FINAL REPORT

P18 Polymer Modified Emulsion Sprayed Sealing Trials: Experimental Protocol (2013/14)

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SUMMARY

The use of polymer modified emulsions (PMEs) for primersealing/sprayed sealing is gaining attention in Queensland but there are no specifications developed for PME binders and no selection and design guidelines available for PME primer seals.

A technical note on selection criteria for PME seals, a trial implementation guideline and a trial specification for PME applicable for Queensland conditions were prepared in their draft forms in 2013 and early 2014 by a consulting company (GHD) for the Department of Transport and Main Roads (TMR). TMR want to validate these draft documents by conducting field trials, and therefore asked ARRB Group to prepare a PME field trial protocol largely based on these three draft documents.

This report presents a PME field trial protocol. In the protocol, particular attention has been given to evaluate the applicability, sustainability, feasibility and the relative performance of selected PMEs available/used in Queensland at the time this protocol was developed (and/or those potentially available) through the construction and monitoring of the trial sites.

The protocol also addresses:

- the selection and evaluation of trial sites
- the design variables to be tested
- guidelines for construction and
- guidelines for monitoring and inspection in the short and long terms.

Conducting field trials according to this protocol will improve understanding of the construction of PME sprayed seal treatments, and also provide an opportunity for the industry to become familiar with the protocol and the specifications for PME binders and construction. The effectiveness of these documents can then be validated and revised as appropriate.

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1 PROJECT BRIEF

The use of polymer modified emulsions (PMEs) for primersealing/sprayed sealing is gaining attention in Queensland since PMEs are expected to have several technical (e.g. extended sealing seasons) and environmental (e.g. no use of cutter oils) advantages over the use of conventional hot bitumens, polymer modified binders (PMBs) or cutback bitumens for the same purpose. However, PMEs are also known to have issues during transport and construction (e.g. a possible 'run off' problem at ambient temperature) and thus require appropriate guidelines for their use (e.g. how to store the material). These advantages and issues are briefly discussed in Section 2.

The use of PMEs for sealing applications may increase with time due to these potential advantages. Given this, TMR has prepared draft technical notes for the selection criteria for PME seals, a trial implementation guideline for PME (Department of Transport and Main Roads 2012) and a trial specification for sprayed seal emulsion surfacing (Department of Transport and Main Roads 2013). Since these documents will need to be validated by conducting field trials, TMR requested ARRB Group to develop a field trial protocol for PME sealing binders largely based on these draft documents. Conducting field trials according to the protocol would therefore provide an opportunity to review the effectiveness of these documents which can then be revised as appropriate.

1.1 Aim of the Project

The aim of this project is to develop a PME primerseal/sprayed sealing field trial protocol based on the following documents:

- TMR 'Polymer modified emulsion trial implementation guideline' (Department of Transport and Main Roads 2012)
- TMR 'Trial specification for sprayed seal emulsion surfacing using bitumen emulsions' (including polymer modified bitumen emulsions) (Department of Transport and Main Roads 2013)
- 'Austroads 'PMB sprayed seal trials experiment protocol' (BSRRG committee internal report 2011).

2 BACKGROUND

2.1 Polymer Modified Emulsions

Some potential technical and environmental advantages of using PMEs for primersealing/sprayed sealing are considered to be as follows:

- PMEs more easily percolate wet/damp aggregates and base (attributed to the enhancement of chemical wetting by emulsifying agents).
- Some PMEs are more robust than unmodified emulsions.
- The sealing season may be extended.
- PMEs may be able to provide surfacing options that can be used in cooler weather (Vercoe et al.2006; Parfitt 1999).
- Benefits are expected in terms of work health and safety (WH&S), such as through a lower spraying temperature (< 100 °C) that leads to reduced risk of explosion and fuming (e.g. Neaylon et al. 1997).

Potential issues when using PMEs include:

- There may be a delay between application and opening to traffic to ensure that the emulsion has broken and cured sufficiently (e.g. Neaylon et al. 1997; Parfitt 1998; Parfitt 1999).
    - Breaking of emulsion sealing binder is deferred by high humidity (i.e. moisture content of pavement and aggregates and climatic humidity) and spreading of aggregates. More aggregate is required when rack-in coat is used to cover the emulsion before opening to traffic.
    - Breaking of emulsion sealing binder may be deferred or not take place in high temperatures.
- There may be a 'run off' (low viscosity) problem at ambient temperature at which PME binder may run into water channels and gutters. In addition, PME seals can be damaged in the event of rainfall prior to breaking of emulsion and up to 24 hours after spraying (e.g. Booth et al. 1995; Neaylon & Gillespie 1994; Thompson 2012).
- Emulsion binder can be considerably less stable than hot bitumen and PMB, especially over long haulage distances.
- Emulsion seals are manufactured to a given stability, which may be related to nominal temperature ranges and the aggregate expected on-site – there is a lack of on-site adjustability and adaption to changing conditions as compared to hot conventional PMB and cutback seals.
- There are additional transport costs and energy consumption in carting emulsions over long distances.

One of the critical factors in failure of PME seals/primer seals is the 'green strength' issue.

The *Glossary of Austroads terms* (Austroads 2010a) defines a 'green strength' of emulsion binders as:

> The cohesive strength developed in the binder at any time between application and complete cure.

High 'green strength' is essentially preferred in order to minimise the 'cheesy state' – a state when the emulsion has broken but the water still remains in the binder film. The green strength is directly related to when the seal can be opened to traffic (Howard et al. 2011). Until the emulsion seal has broken and cured sufficiently to hold the aggregate particles in place, it is vulnerable to stone loss caused by traffic action. Insufficient 'green strength' is believed to be the critical cause of stone loss in the field due to the binder not being fully cured to permit proper binder to aggregate bonding. This 'green strength' issue has been supported by a number of emulsion road trials

conducted in Australia and overseas (e.g. Gransberg & James 2005; King & Johnston 2012; Neaylon et al. 1997; Parfitt 1998; Parfitt 1999; Thompson & Cremasco 2010).

More information about emulsion seals such as the adhesion mechanism, green strength and breaking and curing process can be found in a published Austroads report 'Literature review of the adhesion mechanisms in emulsion seals' (Austroads 2014).

The successful selection, design and application of PME sprayed sealing treatments has relied on skilled practitioners and site supervisors who are able to apply proper judgement and 'rules of thumb' to take into account the many variables that can affect performance on site.

2.2 About the Trial Protocol

The field trial protocol which has been developed is presented in Section 3 to Section 6 in this report. The protocol aims to provide guidelines and principles in establishing PME primerseal/sprayed sealing trials in Queensland.

When PME primerseal/ sprayed sealing trial sites are ready to be constructed (subject to available resources and strategic planning); the applicability, sustainability, feasibility of selected PMEs currently available/used in Queensland (and/or those potentially available) should be evaluated through the construction and monitoring of the trial sites. Relative performance should also be assessed provided control sites can be included in a trial. If funded for subsequent work this could include monitoring performance over the longer term.

The performance of selected PME binders should be investigated at the following two levels:

1. As a PME seal/primer seals – evaluated by examining the four crucial properties of bitumen emulsion that underpin effective applications (Read & Whiteoak 2003) as below:
    (a) Product stability: for example during the course of storage, settlement, pumping, heating, transport to trial site and application, breaking and curing (i.e. green strength).
    (b) Rheology: optimum viscosity of the binder that is low enough for ease of handling, but high enough to prevent material 'run off' in challenging pavement conditions such as cambers or steep slopes.
    (c) Breaking: breaking time is affected by environmental conditions (e.g. temperature, humidity and wind speed) and external mechanical agitation (e.g. slow moving traffic and rolling) (Asphalt Institute 2006; Gorman et al. 2004; Isacsson 1985; Read & Whiteoak 2003). Rapid and complete breaking and curing (green strength) of emulsion after application are important for effective adhesion to the aggregates and pavement. The breaking time can be decreased by some of the key parameters as listed below:
        - increase in bitumen content and emulsifier content in the aqueous phase, having larger bitumen particles
        - application of aggregates (due to absorption of emulsifier on the aggregate and water evaporation)
        - use of breaking agent.
    (d) Adhesivity: degree of adhesion between the PME seals/primer seals and the base course and cover aggregate.

    More information on these four properties is presented in the Austroads report on adhesion in emulsion seals (Austroads 2014).

2. Resistance to stripping of aggregate by trafficking, usually in the presence of water. The degree of stripping can be assessed by using test method Q720 *Loose aggregate on sprayed seals* (Q720) (Department of Transport and Main Roads 2014).

The trial protocol addresses:

- the selection and evaluation of trial sites
- the design variables to be tested
- guidelines for construction
- guidelines for monitoring and inspection in the short and long terms.

The establishment of the trial would provide better understanding of the construction of PME treatments, and also provide an opportunity for the industry to be familiar with the this trial protocol, trial specifications for emulsion sealing binders (Department of Transport and Main Roads 2013) and construction which can then be validated and revised as appropriate.

3 SITE SELECTION

Districts/regions of TMR are to identify potential trial sites using the 'Trial site selection worksheet' (refer Appendix A) and submit to the Pavement, Research and Innovation Section of TMR for assessment. These candidate sites are to be inspected by the Pavement, Research and Innovation Section for suitability in addressing the trial objectives based on a number of criteria:

3.1 Site Selection Rationale

The sites used for these field trials should (Department of Transport and Main Roads 2012):

- avoid high risk areas (e.g. areas with high traffic volumes, politically sensitive areas or exposed road sections and environmentally sensitive areas)
- be straight and uniform in appearance, have a minimum section size of 20 000 m^2, with a preferable size > 50 000 m^2 that is sufficient to include a control section and additional sections for the use of more than one PME product and aggregate combination
- include a control section consisting of C170 bitumen and/or unmodified emulsion binder (e.g. cationic rapid setting (CRS) with 60% binder content)
    - control sections with comparable PMBs could potentially be included
- have appropriate allowances for material stockpiles and construction vehicle movements and
- preferably be on a section of road where environmental, pavement and traffic conditions are similar.

The hauling times between the location of manufacture and trial sites, as well as the handling and storage requirements should be considered and agreed by the manufacturer/supplier and contractor, and then well documented. Initial trials could focus on areas closer to binder suppliers.

Initial focus is on trial sites conducted on a newly constructed and completed base layer. It may be an initial seal, temporary primerseal, or preferably a more permanent primerseal. However, reseals could also be included.

Ideally PME sprayed sealing trials would be trialled for at least one year (preferably two) and undertaken in a number of areas to represent the various climatic conditions expected, including the West, East, North and South of the state.

4 DESIGN

All PME primerseal/initial seal designs should be completed either by the TMR District concerned or the Pavement, Research and Innovation Section, and in consultation with the supplier/manufacturer. If the design is carried out by the TMR District, it should also be reviewed by the Pavement, Research and Innovation Section.

Selection and design of PME seal should be in accordance with the trial selection and design guidelines, or Austroads sprayed seal design method AP-T68/06 (Austroads 2006b) as relevant; this includes the use of appropriate PMB factors. (The former will be more likely the case as there is no/limited guidance in Austroads for PMEs.) The required residual binder at 15 °C should be determined as specified in Part 2 of the TMR trial specifications (Department of Transport and Main Roads 2013). The residual binder is used to determine the spray application rate.

Contractor designs are also an option.

4.1 Aggregate Selection

The following design factors with regard to aggregate are to be considered when establishing the trials:

- Type:
  - A single type of aggregate source from the same quarry should be used as the control in the trial for all the emulsion sealing binders. (Compatibility with the emulsion(s) to be used should be considered.)
- Size:
  - For single/single seals sizes 10 mm and/or 7 mm are to be used.
  - Depending on the design and sealing operations, a smaller size of aggregate (e.g. 5 mm) may be required to use as a rack-in coat before rolling).
- Properties:
  - The selected aggregate is to be tested to ensure that the properties comply with the TMR trial specification (Department of Transport and Main Roads 2013 - Part 3: Clauses 5, 8 and 13). Tests are to be conducted by the contractor and reported to TMR.
- Aggregate spread rate (ASR):
  - The ASR is to be designed in accordance with the Austroads sprayed seal design method AP-T68/06 (Austroads 2006b) and measured on site using an aggregate canvas mat and scales (Department of Transport and Main Roads 2013 - Part 1: Clause 15).

Weather conditions and how precoating takes place needs to be considered for all aggregates used. Approval of the aggregate selection and test results is to be sought from TMR before the construction of any trials.

4.2 Binder Selection

As well as using conventional C170 bitumen as a control, the number and type of emulsion binders (i.e. those specified by Department of Transport and Main Roads (2013)) to be included in a trial would be determined by TMR. Emulsion binders that are potentially available in Queensland may be included. Control sections with comparable PMBs could potentially also be included. The number and types of emulsion binders would depend on a number of factors including project constraints, site locations and length, number of sites and available resources.

Each trial site should include candidate emulsion binders as advised by TMR. Different manufacturers may be used for trials in different locations or regions.

5 CONSTRUCTION

5.1 General

During the construction of a trial, it is preferred that a site supervisor is assigned to take responsibility for all spraying construction activities, at all sites included in the trial. This is to ensure consistency in work practices throughout the construction.

Each test section, if deemed appropriate by the site supervisor or TMR, should be left with a small segment of the existing pavement by covering it with paper before spraying. All compliance sampling and testing requirements as outlined in the trial specification (Department of Transport and Main Roads 2013) should be undertaken and reported.

Construction should be strictly in accordance with Part 1 of the TMR trial specification (Department of Transport and Main Roads 2013). Where certain properties of the trial sections are not in accordance with the trial specification and need evaluation, they should be in accordance with this trial protocol.

Note that when planning trials contingency arrangements need to be planned, decided and included/funded (e.g. an arrangement for dry matting if stripping occurs) prior to any of the works commencing. All the details mentioned in Section 5.2 to Section 5.4 are required for control sections as well.

5.2 Pre-construction Activities

5.2.1 Existing Surface Data

Once a site has been chosen as appropriate for the trials, the existing condition of the site should be well-documented so that any anomalies that arise during the trial may be explained.

The following data should be collected before the sealing trial is constructed (Austroads report 2011):

- an estimate of the binder absorption by the existing surface
- an estimate of the aggregate embedment as determined by the ball penetration test (Austroads 2010b) if appropriate
- the surface texture of existing surface (with regular measurements needed in the transverse and longitudinal directions for each lane and in the longitudinal direction for each shoulder)
- photographs of existing surface prior to placement of the trial seal
- size of underlying seal also needed if the trial is a reseal.

5.2.2 Seal Design Data

The traffic data and seal design inputs are to be obtained in accordance with the TMR trial specification (Department of Transport and Main Roads 2013: Part A: Clauses 7.3 and 7.4). Sufficient sampling and testing should be carried out to ensure that the seal is constructed as designed (e.g. aggregate spread and binder application rates) and the selected emulsion binders and aggregate used in the trial comply with relevant requirements of the specification (e.g. Department of Transport and Main Roads 2013: Part 2 and Part 3).

All the experimental candidate emulsion binders (Section 4.2) for use in the trial are to be subjected to a binder recovery test (to be advised by TMR). This is to minimise discrepancies between test results. The residual binders recovered from ‘as delivered’ and ‘as manufactured’ PME samples are to be tested to assess their conformity to the TMR trial specification (Department of Transport and Main Roads 2013: Part 2). Other binders (e.g. for control/comparison sections) need to be sampled and tested at the point of delivery and point of manufacture in accordance with the relevant specification(s).

The worksheet in Appendix B details visual inspection and measurement requirements. Confirmation of the seal design must be obtained prior to commencing construction of trials.

5.2.3 Data Record

The following information is to be recorded during binder manufacture, transport and storage:

- manufacture: date, time and location of manufacture of binders
- transport:
  - haulage distance, delivery date and travel time from the manufacturing plant to the trial site
  - temperature history: including heating events and their duration and temperatures during transport
  - circulation details during transport
  - details of the binders that were transported using the same tank/container prior to the introduction of the PME binder for the current work.
- Storage:
  - date and time for introduction into the storage facility
  - details of the storage facility (e.g. type)
  - temperature history: including heating events and their duration and temperatures during storage
  - circulation details during storage
  - details of the binders that were stored in the storage tank/container prior to introduction of the PME binder for the current work.

5.3 During Construction

5.3.1 Sampling

One person is to be assigned to manage the sampling during construction. Samples need to be clearly traced to manufacturing and construction lots.

Sampling of Aggregate

- Samples of the aggregate used should be taken, with the time, date and condition (e.g. dusty/clean, dry/damp, etc.) recorded.
- A 20 kg sample of each aggregate used for the trials should be collected.

Sampling of Binder: As Manufactured and As Delivered

Samples of each binder should be taken, with the time and date recorded, at two stages of product delivery:

- Ex-factory (as manufactured) – take two representative samples of 10 L in TMR approved containers during transfer to the transport vehicle/container.
- From on-site storage just prior to loading into the sprayer (as delivered) – take two representative samples of 10 L in TMR provided plastic containers

Both as manufactured and as delivered samples are to be tested for compliance according to the standard test methods specified in TMR (2013) and within the recommended time frame as specified by the manufacturer/supplier since sampling. Timing between sampling and testing needs to be recorded as well.

All samples should be clearly and uniquely labelled and stored appropriately.

5.3.2 Data Record

Record the following seal design and climatic parameters during construction of the trial:

- Binder on the trial site:
  - — date and time of binder arrival on the trial site
  - — temperature history: including heating events and duration and temperatures between arrival on the trial site and loading into the sprayer
  - — date and time of transferring the binder from storage into the sprayer
  - — temperature history: include heating times and temperatures while stored in the sprayer
  - — circulation details while stored in the sprayer
  - — on-site viscosity measurements using the Rheon handheld viscometer (for information only)
  - — date and time of spraying.
- For each spray run:
  - — binder and aggregate used (including degree of pre-coating and agent used)
  - — nozzles used for each binder
  - — the design and actual binder application rates
  - — the design and actual aggregate spread rates
  - — the details of the rack-in coat (when applicable) including the size of aggregate used
  - — details of the rolling including the type of roller used, rolling speed, number and duration of roller passes.
- Ambient temperature (T_a), pavement temperature (T_p), time (t), humidity (H) and wind speed (if appropriate) when:
  - — spraying binder
  - — spreading the aggregate
  - — the binder breaks, including the duration of breaking and curing time
  - — applying rack-in coat (when applicable)
  - — rolling including time that rolling commences and ceases.

After rolling, record:

- time of brooming
- time and duration open to controlled traffic and the traffic speed limit
- time between treatments/applications (for double/double seals)
- measures taken to determine when the trial sections are suitable for opening
- time when the speed limit was raised and a new speed limit was applied (if applicable)
- any other information / data that may be of interest
- the minimum ambient temperature achieved 12–24 hours after completion of the seal
- results of an immediate inspection of initial adhesion-cohesion of seal (refer to Appendix B)
- the degree of aggregate stripping at each trial section (BWP and OWP) using Q720
- the time open to uncontrolled traffic and measurements implemented.

Ideally the climate history would be logged using an onsite piece of equipment. Sprayed sealing sheets need to be completed, verified and provided. Traffic management practices need to be recorded.

5.4 Post-construction

At the end of the day of trial construction:

- Inspect and re-photograph all the trial sections.
- Take note of any bleeding, material run-off and any type of distress evident on the bituminous surfacing.
- If stripping has occurred, photograph and determine the degree of aggregate stripping observed in between wheel paths (BWPs) and outside wheel paths (OWPs) for each trial section. Q720 should be used to measure the stripping value.

The next morning:

- Inspect and re-photograph all the trial sections – take note of any bleeding, material run-off and distress.
- Re-photograph and determine the degree of stripping in each trial section (BWP and OWP).

6 POST-CONSTRUCTION MONITORING

Unless advised otherwise, the trial should not be covered by a new surfacing, asphalt overlay or any other means within 12 months (preferably 24 months) and without first consulting the relevant TMR District and TMR's Engineering and Technology Branch. The trial should be regularly monitored by TMR.

Experience with Austroads seal trials has shown that approximately two years trafficking would be needed before any preliminary conclusions may be drawn in relation to the performance of a sprayed seal trial. Assessment made before this has not been found to be of value because the aggregate mosaic is still settling under traffic. However, long-term monitoring needs to be continued to confirm or amend any preliminary conclusions (Baburamani et al. 2000).

After construction, it is suggested that a short-term monitoring (see Section 6.1) be conducted on a regular basis for up to two years. After two years, a long-term monitoring program (see Section 6.2) should be in place to inspect the seal performance every two years until 10 years after construction if applicable. In addition, field samples should be taken at regular intervals so that the viscosity of binder can be measured in a laboratory. The viscosity data can be related to binder condition and may be indicative of cracking of the binder or loss of aggregate particles.

As a minimum, visual assessments should be made, possibly supplemented by pavement condition monitoring results (e.g. laser texture depths). Laboratory testing would ideally be included as well.

Prior to any rehabilitation treatment, the regional representative should notify TMR's Engineering and Technology Branch of the timing and nature of the required rehabilitation treatment and where failure or distress is observed (e.g. following a sudden heavy rain event or cold snap). An inspection of the section in question should be scheduled to determine/recommend if a final inspection and sampling are warranted.

An inspection report should be prepared and forwarded to TMR's Engineering and Technology Branch upon completion of each trial site inspection. Any anomalies should be reported immediately. Each binder and aggregate combination is to be reported separately.

6.1 Short-term Monitoring

An initial assessment (immediately after construction) and short-term monitoring of a trial (up to two years) should always be performed to identify deficiencies that arise from construction practices not related to the design of the sprayed seal. It is suggested a short-term monitoring be conducted after:

- seven days
- one month
- six months (if appropriate)
- one year
- two years.

It is essential that the type, severity and extent of the distress (e.g. bleeding and stripping) evident on the bituminous surfacing be well defined and be assessed quantitatively and/or qualitatively. Visual assessment of the distress is important to evaluate the condition and performance of the bituminous surfacings.

The monitoring includes:

- site description information
- photographic records of surface detail and overall site layout

- a visual inspection to rate the seal performance items as listed in Appendix B
- field measurements of embedment (where appropriate) by the ball penetration test *AG:PT/T251* (Austroads 2010b) and texture depth (where appropriate) by the sand patch test *AG:PT/T250* (Austroads 2008)
- sampling to enable laboratory viscosity measurement of recovered binder by microviscometry.

A worksheet for recording site information and assessment is provided in Appendix B for each trial inspection. While many of the assessment parameters may not be applicable during initial monitoring (e.g. aggregate polishing), it is good practice to record these parameters for future reference.

It is important to pay attention to the following for each trial inspection:

- Locate the start and end of the trial sections accurately.
- Clearly identify the trial sites, and post appropriate signs so that the regions would not conduct resealing or other maintenance treatments on the trial sites inadvertently.

6.2 Long-term Monitoring

Long-term monitoring of the trial to assess seal performance by visual site inspection, field and laboratory testing is important for on-going improvement of the cost-effectiveness of the surfacing technology. In addition, it enables verification and validation of the design procedure and construction practice of emulsion seals. The performance assessment program also assists in developing appropriate pavement maintenance and management strategies, including optimum resealing/rehabilitation programs.

An inspection of the trial sections should be scheduled at two, four, six, eight and 10 years and prior to normal intervention and at the onset of severe visible distress/failure, whichever occurs earlier.

It is most important that an inspection be scheduled when the seal is about two years old as this will often provide a guide to future performance. Long-term monitoring is similar to the short-term monitoring (Section 6.1) and includes the items listed below:

- photographic records of surface defects and the overall condition of the site
- visual inspection, field measurements and laboratory viscosity measurement of recovered binder as described Section 6.1
- measurement of ‘seal behaviour‘ using test method AG: PT/T253 (Austroads 2006a) from samples taken from the trial sections.

6.2.1 Failure Criteria

For the purpose of long-term performance assessment, the failure of a sprayed seal surfacing may be defined according to the presence of one or more of the following distress modes:

- mosaic/aggregate loss (stripping)
- bleeding/flushing
- binder oxidation or hardening.

The distress may or may not coincide with accepted intervention levels. The failure limits are defined with respect to the property assessed, its severity and extent and also the corresponding rating as shown in Table 6.1. Seal failure is considered to have occurred when any of these limits are exceeded. For example, a seal will be said to have failed if 15% or more of the trial section has a surface texture rating of 5.

Table 6.1: Failure limits of seal performance (Austroads 2011)

Property	Failure limits (%)	Rating
Mosaic (aggregate stripping) of total area	30	5
Binder level within wheel path	15	5
Surface texture over the total area	15	5 (< 0.7 mm)

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APPENDIX A TRIAL SITE SELECTION WORKSHEET

The trial site selection worksheet is based on the appendix given in the TMR 'Polymer modified emulsion trial implementation guideline' (Department of Transport and Main Roads 2012).

Note: All proposed trial sections need to be submitted to TMR's Engineering and Technology section for assessment to determine the suitability of the section against identified trial objectives.

1. LOCATION OF TRIAL SECTION

Description of the location of the trial section including local government region, start and end points of trial area, topography and proximity to nearby population centres and any other notes of interest.

Trial site local name:			
Road name and number			
Contract number			
Start chainage (km) (gazettal)		**End chainage (km) (gazettal)**	
Distance from the PME manufacturer plant (km)		**Date of line-marking**	
Topography / GPS location / local points of reference			
Lane(s) and carriageway(s)			
Other notes			

2. SIZE OF TRIAL SECTION

Length (m)		**Width (m)**		**Area (m^2)**	

3. ENVIRONMENTAL CONDITIONS

Details on the environmental conditions at the location of the trial including ambient temperature, annual rainfall, humidity, Average Recurrence Interval (ARI) of trial section and any locations along the trial section prone to flooding.

Table A 1: Climatic conditions at the trial site (obtain the Bureau of Meteorology data from the nearest station)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean maximum temperature (°C)													
Mean minimum temperature (°C)													
Mean rainfall (mm)													
Humidity %													
ARI													

4. TRAFFIC VOLUMES

Traffic volumes along the trial section

Average annual daily traffic volumes (AADT) (gazettal and against gazettal)		**Peak hour traffic volumes**	
Percentage of heavy vehicles (%)		**Historical growth rates**	

5. PAVEMENT INFORMATION

Details on the proposed pavement works along the trial section (e.g. reseal, base type, base thickness, existing subgrade CBR and swell conditions, proposed subgrade treatments, drainage etc.)

6. INTENDED MATERIALS

(a) Intended Binder Materials

Details on the intended binder materials (binder type, modified/ unmodified, quality conformance requirements)

(b) Intended Aggregate Materials

Details on the intended aggregate materials (aggregate type, nominal stone size, coating, grading, particle density and water absorption of fine aggregate, dry density / moist content relation of a soil etc.)

Aggregate type		**Nominal size (mm)**	
Aggregate ALD (mm)		**Aggregate FI**	
Particle density (kg/m^3)		**Water absorption of fine aggregate**	
Dry density (kg/m^3)		**Coating**	
Grading			
Others (please specify)			

7. MATERIAL SOURCE

(a) Source of Binder Materials

Source of intended binder materials

Manufacturer name	
Manufacturer location	
Quality compliance accreditation details	

(b) Source of Aggregate Materials

Source of intended aggregate materials

Quarry name	
Location	
Quality compliance accreditation details	

8. CONSTRUCTION BY

RoadTek ☐ Private Contractor ☐

9. TIMING OF TRIALS

Details on the proposed timing of the trials (e.g. start date, end date)

10. OTHER INFORMATION

Other information that may be relevant

11. CONTACT DETAILS

Name:		**Company/ District**		**Date**	
Phone:		**Email:**			

APPENDIX B SPRAY SEAL INSPECTION WORKSHEET

The worksheet on the following pages should be used to assess and record the condition of the trial road surface.

1. GENERAL

Trial name & section (GPS location)				**TMR ID #**	
Date and time of inspection					
Assessor(s)					
Road name/number					
Chainages		**Start chainage (km) (gazettal)**		**End chainage (km) (gazettal)**	
Trial size (m^2)					
Treatment type				**Year laid**	
Photographic record details (please mark location on the 'map')	**YES/ NO**				
Environmental conditions	**Rain /cloudy /windy /shady/other (please specify):**				
	Air temperature (° C)				
	Pavement temperature (° C)				
	Air humidity (H)				
	Wind speed (km/h)				
Alignment (description of vertical and horizontal)					
Sampling for viscosity measurement (200 mm x 200 mm sample)	**YES / NO**				

* The air temperature is measured in the shade; the pavement temperature on the test site either on the OWH or BWP.

2. VISUAL INSPECTION

2.1 Aggregate Mosaic/Stripping

Condition	Rating Index	OWP	BWP
Aggregate particles closely packed and uniformly distributed, and no stone loss	**0**		
Single, isolated stone loss	**1**		
Single, isolated pockets of stone loss	**3**		
Widespread pockets of stone loss	**5**		

2.2 Binder Level up to the Aggregate Particle *

Binder height up the stone	Rating Index	OWP	BWP
x > 1	**5**		
2/3 < x < 1	**3**		
x = 2/3	**0**		
1/2 > x < 2/3	**- 3**		
x < ½	**- 5**		
1/3 < x < ½	**-6**		
x < 1/3	**-7**		

* Examine a minimum of five aggregate particles at each location

2.3 Adhesion and Cohesion

Visual inspection measure	Score / measure
Adhesion (%)	
Cohesion (%)	

1. **Adhesion**: The degree to which the binder sticks to the surface of the aggregate (0 – 100%).
2. **Cohesion**: The degree to which the binder prefers to stick to itself (0 – 100%).

2.4 Binder Condition *

Binder condition #	Rating Index	OWP	BWP
Binder black and shiny very sticky, adheres to and stains fingers Screwdriver forms thin tails Aggregate particles 'ease' out when removed	**0**		
Binder black and shiny Tacky, slightly stains fingers Screw driver may form short tails Aggregate particles 'harder' to remove	**1**		
Binder little shiny to slightly dull-hard black coating on aggregate particles Slightly tacky does not stain fingers and screw driver No tails formed aggregate particles 'difficult' to remove	**3**		
Binder black and dull May form brownish-black powder and some cracking may be evident Aggregate particles will 'pop' out after some effort	**5**		
Crystalline	**7**		

* To be assessed in conjunction with the texture condition

The above definitions relate to binder when warm. If it is a cold day, you will have to estimate this. The pavement temperature can also be recorded to help place the field binder condition estimate into context.

2.5 Aggregate Performance

Aggregate performance		Severity[3] (0 – 5)	Note
Satisfactory (i.e. no break down or polished aggregate particles)	YES / NO		
Aggregate particles break down[1]	YES / NO		
Polished aggregate particles[2]	YES / NO		

1 **Aggregate particles break down** is the disintegration of an aggregate under environmental and/or trafficking conditions.
2 **Polished aggregate particles** are the result of the abrasive effect of traffic, where the upper faces of the aggregate become smoother and rounder.
3 **Severity** for both measures is between **0 (minor)** and **5 (severe)**.

2.6 General Comments and Remarks

Do you recommend any follow-up action? If YES, please specify action required:

2.7 Overall Visual Rating [e.g. (B - I), (C - II), (A - III)]

3. FIELD TESTING AND MEASUREMENTS (Local Staff)

3.1 Surface Texture *

Condition of the seal	Rating Index	OWP	BWP
Flushed/bleeding: where binder is at the top of the aggregate	**5**		
Black: where binder is just below top of aggregate	**4**		
Smooth (S): where binder is between 'black' and 'mat'	**3**		
Well textured/Mat: where binder is 2/3 of the way up the aggregate	**0**		
Hungry: where binder is 1/2 the aggregate height	**-3**		
Very hungry: where binder is < 1/2 the aggregate height	**-5**		
Extremely hungry: where binder is 1/3 of the aggregate height	**-7**		

*Measure by sand patch test at 5 locations per section, within two weeks either prior to or after an inspection

3.2 Embedment

	OWP	BWP
Embedment (mm)*		
Pavement temperature (° C) #		
Air temperature (° C) #		

Measure by ball penetration testing at 5 different locations per section, within two weeks either prior to or after an inspection.

The pavement temperature is measured on the OWH or BWP; the air temperature is measured in the shade on the trial section.