

## **Quarry Registration System**

# **QRS4: Assigning quarry-specific testing frequencies for source rock tests**

**May 2019**

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## 1 Introduction

QRS4 forms part of the Quarry Registration System and:

- guides the Applicant when nominating the quarry-specific source rock testing frequency levels (hereafter called testing frequency levels) for the 'nominated products' listed in his or her quarry registration application
- guides the Applicant when selecting supporting documentation to include as part of his or her quarry registration application
- details the approval process for quarry-specific source rock testing
- details requirements during production of 'nominated products' after registration.

QRS4 only applies to source rock tests as detailed in the Tables of Appendices A to H2.

It applies to hard rock quarries and major sand and gravel quarries that produce fine and coarse crushed aggregates. It does not apply to natural sand quarries.

Source rock properties and testing frequencies are quarry-specific and detailed on the Quarry Registration Certificate issued as part of the QRS. The QRS provides testing of each of these properties, undertaken as part of the quarry's ongoing production. Notwithstanding this, each sample for a test nominated on the Quarry Registration Certificate shall be taken from a processed product which, for all characteristics required by a departmental Contract, is consistent with the product supplied under that contract.

QRS4 contains:

- a description of the three testing frequency levels from which the Applicant can select and nominate in his or her submission and which, for successful applications, are detailed on the Quarry Registration Certificate
- a methodology for Applicants to use in selecting the testing frequency level for nomination in his or her submission
- the rules to be followed when moving between testing frequency levels
- tables detailing testing frequencies for the three levels for respective source rock tests / properties applicable to 'nominated products' used by Transport and Main Roads.

## 2 Referenced documents

**Table 2 – Referenced documents**

Reference	Title
MRTS01	<i>Introduction to Technical Specifications</i>
MRTS04	<i>General Earthworks</i>
MRTS05	<i>Unbound Pavements</i>
MRTS06	<i>Reinforced Soil Structures</i>
MRTS07B	<i>Insitu Stabilised Pavements using Cement or Cementitious Blends</i>
MRTS07C	<i>Insitu Stabilised Pavements using Foamed Bitumen</i>
MRTS08	<i>Plant-Mixed Heavily Bound (Cemented) Pavements</i>
MRTS09	<i>Plant-Mixed Pavement Layers Stabilised using Foamed Bitumen</i>
MRTS10	<i>Plant-Mixed Lightly Bound Pavements</i>
MRTS11	<i>Sprayed Bituminous Treatments (Excluding Emulsion)</i>
MRTS12	<i>Sprayed Bituminous Emulsion Surfacing</i>
MRTS13	<i>Bituminous Slurry Surfacing</i>
MRTS22	<i>Supply of Cover Aggregate</i>
MRTS30	<i>Asphalt Pavements</i>
MRTS32	<i>High Modulus Asphalt (EME2)</i>
MRTS39	<i>Lean Mix Concrete Sub-base for Pavements</i>
MRTS40	<i>Concrete Pavement Base</i>
MRTS50	<i>Specific Quality System Requirements</i>
MRTS70	<i>Concrete</i>
MRTS101	<i>Aggregates for Asphalt</i>
Technical Note TN102	<i>Selecting Testing Frequencies for Acceptance Sampling of Pavement Materials</i>
Code of Practice	<i>Testing Frequencies for Extractive Industry in Queensland by Cement Concrete &amp; Aggregates Australia, September, 2005</i>

## 3 Testing frequency levels

QRS4 is based on three levels of testing frequencies which represent an increasing confidence in product quality compliance. They are:

- **Default level** – representing low confidence in the product conformance.
- **Medium level** – representing medium confidence in the product conformance.
- **Low level** – representing high confidence in the product conformance.

## 4 Criteria for selection of testing frequency levels

The three testing frequency levels are based on a quarry's capacity with respect to seven major factors which affect the confidence in the quarry consistently producing conforming products.

These factors are:

- (i) quarry quality management system status
- (ii) quarry staff experience and qualifications
- (iii) quarry product performance history
- (iv) quarry working status and size
- (v) quarry production practices
- (vi) quarry source characteristics, and
- (vii) quarry source rock strength and durability properties.

Factors (i) to (vi) are somewhat subjective in nature but factor (vii) is based on a statistical evaluation of the important source rock properties of strength and durability as described following.

All nominations must be supported and demonstrated through submission of both source rock and product test raw data and NATA-endorsed test reports in the following format:

- electronic PDF for individual NATA-endorsed test reports
- identification of each departmental project job number / identifier, Test Method, 'stockpile lot' identifier / number, lot identifier / number, date tested, property tested, and 'nominated product'
- for each property of each 'nominated product', Microsoft Excel™ or similar spreadsheets for test result summaries as specified by the TM(QRS).

#### **Statistical evaluation of source rock properties**

Currently, **strength** and **durability** are the only tests used in this statistical analysis as they are very important when determining source rock quality. The test results are used to help determine an appropriate testing frequency level for the quarry. Strength and durability are determined by the following laboratory tests:

- Wet Strength (WS)
- Wet / Dry Strength Variation (WDSV)
- Degradation Factor (DF)
- Water Absorption (WA)
- Particle Density (PD).

These tests are routinely carried out on most of the quarry product used by Transport and Main Roads.

Notes: Other source rock tests defining different rock properties including alkali silica reactivity, water absorption, particle density and polished aggregate friction value have not been included in this statistical analysis because:

- they are generally carried out on a much more infrequent basis (six months or yearly), and
- the testing frequency specified is often the same for the three testing frequency levels (*Default, Medium, Low*).

The statistical analysis of the laboratory test results for strength and durability is based on the calculation of a multiplier (m) where:

$$m = \frac{\bar{X}-L}{S} \quad \text{for tests with a minimum specification limit, that is, WS, DF and PD}$$

and

$$m = \frac{L-\bar{X}}{S} \quad \text{for tests with a maximum specification limit, that is, WDSV and WA}$$

where:

$m$  = multiplier

L = Specification limit

S = standard deviation of whole data set of most recent results

$\bar{x}$  = rolling mean calculated using the 10 most recent results with no data more than two years old (if these criteria cannot be met, older test results may also be used for similar and homogenous material, provided at least five results are less than two years old).

The value of  $m$  appropriate to each of the three testing frequency levels is shown in Table 4(A).

**Table 4(A) –  $m$  values for testing frequency levels**

Testing frequency level	Value of multiplier ( $m$ )
Default	$0 \leq m < 1.3$
Medium	$1.3 \leq m < 2.0$
Low	$m \geq 2.0$



## Testing frequency level descriptions

This section describes the three testing frequency levels, which are broadly based on the *Code of Practice – Testing Frequencies for Extractive Industry in Queensland* (Cement Concrete and Aggregates Australia, September 2005).

- **Default level**

This level should be nominated by the quarry operator as part of the submission if:

- the quarry is new, or only intermittently worked or has not had departmental registration in the last two years
- there is little or no data history or evidence of production control, and
- there are significant concerns regarding the supply of material conforming to a Technical Specification supported by an interactive consideration that many of the following are evident:
  - a rudimentary quarry quality management system is in place with only limited documentation and possible first party or no auditing carried out
  - the quarry operator's staff have limited experience and no qualifications from accredited training courses such as those conducted by the Institute of Quarrying Australia (IQA)
  - repeated nonconformance and/or marginal conformance against 'nominated product' properties and their specified limits have been recorded
  - the quarry is an intermittently-worked operation with low production volumes (output less than 50,000 tonnes/year) or an operation without a history of adequate performance / service and is unable to furnish quality records which display same
  - the quarry production practices are not considered capable of ensuring consistently-conforming product; such practices may be characterised by inadequate overburden stripping and treatment of unsuitable materials, poorly maintained plant and equipment, inadequate use of imported additives, poor blending / stockpiling procedures and so on
  - the quarry source characteristics are unfavourable in that the deposit is heterogeneous, contains significant quantities of unsuitable material and is difficult to selectively work; unsuitable material is that material which, if used, would produce a significant risk of marginal or nonconforming product, and/or
  - quarry source rock properties are statistically only just above Technical Specification limit requirements. Multiplier ( $m$ ) range is given as  $0 \leq m < 1.3$ . There could be less than a 90% probability the test value will meet Technical Specification requirements.

- **Medium level**

This level should be nominated by the quarry operator as part of the submission when there is a sufficient level of confidence in the supply of material conforming to the Technical Specification with many of the following evident:

- a documented quarry quality management system complying with, or with relevant elements based on AS/NZS ISO 9001 is in place but does not always fully address all product quality concerns (the system is usually only subject to internal first or second party audit)
- the quarry operation has a history of adequate performance / service and is able to furnish quality records which display same
- the quarry operator's staff have some experience but are generally lacking in qualifications from accredited training courses such as those conducted by the IQA
- the quarry is a continuously-worked operation or an intermittent producer with total output exceeding 50,000 tonnes/year
- quarry production practices are considered marginally-capable of ensuring consistently-conforming product; such practices may be characterised by marginally-successful or limited overburden stripping and treatment of unsuitable / marginal materials, reactive maintenance / repairs on plant and equipment, marginal quality imported additives, passable blending / stockpiling procedures and so on
- quarry source characteristics are marginal in that the deposit is somewhat heterogeneous, containing some unsuitable or marginal material and there may be some difficulty in selectively working the deposit (marginal material is that material which, if used, would produce some risk of marginal or nonconforming product), and/or
- quarry source rock properties are generally statistically greater than Technical Specification requirements. Multiplier ( $m$ ) range is given as  $1.3 \leq m < 2.0$  indicating there is greater than a 90% probability the test value will exceed Technical Specification requirements.

- **Low level**

This level should be nominated by the quarry operator as part of the submission when there is a high level of confidence in the supply of material conforming to the specification, supported by an interactive consideration that most of the following are evident:

- a documented quarry quality management system complying with, or with relevant elements based on AS/NZS ISO 9001 is in place and fully operational, the system is subject to regular independent second- or third-party audit and contains procedural documentation relevant to achievement and maintenance of product quality
- the quarry operator's staff have extensive experience and relevant qualifications from accredited training courses such as those conducted by the IQA
- the quarry is a continuously-worked operation with a good history of satisfactory performance / service and is able to furnish quality records which display same
- the quarry is a large operation that has been continuously worked over a long period

- quarry production practices are considered capable of ensuring consistently-conforming product; such practices may be characterised by successful stripping / spoiling of overburden and treatment of unsuitable / marginal materials, rigorous scalping practices, high-quality, well-maintained plant and equipment, judicious use of quality imported additives, high quality blending / stockpiling procedures and so on
- quarry source characteristics are favourable in that the deposit is relatively homogeneous and predictable, containing little unsuitable or marginal materials which are easily capable of being selectively worked
- quarry source rock properties statistically differ from Technical Specification requirements; multiplier ( $m$ ) is given as  $\geq 2.0$  indicating greater than 98% probability the test value will exceed Technical Specification requirements.

Table 4(B) following summarises the operational and testing criteria for nominating the three testing levels, which should be used in conjunction with the criteria described previously. Section 5 describes the recommended selection process.

**Table 4(B) – Summary of interactive criteria for nominating testing frequency levels**

Factors	Testing frequency levels		
	Default	Medium	Low
Quarry quality management system status	Rudimentary quality management system in place with limited documentation and auditing	Operational and documented quality management system in place Internally audited	Fully operational, documented quality management system in place Independently audited
Quarry staff experience and qualifications	Staff have limited experience and no qualifications from accredited training courses	Staff have some experience but generally lacking in qualifications from accredited training courses	Staff very experienced with relevant qualifications from accredited training courses
Quarry product performance history	Repeated nonconformances and or marginal conformances, poor or no records	Some history of adequate performance Records are accessible	Continuously worked deposit with a good history of satisfactory performance Records are accessible
Quarry working status and size	Quarry new or intermittently worked Small operation	Continuously or intermittently worked Medium to large operation	Continuously worked over long period Large operation
Production practices for quarry products	Poor: overburden management, plant maintenance, stockpiling procedures, blending procedures, treatment of unsuitable materials	Average: overburden management, plant maintenance, stockpiling procedures, blending procedures, treatment of unsuitable materials	Good: overburden management, plant maintenance, stockpiling procedures, blending procedures, treatment of unsuitable materials
Quarry source characteristics	Heterogeneous containing significant quantities of unsuitable material that are difficult to selectively quarry	Marginal containing some unsuitable material Minor difficulty is experienced selectively working the deposit	Relatively homogenous and predictable Contains little unsuitable material that is easily identified and worked
Quarry source rock property multiplier (m)	$0 \leq m < 1.3$ (based on minimum of 10 tests)	$1.3 \leq m < 2.0$ (based on minimum of 10 tests)	$m \geq 2.0$ (based on minimum of 10 tests)

## 5 Testing frequency level selection process

The Applicant should use the criteria described in Section 4 and summarised in Table 4(B) to determine appropriate testing frequency levels to nominate for his or her quarry.

The recommended steps to use are listed following:

**Step 1** – For each factor (i) to (vii), determine which cell of Table 4(B) best describes the quarry (these selections must be supported by documented evidence where appropriate).

**Step 2** – Use the weightings (W) and ratings (R) shown in Table 5 to calculate a points total.

**Table 5 – Assessment scoring matrix**

Factor	% Weighting (W)	Rating (R) for Levels			Points
		L1	L2	L3	
Quarry quality management system status	10	1	3	5 ✓	5 x 10 = 50
Quarry staff experience and qualifications	10	1	3	5 ✓	5 x 10 = 50
Quarry product performance history	10	1	3	5 ✓	5 x 10 = 50
Quarry working status and size	10	1	3 ✓	5	3 x 10 = 30
Quarry production practices	15	1	3 ✓	5	3 x 15 = 45
Quarry source characteristics	20	1	3	5 ✓	5 x 20 = 100
Quarry source strength and durability	25	1	3	5 ✓	5 x 25 = 125
				<b>Total</b>	<b>450</b>

The point total for the example is 450.

**Step 3** – If total points <220, select *Default* level

If total points 220–420, select *Medium* level \*

If total points >420, select *Low* level \*

\* Selection to these levels is also subject to other mandatory requirements being met.

### Mandatory requirements

- Even if the points score is >220, the *Default* level must be adopted initially for all newly registered quarries or small (<50,000 tonnes annual production) intermittently worked quarries.
- Regardless of the overall points score from Table 5, a quarry can only be assigned to a *Medium* testing frequency level for source rock strength and durability tests if the multiplier (m) value range is  $0 \leq m < 1.3$ .
- Regardless of the overall points score from Table 5, a quarry can only be assigned to a *Low* testing frequency level for source rock strength and durability tests if the multiplier (m) value is  $\geq 2.0$ .

- A quarry that is reregistering and has not nominated new testing frequency levels will be either assigned to existing frequency levels or, if existing frequency levels do not exist, will be assigned the *Default* testing frequency level for source rock testing.
- The Applicant's self-assessment of testing frequency levels must be supported by providing copies of the relevant testing data and documentation as listed following:
  - quality system status:
    - quality management system certificate
    - quarry Materials quality Management Plan (MQMP)
    - in the absence of a singular MQMP, procedural documentation relevant to achievement and maintenance of product quality; these should cover quarry development, stockpile management, risk management, inspection and test plans and so on
  - Staff experience and qualifications:
    - tables of key personnel showing responsibilities, experience, qualifications
    - written confirmation of staff attendance at relevant internal and external training courses
    - proof of NATA accreditation for material testing laboratory used
  - Source rock strength and durability:
    - copies of NATA-endorsed test results (minimum of 10) from the last two years for the relevant 'nominated products'; if these criteria cannot be met, older test results may also be used for homogenous material, provided at least five results are less than two years old.

## **6 Moving between testing frequency levels**

When a quarry operator wishes to move to a testing frequency level that is lower than the level registered on the Quarry Registration Certificate, the operator shall reapply to the TM(QRS) and provide the relevant data and evidence to support the application. Evidence shall be supplied to the TM(QRS) in the same format as detailed in Section 4 previously.

Sections 6.1 to 6.3 describe the advancement and demotion criteria within the QRS.

### 6.1 Advancement from the Default Level to Medium Level

The following criteria must be met and demonstrated through:

- submission of raw data and NATA-endorsed test reports
- the quarry has been operating and registered for a minimum of 12 months
- the quarry is working continuously or intermittently with a minimum total output exceeding 50,000 tonnes/year (quarries with output less than 50,000 tonnes/year and meeting all the other advancement criteria may be considered for advancement on a case-by-case basis)
- the quarry meets the quality and production requirements for the *Medium* frequency level
- source rock properties of strength and durability as measured by the Wet Strength (WS), Wet / Dry Strength Variation (WDSV), Degradation Factor (DF), Water Absorption (WA) and Particle Density (PD) tests differ from Technical Specification requirements, and
- the rolling mean ( $\bar{x}$ ) and standard deviation (S) calculated from the last 10 results (from tests no more than two years old) must meet the following requirements:

- (i) for WS, PD and DF

$$m \geq 1.3$$

where:

$$m = \frac{\bar{X} - L}{S}$$

- (ii) for WDSV and WA

$$m \geq 1.3$$

where:

$$m = \frac{L - \bar{X}}{S}$$

Note: If 10 test results cannot be sourced from specific departmental materials for last two years, then it is permissible to use tests from materials not used on departmental projects, provided they are from the same quality of rock source.

## 6.2 Advancement from the Medium level to the Low level

The following criteria must be met and demonstrated:

- submission of raw data and NATA-endorsed test reports
- the quarry meets the standards required for the *Low* level
- no nonconformances recorded over the last six months

Source rock properties for strength and durability as determined by the Wet Strength (WS) value, Wet / Dry Strength Variation (WDSV), Degradation Factor (DF), Water Absorption (WA) and Particle Density (PD) tests differ from Technical Specification requirements, with the rolling mean and Standard Deviation (SD) calculated from the last 10 results (from tests no more than two years old or if these criteria cannot be met, older test results may also be used for homogenous material provided at least five results are less than two years old).

- must meet the following requirements:

- (i) for SW, DF and PD

$$m \geq 2.0$$

where:

$$m = \frac{\bar{X} - L}{S}$$

- (ii) for WDSV and WA

$$m \geq 2.0$$

where:

$$m = \frac{L - \bar{X}}{S}$$

## 6.3 Demotion

Demotion to a higher frequency level will occur if nonconformance is obtained when a quarry is on either the *Low* or *Medium* test frequency levels. If the quarry is already on the *Default* testing frequency level, then it must remain there, and the conformance test level is reset to zero for the test / property.

A potential nonconformance should be confirmed by doing two additional check tests on samples obtained from the same lot. If both check tests are conforming, the initial testing frequency can be maintained.

If a demotion occurs, the quarry operator must notify in writing within three working days:

- the TM(QRS), and
- all Administrator/s of departmental projects that are using the quarry product.



## 7 Testing frequency tables

### 7.1 General

Tables in Appendix A1 to Appendix H2 contain the source rock minimum testing frequencies assigned to the testing frequency levels for the stated tests and departmental Technical Specifications. In summary, the list of tables addresses:

- Appendix A – MRTS04 *General Earthworks* (rock fill and high permeable drainage materials)
- Appendix B – MRTS05 *Unbound Pavements*, MRTS07B *Insitu Stabilised Pavements using Cement or Cementitious Blends*, MRTS07C *Insitu Stabilised Pavements using Foamed Bitumen*, MRTS08 *Plant-Mixed Heavily Bound (Cemented) Pavements*, MRTS09 *Plant-Mixed Pavement Layers Stabilised using Foamed Bitumen* and MRTS10 *Plant-Mixed Lightly Bound Pavements*
- Appendix C – MRTS06 *Reinforced Fill Materials*
- Appendix D – MRTS13 *Bituminous Slurry Surfacing*
- Appendix E – MRTS22 *Supply of Cover Aggregate*, MRTS11 *Sprayed Bituminous Treatments (Excluding Emulsion)* and MRTS12 *Sprayed Bituminous Emulsion Surfacing* (fine and coarse)
- Appendix F1 to F2 – MRTS30 *Asphalt Pavements* and MRTS32 *High Modulus Asphalt (EME2)* and MRTS101 *Aggregates for Asphalt*
- Appendix G1 to G2 – MRTS39 *Lean Mix Concrete Sub-base for Pavements* and MRTS40 *Concrete Pavement Base*
- Appendix H1 to H2 – MRTS70 *Concrete* (fine and coarse) (for structural use).

### 7.2 Source rock tests

Each table contains the source rock tests and minimum testing frequencies applicable to each departmental 'nominated product' for the three testing levels *Default*, *Medium* and *Low*.

Source rock testing frequencies are the same across most aggregate uses (for example, for concrete, asphalt, cover aggregate); however, for unbound paving material, the frequencies are at higher levels to account for increased risk associated with possible source rock variability.

The listed source rock tests are derived from both current and proposed departmental Technical Specifications. They have been chosen to determine fundamental source rock properties including strength, durability, frictional characteristics, particle density, water absorption and alkali-silica reactivity.

Where possible, Australian Standard AS Test Methods have been adopted in the recent harmonisation changes in the Technical Specifications, noting that some departmental Technical Specifications may still list departmental Q Test Methods.

### **7.3 Assumptions**

The tables are based on the following assumptions with respect to sampling and testing procedures:

- samples have been taken from the stockpile at the source of production
- random sampling was used in accordance with departmental Test Method Q050
- testing was carried out in NATA-accredited laboratories certified to perform the designated Test Method.

The tables are based on specific stockpile sublots with a maximum size of 5000 tonnes.

The tabulated frequencies are minimum requirements.

## Appendix A

### Source rock compliance testing frequency requirements for:

#### MRTS04 General Earthworks

#### Relevant quarry 'nominated products' – rock fill material and high permeability drainage material

General notes:

1. Tables following refer only to in-quarry testing from the stockpiles.
2. Tabled test frequencies are minimum.
3. Quantities shown in tonnes or cubic metres.

**Table A1 – Source rock maximum lot size**

Maximum lot size	5000 t
------------------	--------

**Table A2 – Source rock testing frequencies**

Source test property	Test Method	Minimum test frequency level		
		Default	Medium	Low
Petrographic analysis	ASTM C295	6 monthly	Yearly	Yearly
Wet strength <sup>1</sup>	AS1141.22	1 per 2500 t (1 per 1000 m <sup>3</sup> )	1 per 5000 t (1 per 2000 m <sup>3</sup> )	1 per 10,000 t (1 per 4000 m <sup>3</sup> )
Wet / dry strength variation	AS1141.22	1 per 2500 t (1 per 1000 m <sup>3</sup> )	1 per 5000 t (1 per 2000 m <sup>3</sup> )	1 per 10,000 t (1 per 4000 m <sup>3</sup> )
Degradation factor <sup>2</sup>	Q208B	1 per 2500 t (1 per 1000 m <sup>3</sup> )	1 per 5000 t (1 per 2000 m <sup>3</sup> )	1 per 10,000 t (1 per 4000 m <sup>3</sup> )
Water absorption	AS1141.6.11	1 per 2500 t (1 per 1000 m <sup>3</sup> )	1 per 5000 t (1 per 2000 m <sup>3</sup> )	1 per 10,000 t (1 per 4000 m <sup>3</sup> )
Point load strength index $Is_{(50)}^3$	AS4133.4.1	1 per 2500 t (1 per 1000 m <sup>3</sup> )	1 per 5000 t (1 per 2000 m <sup>3</sup> )	1 per 10,000 t (1 per 4000 m <sup>3</sup> )
Crushed particles <sup>4</sup>	AS 1141.18	1 per 2500 t (1 per 1000 m <sup>3</sup> )	1 per 5000 t (1 per 2000 m <sup>3</sup> )	1 per 10,000 t (1 per 4000 m <sup>3</sup> )

Notes

1. Only applicable to materials used for high permeability drainage material.
2. Test is only required if rock fill is subject to inundation for more than 12 hours.
3. Only applicable to materials used for rock fill material.
4. Only applicable to Type 1 High Standard Granular (HSG) Base.

**Table A3 – Product testing frequencies**

Product test property	Test Method	Minimum testing frequency level
Particle size distribution	AS1289.3.6.1	Refer to MRTS04
Maximum particle size	AS1289.3.6.1 or Q230	

## Appendix B

### Source rock compliance testing frequency requirements for:

#### **MRTS05 Unbound Pavements**

#### **MRTS07B Insitu Stabilised Pavements using Cement or Cementitious Blends**

#### **MRTS07C Insitu Stabilised Pavements using Foamed Bitumen**

#### **MRTS08 Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends**

#### **MRTS09 Plant-Mixed Pavement Layers Stabilised using Foamed Bitumen**

#### **MRTS10 Plant-Mixed Lightly Bound Pavements**

### Relevant quarry 'nominated product' – unbound paving materials

General notes:

1. Tables following refer only to in-quarry testing from the stockpiles.
2. Tabled test frequencies are minimum.
3. Quantities shown in tonnes.

**Table B1 – Source rock maximum lot size**

Maximum lot size	5000 t
------------------	--------

**Table B2 – Source rock testing frequencies**

Source test property	Test Method	Minimum test frequency level		
		Default	Medium	Low
Petrographic analysis	ASTM C295	6-monthly	Yearly	Yearly
Wet strength	AS1141.22	1 per 2500 t	1 per 5000 t	1 per 10,000 t
Wet / dry strength variation	AS1141.22	1 per 2500 t	1 per 5000 t	1 per 10,000 t
Degradation factor	Q208B	1 per 2500 t	1 per 5000 t	1 per 10,000 t

**Table B3 – Product testing frequencies**

Product test property	Test Method	Minimum testing frequency level
Flakiness index	AS1141.15	Refer to MRTS05, MRTS07B, MRTS07C, MRTS08, MRTS09, MRTS10
Crushed particles	AS1141.18	
Particle size distribution	AS1289.3.6.1	
California Bearing Ratio (CBR)	Q113A, Q113C	
Liquid limit	Q104A	
Plastic limit and plasticity index	Q105	
Linear shrinkage	Q106	

## Appendix C

### Source rock compliance testing frequency requirements for:

#### MRTS06 Reinforced Soil Structures

#### Relevant quarry 'nominated product' – reinforced fill materials

General notes:

1. Tables following refer only to in-quarry testing from the stockpiles.
2. Tabled test frequencies are minimum.
3. Quantities shown in tonnes.

**Table C1 – Source rock maximum lot size**

Maximum lot size	5000 t
------------------	--------

**Table C2 – Source rock testing frequencies**

Source test property <sup>1</sup>	Test Method	Minimum test frequency level		
		Default	Medium	Low
Petrographic analysis	ASTM C295	6-monthly	Yearly	Yearly
Wet strength	AS1141.22	1 per 2500 t	1 per 5000 t	1 per 10,000 t
Wet / dry strength variation	AS1141.22	1 per 2500 t	1 per 5000 t	1 per 10,000 t
Degradation factor	Q208B	1 per 2500 t	1 per 5000 t	1 per 10,000 t

Note:

1. Applicable source material tests will be required prior to the material procurement (refer Table 5.3 in MRTS06 for details).

**Table C3 – Product testing frequencies**

Product test property	Test Method	Minimum testing frequency level
Effective angle of friction at constant volume	Q181C	Refer to MRTS06
Permeability	AS1289.6.7.1	
Particle size distribution	AS1289.3.6.1	
Relative compaction	AS1289.5.4.1 or AS1289.5.7.1	
Density index	AS1289.5.6.1	
pH	AS1289.4.3.1	
Electrical resistivity	Q122B	
Chloride content	Q130B	
Sulfate content	Q131B	

## Appendix D

### Source rock compliance testing frequency requirements for:

#### MRTS13 Bituminous Slurry Surfacing

#### Relevant quarry 'nominated product' – slurry surfacing aggregate (coarse)

General notes:

1. Tables following refer only to in-quarry testing from the stockpiles.
2. Tabled test frequencies are minimum.
3. Quantities shown in tonnes.

**Table D1 – Source rock maximum lot size**

Maximum lot size	5000 t
------------------	--------

**Table D2 – Source rock testing frequencies**

Source test property	Test Method	Minimum test frequency level		
		Default	Medium	Low
Petrographic analysis	ASTM C295	6-monthly	Yearly	Yearly
Wet strength	AS1141.22	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Wet / dry strength variation	AS1141.22	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Polished Aggregated Friction Value (PAFV) <sup>1</sup>	Q203	Yearly <sup>1</sup>	Yearly <sup>1</sup>	Yearly <sup>1</sup>
Sand equivalent <sup>2</sup>	AS1289.3.7.1	Yearly	Yearly	Yearly

Notes:

1. Where the typical PAFV of the aggregate is less than two greater than the specified value, the minimum testing frequency shall be increased to one per six months.
2. Only applicable to fine aggregate only.

**Table D3 – Product testing frequencies**

Product test property	Test Method	Minimum testing frequency level
Particle size distribution	AS1141.11.1	Refer to MRTS13

## Appendix E

### Source rock compliance testing frequency requirements for:

#### MRTS11 Bituminous Slurry Surfacing (Excluding Emulsion)

#### MRTS12 Sprayed Bituminous Emulsion Surfacing

#### MRTS22 Supply of Cover Aggregate

#### Relevant quarry 'nominated product' – cover aggregate

General notes:

1. Tables following refer only to in-quarry testing from the stockpiles.
2. Tabled test frequencies are minimum.
3. Quantities shown in tonnes.

**Table E1 – Source rock maximum lot size**

Maximum lot size	5000 t
------------------	--------

**Table E2 – Source rock testing frequencies**

Source test property	Test Method	Minimum test frequency level		
		Default	Medium	Low
Petrographic analysis	ASTM C295	6-monthly	Yearly	Yearly
Wet strength	AS1141.22	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Wet / dry strength variation	AS1141.22	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Degradation factor <sup>1</sup>	Q208B	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Water absorption <sup>1</sup>	AS1141.6.1	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Polished Aggregate Friction Value (PAFV) <sup>2</sup>	Q203	6-monthly	Yearly <sup>1</sup>	Yearly <sup>1</sup>

Notes:

1. Refer to Table 7.1.3 of MRST22 for details.
2. There is no compliance requirement in MRTS11, MRTS12 and MRTS22 for this test; however, test results shall be provided for quarry reregistration purpose only.

**Table E3 – Product testing frequencies**

<b>Product test property</b>	<b>Test Method</b>	<b>Minimum testing frequency level</b>
Flakiness index	AS1141.15	Refer to MRTS11, MRTS12, MRTS22
Crushed particles	AS1141.18	
Weak particles	AS1141.32	
Particle size distribution	AS1141.11.1	
Average least dimension	AS1141.20.3	
Bitumen stripping value – modified plate	Q212B	
Degree of aggregate precoating	Q216	



## Appendix F1

### Source rock compliance testing frequency requirements for coarse aggregate for:

#### MRTS30 Asphalt Pavement

#### MRTS32 High Modulus Asphalt (EME2)

#### MRTS101 Aggregates for Asphalt

#### Relevant quarry 'nominated product' – aggregates for asphalt (coarse)

General notes:

1. Tables following refer only to in-quarry testing from the stockpiles.
2. Tabled test frequencies are minimum.
3. Quantities shown in tonnes.

**Table F1.1 – Source rock maximum lot size**

Maximum lot size	5000 t
------------------	--------

**Table F1.2 – Source rock testing frequencies**

Source test property	Test Method	Minimum test frequency level		
		Default	Medium	Low
Petrographic analysis	ASTM C295	6-monthly	Yearly	Yearly
Wet strength	AS1141.22	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Wet / dry strength variation	AS1141.22	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Degradation factor	Q208B	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Water absorption	AS1141.6.1	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Polished Aggregate Friction Value (PAFV)	Q203	6-monthly	Yearly <sup>1</sup>	Yearly <sup>1</sup>
Particle density (dry basis)	AS1141.6.1	1 per 5000 t	1 per 10,000 t	1 per 20,000 t

Note:

1. Where the typical PAFV of the aggregate is less than two greater than ( $2 \geq \text{PAFV}$ ) the specified value, the minimum testing frequency shall be increased to one per six months.

**Table F1.3 – Product testing frequencies**

Product test property	Test Method	Minimum testing frequency level
Flakiness index	AS1411.15	Refer to MRTS30, MRTS32, MRTS101
Particle size distribution	AS1141.11.1	
Materials finer than 75 µm	AS1141.12	
Fractured face(s)	RMS T239	

## Appendix F2

### Source rock compliance testing frequency requirements for fine aggregate for:

#### MRTS30 Asphalt Pavement

#### MRTS32 High Modulus Asphalt (EME2)

#### MRTS101 Aggregates for Asphalt

#### Relevant quarry 'nominated product' – aggregates for asphalt (fine)

General notes:

1. Tables following refer only to in-quarry testing from the stockpiles.
2. Tabled test frequencies are minimum.
3. Quantities shown in tonnes.

**Table F2.1 – Source rock maximum lot size**

Maximum lot size	5000 t
------------------	--------

**Table F2.2 – Source rock testing frequencies**

Source test property	Test Method	Minimum test frequency level		
		Default	Medium	Low
Petrographic analysis	ASTM C295	6-monthly	Yearly	Yearly
Wet strength <sup>1,2</sup>	AS1141.22	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Wet / dry strength variation <sup>1,2</sup>	AS1141.22	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Degradation factor <sup>1,2</sup>	Q208B	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Particle density (dry basis)	AS1141.5	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Water absorption	AS1141.5	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Weighted percent loss	AS1141.24	1 per 5000 t	1 per 10,000 t	1 per 20,000 t

Notes:

1. Only applicable if the source rock of the fine crushed asphalt aggregate is different than that used to produce the coarse asphalt aggregate.
2. Testing for fine aggregate is not required if it is obtained only from a natural sand source.

**Table F2.3 – Product testing frequencies**

Product test property	Test Method	Minimum testing frequency level
Particle size distribution	AS1141.11.1	Refer to MRTS30, MRTS32, MRTS101
Material finer than 75 µm	AS1141.12	

**Appendix G1****Source Rock Compliance Testing Frequency Requirements for coarse aggregate for:****MRTS39 Lean Mix Concrete Sub-base in Pavements****MRTS40 Concrete Pavement Base****Relevant quarry 'nominated product' – concrete aggregate (coarse)**

General notes:

1. Tables following refer only to in-quarry testing from the stockpiles.
2. Tabled test frequencies are minimum.
3. Quantities shown in tonnes.

**Table G1.1 – Source rock maximum lot size**

Maximum lot size	5000 t
------------------	--------

**Table G1.2 – Source rock testing frequencies**

Source test property	Test Method	Minimum test frequency level		
		Default	Medium	Low
Petrographic analysis	ASTM C295	6-monthly	Yearly	Yearly
Wet strength	AS1141.22	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Wet / dry strength variation	AS1141.22	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Degradation factor	Q208B	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Particle density – dry	AS1141.6.1	Monthly	3-monthly	6-monthly
Water absorption	AS1141.6.1	Monthly	3-monthly	6-monthly
Weak Particles	AS1141.32	1 per 5000 t	1 per 10,000 t	1 per 20,000 t

**Table G1.3 – Product testing frequencies**

<b>Product test property</b>	<b>Test Method</b>	<b>Minimum testing frequency level</b>
Flakiness index	AS1141.15	Refer to MRTS39 and MRTS40
Light particles	AS1141.31	
Fractured faces (two or more)	AS1141.18	
Particle shape, 2:1 and 3:1 ratios	AS1141.14	
Compacted bulk density	AS1141.4	
Particle size distribution	AS1141.11.1	
Material finer than 75 µm	AS1141.12	
Material finer than 2 µm	AS1141.13	
Alkali silica reactivity	AS1141.60.1	
Alkali carbonate reactivity	ASTM C1105	

## Appendix G2

### Source rock compliance testing frequency requirements for fine aggregate for:

#### MRTS39 Lean Mix Concrete Sub-base in Pavements

#### MRTS40 Concrete Pavement Base

#### Relevant quarry 'nominated product' – concrete aggregate (fine)

General notes:

1. Tables following refer only to in-quarry testing from the stockpiles.
2. Tabled test frequencies are minimum.
3. Quantities shown in tonnes.

**Table G2.1 – Source rock maximum lot size**

Maximum lot size	5000 t
------------------	--------

**Table G2.2 – Source rock testing frequencies**

Source test property <sup>2</sup>	Test Method	Minimum test frequency level		
		Default	Medium	Low
Petrographic analysis	ASTM C295	6-monthly	Yearly	Yearly
Wet strength <sup>1</sup>	AS1141.22	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Wet / dry strength variation <sup>1</sup>	AS1141.22	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Degradation factor <sup>1</sup>	Q208B	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Water absorption	AS1141.5	Monthly	3-monthly	6-monthly
Particle density – dry	AS1141.5	Monthly	3-monthly	6-monthly
Weighted percent loss	AS1141.24	Monthly	3-monthly	6-monthly

Notes:

1. Only applicable if the source rock for the fine crushed asphalt aggregate is different than that used to produce the coarse asphalt aggregate.
2. Additional testing only if source rock for crushed fine aggregate production is different from the source rock used in the coarse aggregate production.

**Table G2.3 – Product testing frequencies**

<b>Product test property</b>	<b>Test Method</b>	<b>Minimum testing frequency level</b>
Light particles	AS1141.31	Refer to MRTS39 and MRTS40
Compacted bulk density	AS1141.4	
Particle size distribution	AS1141.11.1	
Material finer than 75 µm	AS1141.12	
Material finer than 2 µm	AS1141.13	
Alkali silica reactivity	AS1141.60.1 or AS1141.60.2	
Alkali carbonate reactivity	ASTM C1105	
Deleterious Fines Index (DFI)	AS1141.11.1 (by washing) and AS1141.66	
Methylene Blue Value (MBV)	AS1141.66	
Organic impurities	AS11.41.34, and if required AS1289.4.1.1	
Sugar presence	AS1141.35	
Acid insoluble residue	Tex-612-J	
Micro-deval abrasion loss	ASTM D728	
Flow cone time	RMS T279	

## Appendix H1

### Source rock compliance testing frequency requirements for coarse aggregate for:

#### MRTS70 Concrete

#### Relevant quarry 'nominated product' – concrete aggregate (coarse) – both hard rock and natural gravel deposit

General notes:

1. Tables following refer only to in-quarry testing from the stockpiles.
2. Tabled test frequencies are minimum.
3. Quantities shown in tonnes.

**Table H1.1 – Source rock maximum lot size**

Maximum lot size	5000 t
------------------	--------

**Table H1.2 – Source rock testing frequencies**

Source test property	Test Method	Minimum test frequency level		
		Default	Medium	Low
Petrographic analysis	ASTM C295	6-monthly	Yearly	Yearly
Wet strength	AS1141.22	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Wet / dry strength variation	AS1141.22	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Degradation factor	Q208B	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Water absorption	AS1141.6.1	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Particle density – dry	AS1141.6.1	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Weak particles	AS1141.32	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Particle size distribution grading <sup>1</sup>	AS1141.11.1	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Sulfate content	AS1012.20.1	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Chloride content	AS1012.20.1	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Weighted percent loss	AS1141.24	1 per 5000 t	1 per 10,000 t	1 per 20,000 t

Note:

1. Testing only applicable for coarse aggregate sourced from natural deposit.

**Table H1.3 – Product testing frequencies**

<b>Product test property</b>	<b>Test Method</b>	<b>Minimum testing frequency level</b>
Flakiness index	AS1141.15	Refer to MRTS70
Particle size distribution	AS1141.11.1	
Material finer than 75 µm	AS1141.12	
Alkali silica reactivity	AS1141.60.1	
Alkali carbonate reaction	ASTM C1105	



## Appendix H2

### Source rock compliance testing frequency requirements for fine aggregate for:

#### MRTS70 Concrete

#### Relevant quarry 'nominated product' – concrete aggregate (fine) – both hard rock and natural sand deposit

General notes:

1. Tables following refer only to in-quarry testing from the stockpiles.
2. Tabled test frequencies are minimum.
3. Quantities shown in tonnes.

**Table H2.1 – Source rock maximum lot size**

Maximum lot size	5000 t
------------------	--------

**Table H2.2 – Source rock testing frequencies**

Source test property <sup>4</sup>	Test Method	Minimum test frequency level		
		Default	Medium	Low
Petrographic analysis	ASTM C295	6-monthly	Yearly	Yearly
Wet strength <sup>1,2</sup>	AS1141.22	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Wet / dry strength variation <sup>1,2</sup>	AS1141.22	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Degradation factor <sup>1,2</sup>	Q208B	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Water absorption	AS1141.5	Monthly	3-monthly	6-monthly
Particle density – dry	AS1141.5	Monthly	3-monthly	6-monthly
Weighted percent loss	AS1141.24	3-monthly	6-monthly	Yearly
Micro-deval abrasion loss	ASTM D7428	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Chloride content	AS1012.20.1	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Sulfate content	AS1012.20.1	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Organic impurities <sup>3</sup>	AS11.41.34, and if required AS1289.4.1.1	3-monthly	6-monthly	Yearly
Sugar content <sup>3</sup>	AS1141.35	3-monthly	6-monthly	Yearly
Light particles <sup>3</sup>	AS1141.31	3-monthly	6-monthly	Yearly
Weak particles	AS1141.32	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Particle size distribution <sup>3</sup>	AS1141.11.1	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Material finer than 75 µm <sup>3</sup>	AS1141.12	1 per 5000 t	1 per 10,000 t	1 per 20,000 t
Material finer than 2 µm <sup>3</sup>	AS1141.13	1 per 5000 t	1 per 10,000 t	1 per 20,000 t

Notes:

1. Testing reports completed on crushed coarse aggregate can be accepted if registration requested is only for fine aggregate.
2. Only applicable to fine aggregates sourced from hard rock quarries.
3. Only applicable to fine aggregates sourced from natural deposit.
4. Additional testing such as X-Ray Diffraction (XRD) and X-Ray Fluorescence (XRF) may be required if source rock for crushed fine aggregate product is different from the source rock used for coarse aggregate product at the discretion of TM(QRS).

**Table H2.3 – Product testing frequencies**

<b>Product test property</b>	<b>Test Method</b>	<b>Minimum testing frequency level</b>
Particle size distribution	AS1141.11.1	Refer to MRTS70
Material finer than 75 µm	AS1141.12	
Material finer than 2 µm	AS1141.13	
Alkali silica reactivity	AS1141.60.1	
Alkali carbonate reactivity	ASTM C1105	
Deleterious Fines Index (DFI)	AS1141.11.1 (by washing) and AS1141.66	

