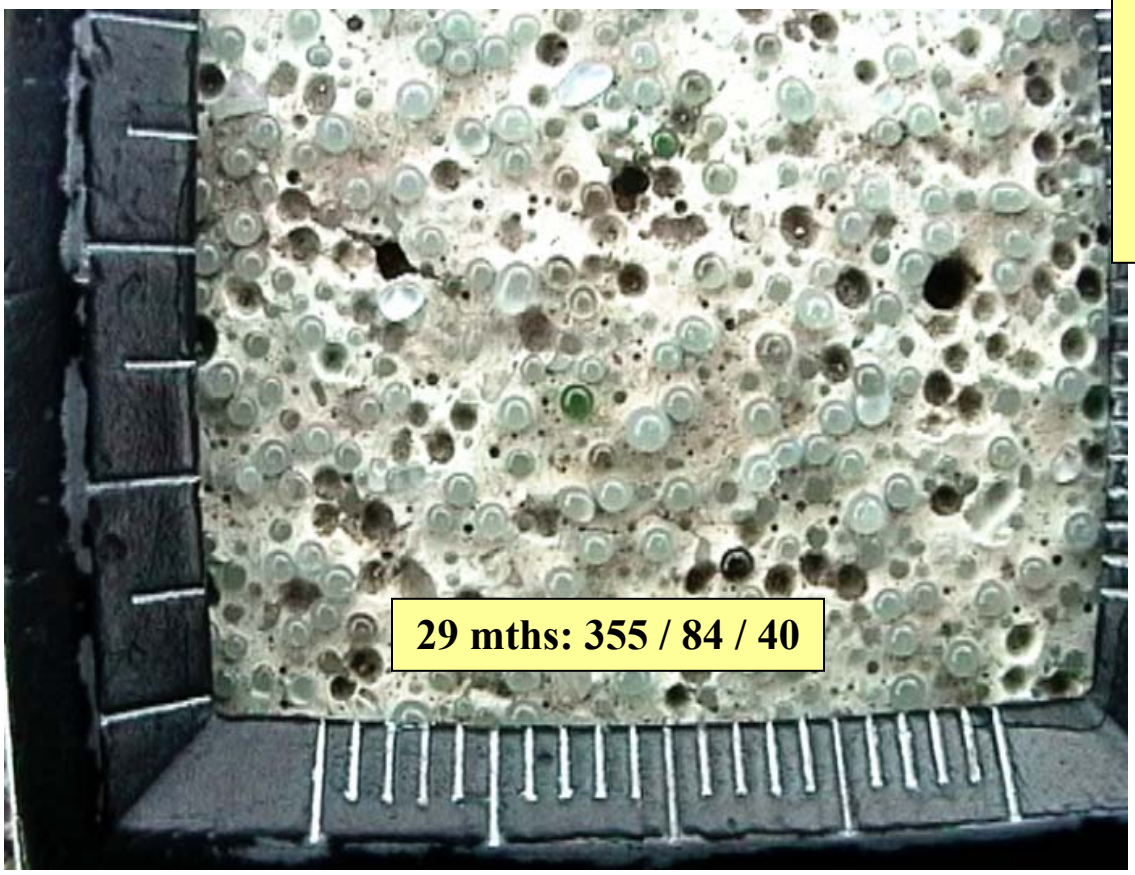
A selection of macro photographs follow, that show how the thermoplastic markings have performed / appeared over time. The three numbers in each photo represent dry retro / wet retro / and skid resistance.

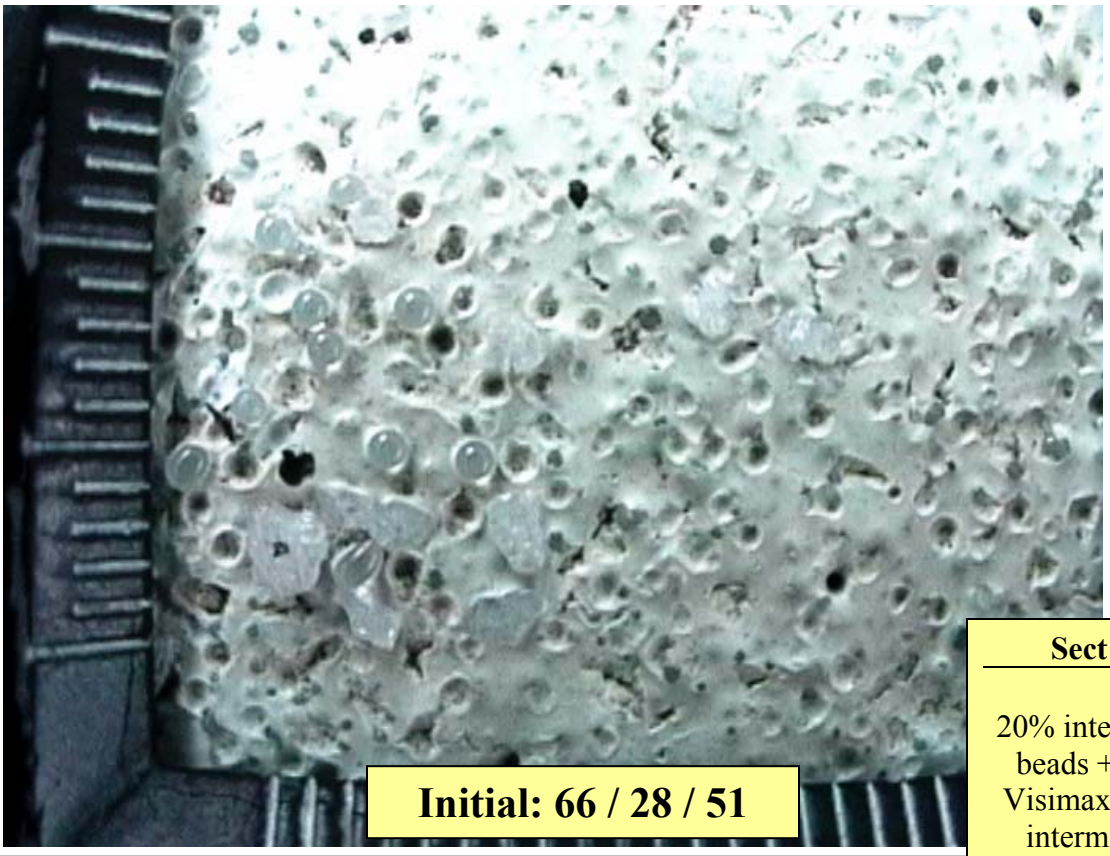
Dry retro / Wet retro / Skid resistance

Sect 15

20% intermix beads + 10% Visimax AC07 intermixed. and Surface applic of Visimax AC07 @ 400g/m2

Section 15, Initial and at 29 months

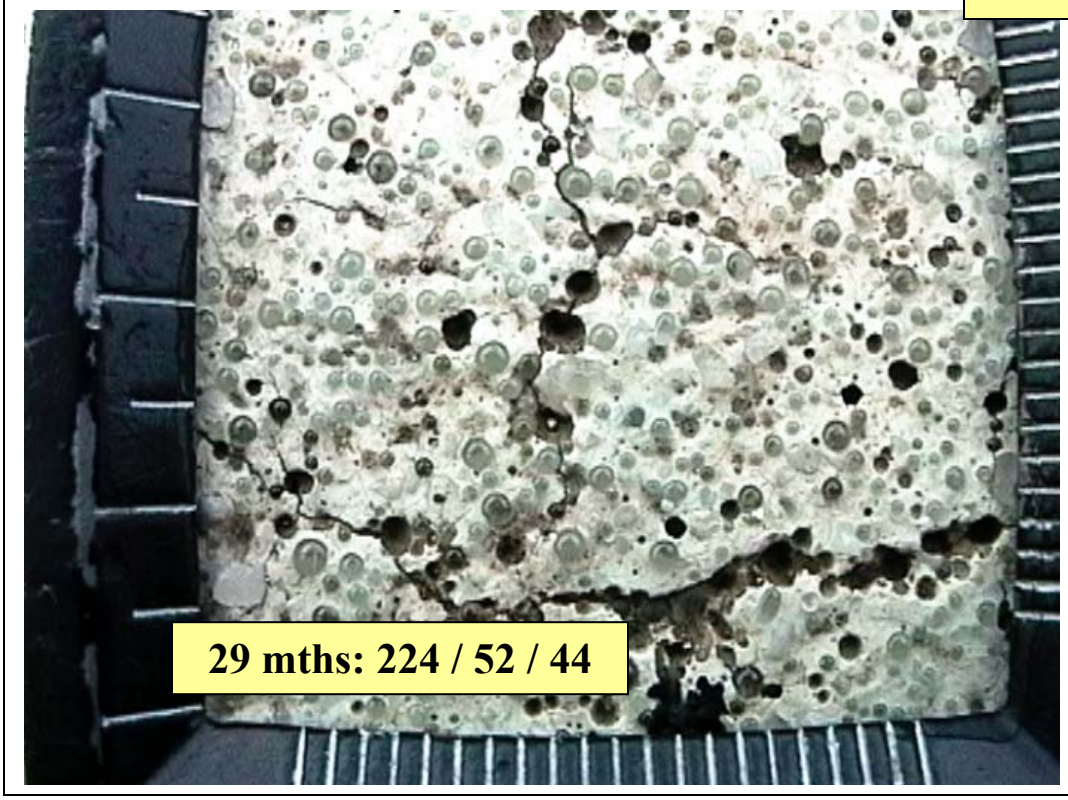


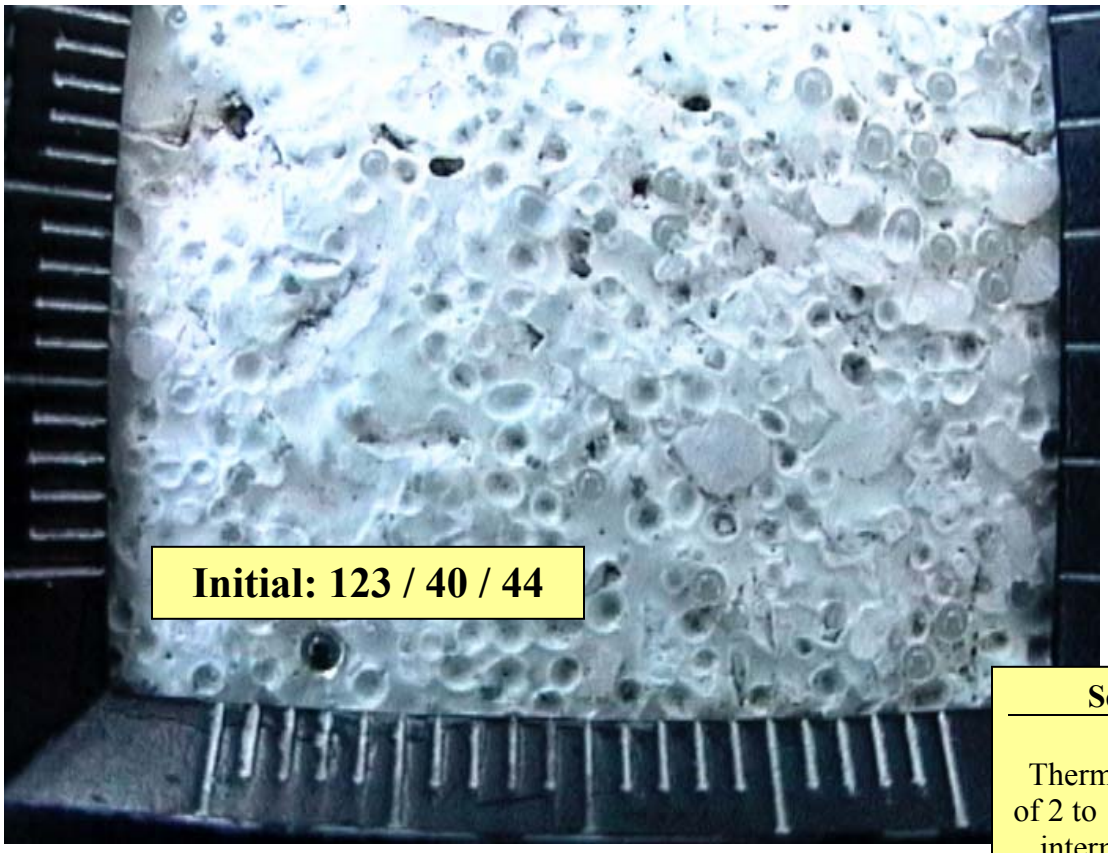


Sect 17

20% intermixed beads + 10% Visimax AC07 intermixed.
and
Surface applic of 2 to 1mm corundum @200g/m2 and Visimax AC07 @ 400g/m2

Section 17, Initial and at 29 months

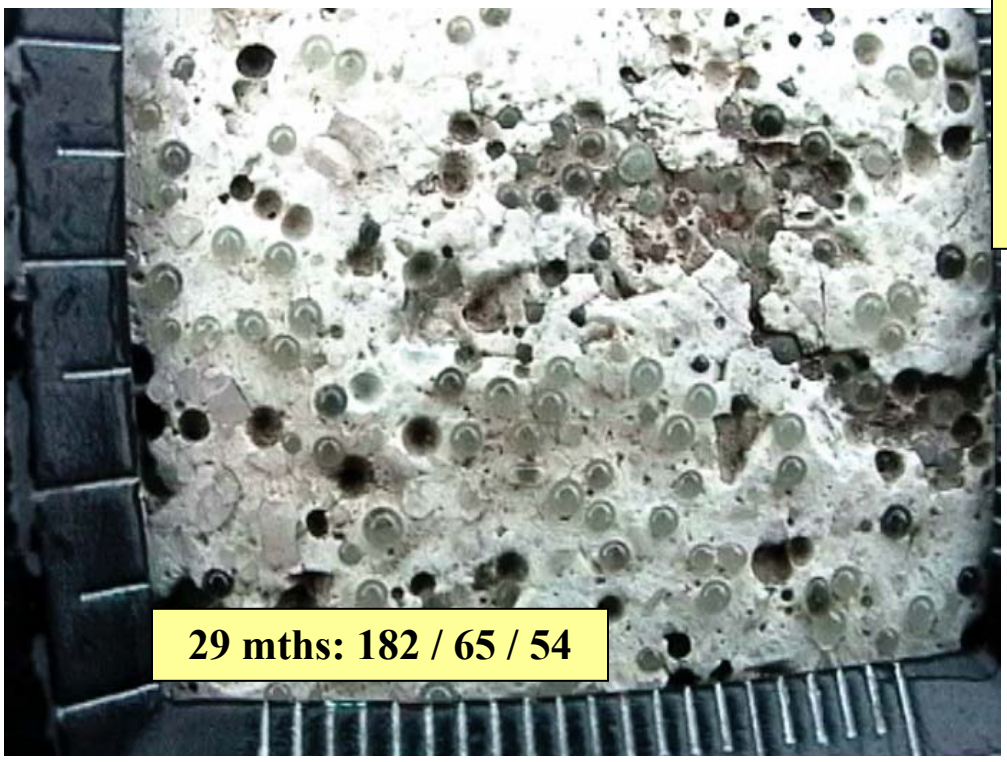


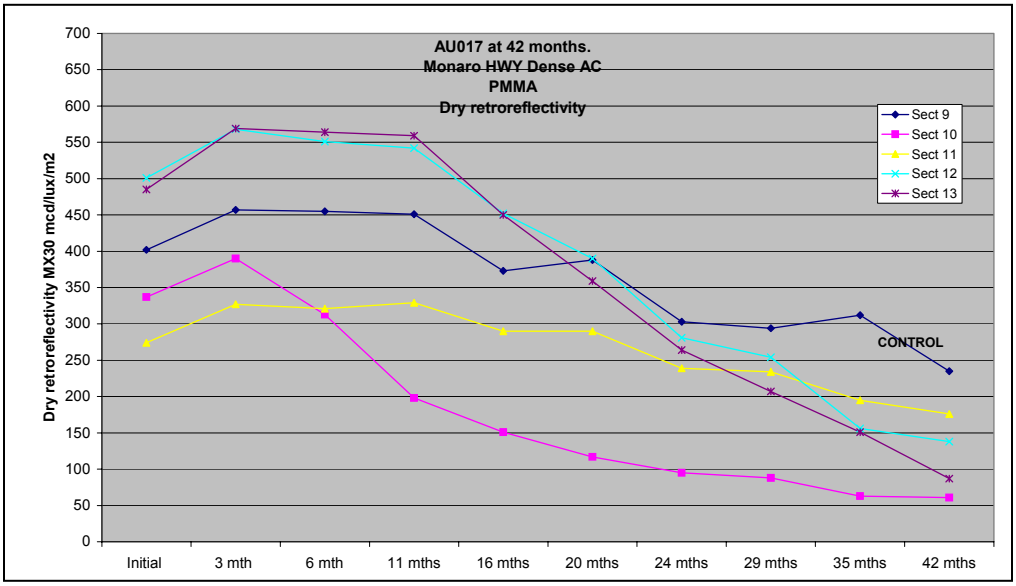


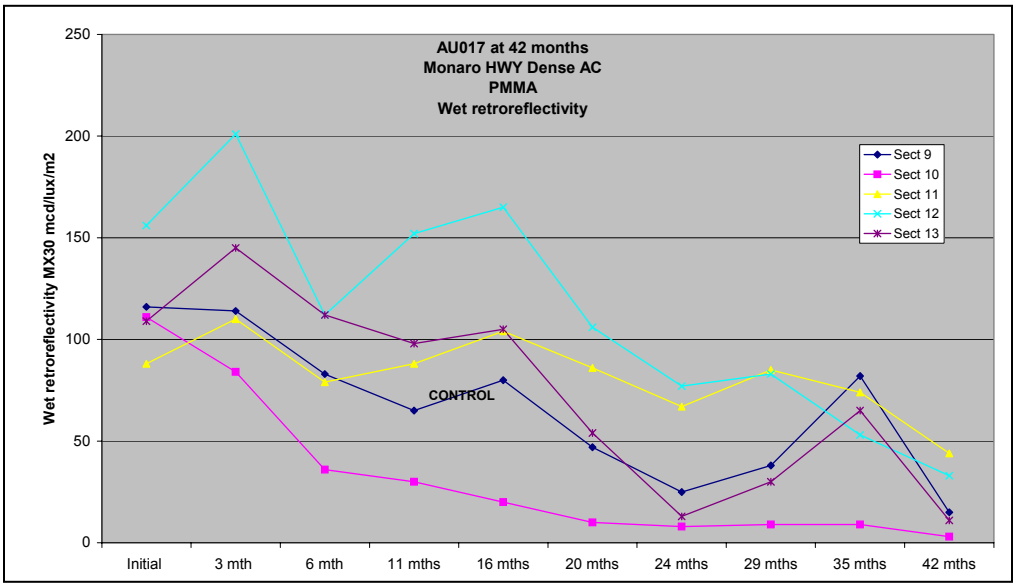
Sect 19

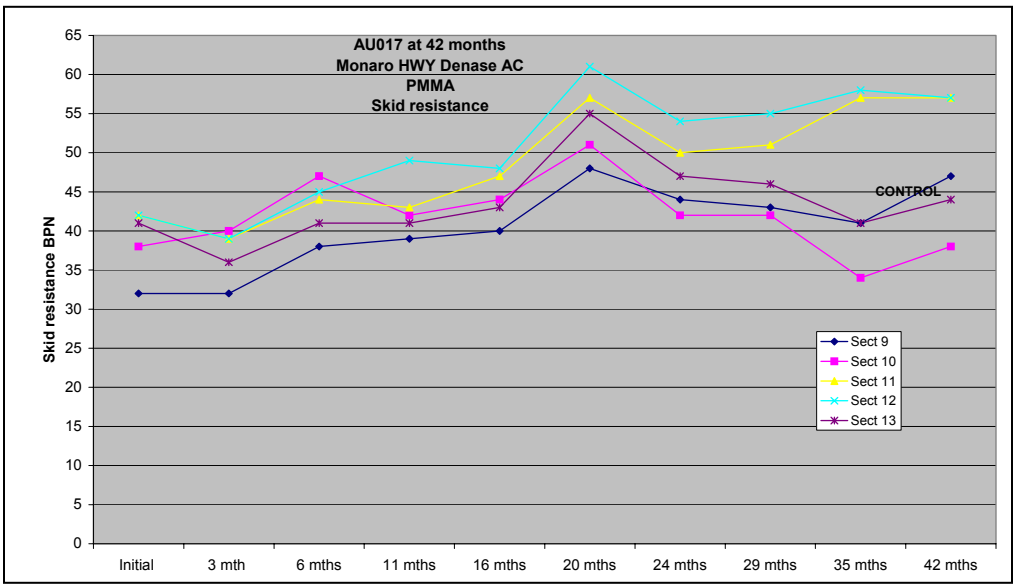
Thermo with ?% of 2 to 1mm quartz intermixed and 20% Visimax AC07 as an intermix.
and
Surface applic of 0.5 to 2.36mm corundum and Visimax AC07 @ 400g/m2

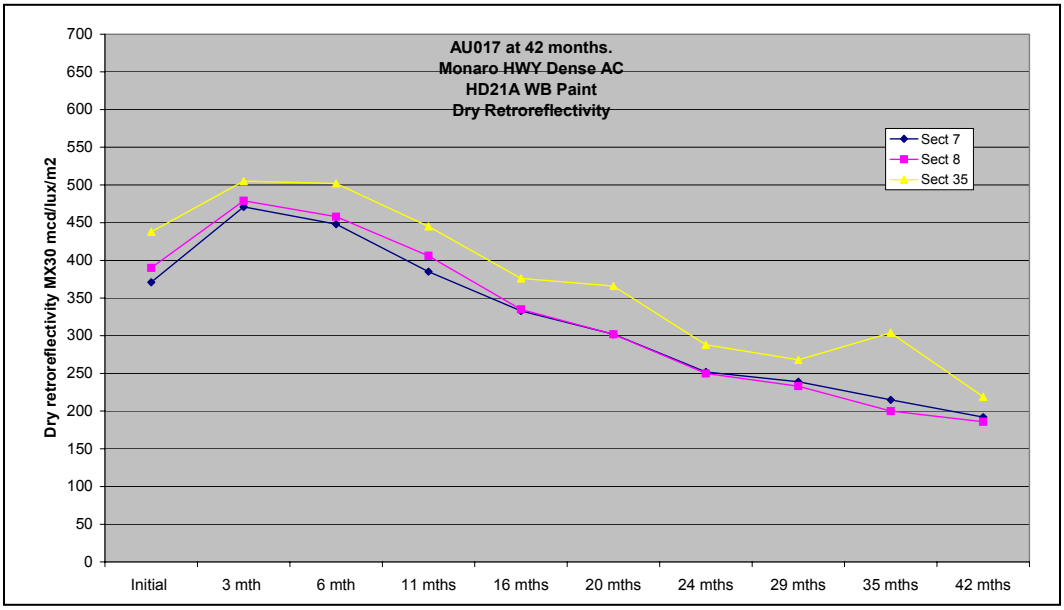
Section 19, Initial and at 29 months

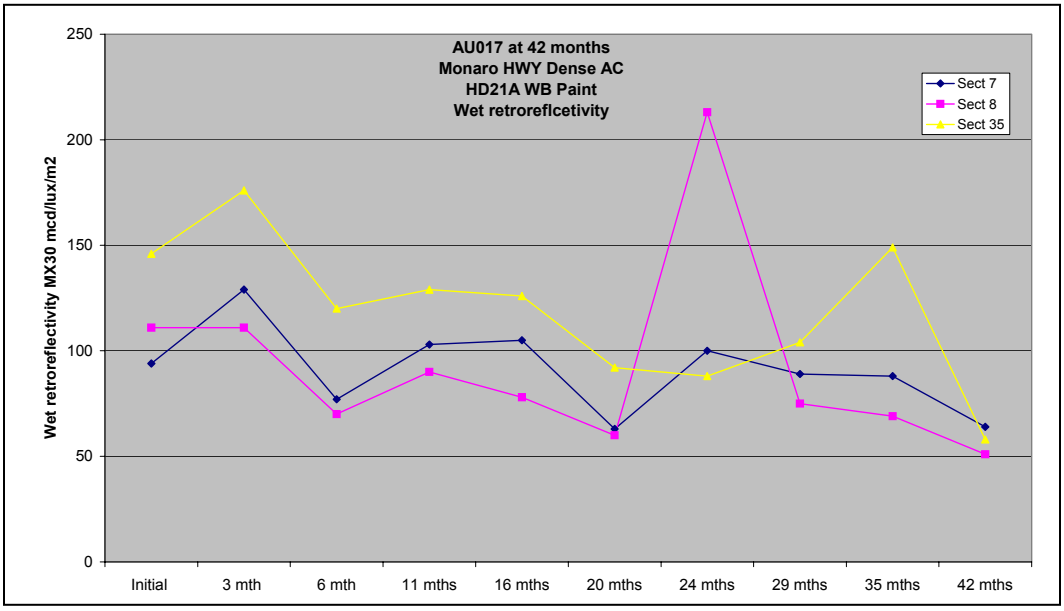


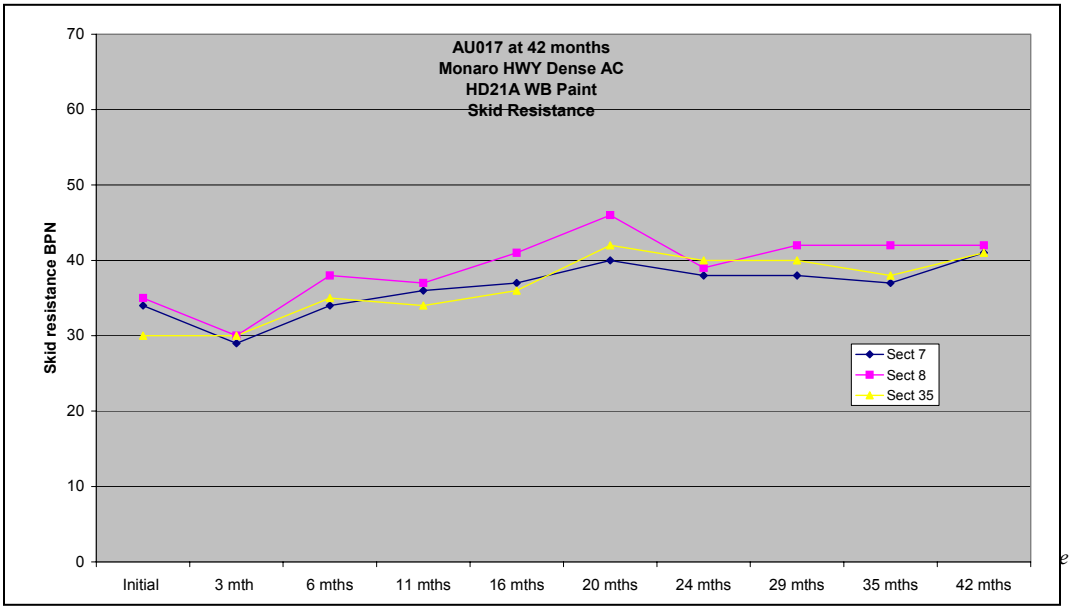

AU017 at 42 months.
Monaro HWY Dense AC
PMMA
Dry retroreflectivity
Dry retroreflectivity MX30 mcd/lux/m2
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
Initial
3 mth
6 mth
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths
Sect 9
Sect 10
Sect 11
Sect 12
Sect 13
CONTROL

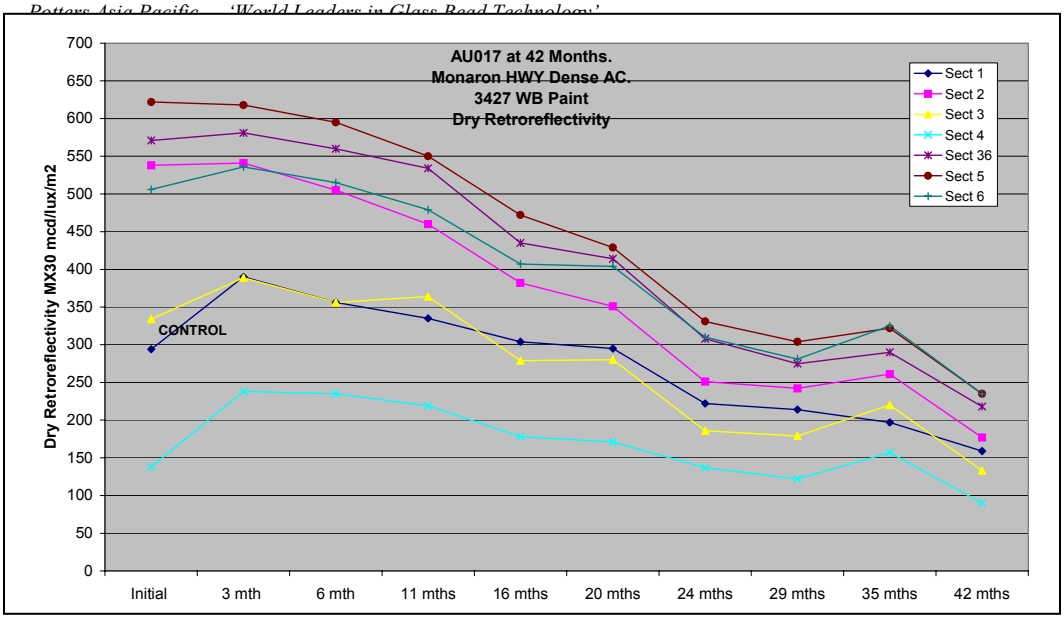

AU017 at 42 months
Monaro HWY Dense AC
PMMA
Wet retroreflectivity
Wet retroreflectivity MX30 mcd/lux/m2
250
200
150
100
50
0
Initial
3 mth
6 mth
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths
Sect 9
Sect 10
Sect 11
Sect 12
Sect 13
CONTROL

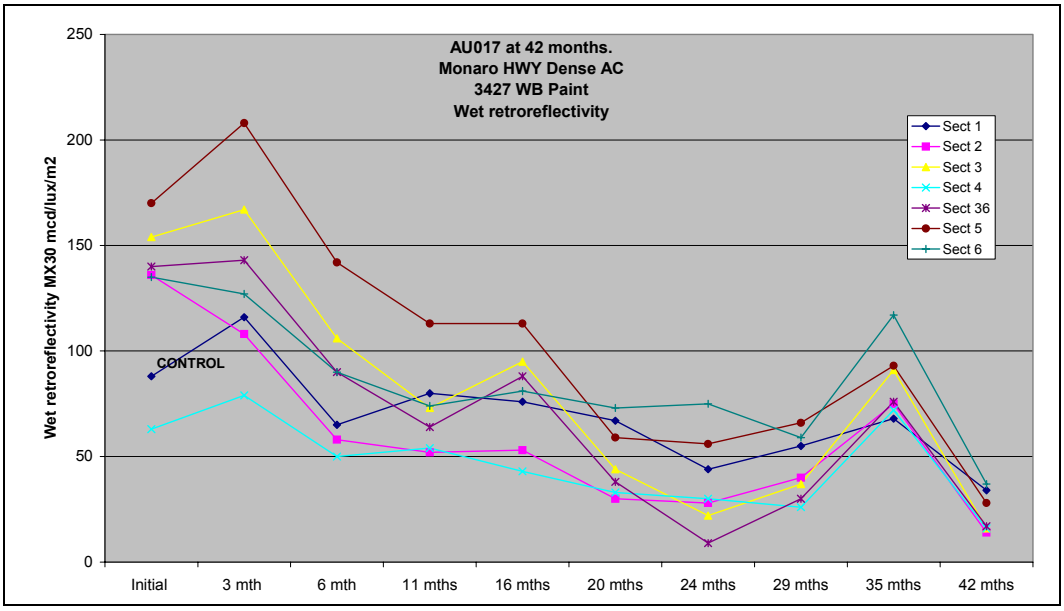

AU017 at 42 months
Monaro HWY Denase AC
PMMA
Skid resistance
Skid resistance BPN
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Initial
3 mth
6 mths
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths
Sect 9
Sect 10
Sect 11
Sect 12
Sect 13
CONTROL

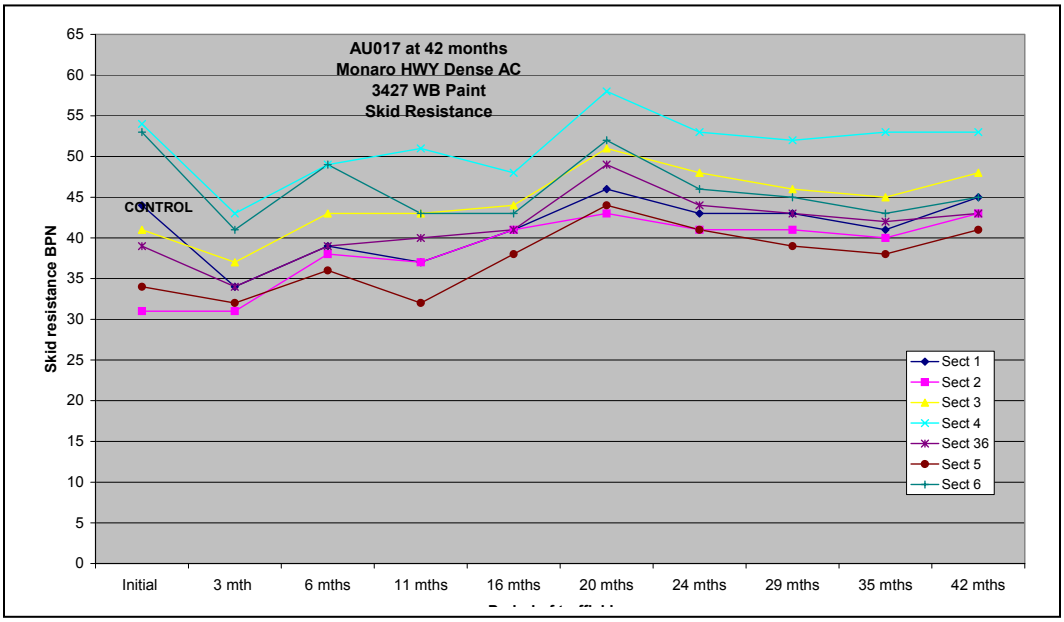

AU017 at 42 months.
Monaro HWY Dense AC
HD21A WB Paint
Dry Retroreflectivity
Dry retroreflectivity MX30 mcd/lux/m2
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
Initial
3 mth
6 mth
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths
Sect 7
Sect 8
Sect 35


AU017 at 42 months
Monaro HWY Dense AC
HD21A WB Paint
Wet retroreflcetivity
Wet retroreflectivity MX30 mcd/lux/m2
250
200
150
100
50
0
Initial
3 mth
6 mth
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths
Sect 7
Sect 8
Sect 35


AU017 at 42 months
Monaro HWY Dense AC
HD21A WB Paint
Skid Resistance
Skid resistance BPN
70
60
50
40
30
20
10
0
Initial
3 mth
6 mths
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths
Sect 7
Sect 8
Sect 35


AU017 at 42 Months.
Monaron HWY Dense AC.
3427 WB Paint
Dry Retroreflectivity
Dry Retroreflectivity MX30 mcd/lux/m2
CONTROL
Sect 1
Sect 2
Sect 3
Sect 4
Sect 36
Sect 5
Sect 6
Initial
3 mth
6 mth
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths


AU017 at 42 months.
Monaro HWY Dense AC
3427 WB Paint
Wet retroreflectivity
Wet retroreflectivity MX30 mcd/lux/m2
CONTROL
Sect 1
Sect 2
Sect 3
Sect 4
Sect 36
Sect 5
Sect 6
Initial
3 mth
6 mth
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths


AU017 at 42 months
Monaro HWY Dense AC
3427 WB Paint
Skid Resistance
Skid resistance BPN
CONTROL
Sect 1
Sect 2
Sect 3
Sect 4
Sect 36
Sect 5
Sect 6
Initial
3 mth
6 mths
11 mths
16 mths
20 mths
24 mths
29 mths
35 mths
42 mths

8. Compare Results

The intention was never to compare basic pavement marking binder systems against one another. The aim was to trial combinations of drop-on and intermixed materials with each binder system (thermo, pmma and paints). However, one cannot help but notice the performance of some waterborne paint systems compared to what some people call 'long life' products. It must be noted that this is a trial and therefore the lane was closed to traffic for a considerable time, allowing a long cure time for the waterborne paints. In the real world, this may not be the case and therefore the results may be quite different.

9. Conclusions

The last time this trial site was visited and measures taken was 42 months after the applications took place, in early May 2007. In spite of not everything working out as planned, many of the pavement marking systems are alive and well and many of them are still performing at a level that one might expect conventional markings to start at on day one.

10. What's Next

Potters continues to partner with RTA and other Road Authorities and Contractors to build performance information for the benefit of industry and the motoring public in the quest for safer performing pavement marking systems. One of the latest projects was applied in April 2006 - Field trial AU020, where the RTA used Potters DART applicator to trial enhancements of thermoplastic audio tactile pavement markings.

A new round of pavement marking field trials is being planned. We look forward to hearing from parties interested in being involved.

Biography - Bob Carnaby

Bob Carnaby has been involved in the road-marking industry for the past thirty-nine years. He has worked in both the public and private sector, always directly involved with road-marking application activities. Over this period Bob has managed road-marking operations, consulted to ARRB Transport Research, sat on Standards committees, and chaired sub committees in the areas of safety and development of training with the Australian Road Marking Industry Association. He has initiated and been involved with large scale road-marking field trials in various parts of the Asia Pacific Region, Europe and the United States.

Bob has presented papers at domestic and international conferences such as, ARRB , Austroads Road Safety, AITPM, Roadmarking Industry associations of Australia and New Zealand, and the Indian Road Congress.

Bob is employed by Potters Asia Pacific as Product Manager, Highway Safety Products.