Technical Specification

Transport and Main Roads Specifications MRTS07A Insitu Stabilised Subgrades using Quicklime or Hydrated Lime

July 2024

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Contents

1 Introduction

This Technical Specification applies to the insitu stabilisation of materials by the addition of quicklime (hydrated and added as a slurry) or hydrated lime.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements* and other Technical Specifications as appropriate.

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

2 Definition of terms

The terms used in this Technical Specification shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Specifications*.

Additional terms used in this Technical Specification shall be as defined in Table 2. Where indicated in Table 2, a more complete definition is contained in the referenced clause.

Table 2 – Definition of terms

Term	Definition
Actual stabilised layer thickness	Achieved stabilised layer thickness as measured from the bottom of stabilised layer to the top of compacted and trimmed stabilised layer.
Allowable working time	The time measured from the commencement of the final moisture incorporation (i.e. mixing) of stabilising agent into the material on the second day of the stabilisation process to completion of compaction and final trimming.
Amelioration period	The time required for lime to react with expansive soil prior to compaction, also known as mellowing period.
Available lime index	The available calcium oxide for quicklime or available calcium hydroxide for hydrated lime in accordance with AS 4489.6.1.
Bulking	Increase in vertical height during the incorporation of the stabilising agent into material using a stabiliser. The increased vertical height of the material is measured from the surface level prior to this incorporation process – refer Figure 8.6.6.4.
Curing materials	Materials applied to the exposed surfaces of the completed stabilised layer for curing.
Design depth	As specified in the drawings and contract documents – refer Figure 8.6.6.4.
Exothermic reaction	Chemical reaction during slacking process generating heat and steam.
Finish surface level	Top level of the stabilised layer as specified in the drawings and contract documents – refer Figure 8.6.6.4.
Hydrated lime	Hydrated lime is a granular form of lime consisting primarily of calcium hydroxide ($Ca(OH)_2$).
Lime slurry	Lime slurry is formed after the quicklime after the quicklime has been fully slaked and takes the form of a slurry.

Term	Definition
Lower reference level	Lower reference level is the finish surface level minus the design depth. It is the bottom level of the stabilised layer as specified in the drawings and contract documents – refer Figure 8.6.6.4.
Moisture ratio (uncompacted) ($MR_{u)}$	The ratio of the insitu moisture content compared to the laboratory optimum moisture content expressed as a percentage for uncompacted materials.
Principal Contractor	The person or entity who is bound to execute the work under the Contract.
Quicklime	Quicklime is a granular form of lime consisting primarily of calcium oxide (CaO), which can be readily slaked.
Slaking	The addition of water to quicklime (the purpose is to fully hydrate the quicklime).
Spot check	Inspecting quicklime after slaking process to identify that all quicklime is completely slaked.
Stabiliser	A single rotor mix in place plant (i.e. plant that mixes insitu) of a type specifically designed for the dual task of reclamation and stabilisation work or designed for stabilising work.
Stabilising agent	Quicklime or hydrated lime.
Stabilising Subcontractor	Contractor or Supplier (including their personnel), engaged by or on behalf of the Principal Contractor with respect to the insitu lime stabilising works under the Contract.
Subgrade	The portion of the formation on which the pavement is constructed, and which provides support to the pavement.
Target depth	Target depth is the mixing depth required by the stabiliser to achieve the lower reference level and shall consider the bulking height – refer Figure 8.6.6.4.

3 Referenced documents

Table 3 lists documents referenced in this Technical Specification.

Table 3 – Referenced documents

Reference	Title
AS 4489.6.1	*Test methods for limes and limestones – Lime index – Available lime*
MRTS01	*Introduction to Technical Specifications*
MRTS04	*General Earthworks*
MRTS23	*Supply and Delivery of Quicklime and Hydrated Lime for Road Stabilisation*
MRTS50	*Specific Quality System Requirements*
MRTS56	*Construction Surveying*
NGTM	*Nuclear Gauge Testing Manual*

4 Standard test methods

The standard test methods listed in Table 4 shall be used in this Technical Specification.

Further details of test method numbers and test descriptions are given in Clause 4 of MRTS01 *Introduction to Technical Specifications*.

Table 4 – Standard test methods

Property to be tested	Method No.
Available lime index	AS 4489.6.1
Calculation of characteristic value of a lot	Q020
California bearing ratio	AS 1289.6.1.1
Capillary rise	Q125D
Curing moulded specimens of stabilised material	Q135B
Deviation from a straightedge	Q712
Ferrous Oxide FeO content*	Determination of ferrous iron by acid digestion
Moisture Density Relationship (MDR)	Q142A, Q143, Q144A
Lime content of lime treated materials	AS 5101.3.2
Lime demand	Q133
Linear shrinkage	AS 1289.3.4.1
Moisture content	AS 1289.2.1.1, AS 1289.2.1.4, AS 1289.2.1.6
Organic content	Q120B
Particle size distribution	AS 1289.3.6.1
Plastic limit and plasticity index	AS 1289.3.1.1, AS 1289.3.2.1, AS 1289.3.3.1
Proof rolling test	Q723
Relative compaction	Q140A, Q141A, Q141B
Moisture ratio of uncompacted soils and crushed rock	Q250
Sampling – aggregates	AS 1141.3.1
Selection of sampling or test sites	AS 1289.1.4.2
Spot sampling of soils, crushed rock and aggregates	Q061
Stabilising agent content	Q134A
Sulfate content	AS 1289.4.2.1, other published or validated classical chemistry technique or instrumentation technique#
Surface spread rate of stabilising agent	Q719^
Unconfined compressive strength of stabilised materials	Q115

Property to be tested	Method No.

* Private analytical laboratories will use in-house methods based on classical techniques.

Instrumentation techniques may include Ion Chromatography / Inductively Coupled Plasma / Discrete Analyser and so on. NATA endorsed test results are evidence of a validated technique.

^ For Q719, the requirement for the test to be carried out by a registered NATA and Construction Materials Testing (CMT) Supplier in accordance with MRTS50 *Specific Quality System Requirements*, shall be relaxed.

5 Quality system requirements

5.1 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are specified in Clause 5.2 of MRTS01 *Introduction to Technical Specifications*.

The Hold Points, Witness Points and Milestones applicable to this Technical Specification are summarised in Table 5.1.

Table 5.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
5.2.2	1. Approval of construction procedures, construction program and proposed material sources		Supply of the construction procedures and construction program for the stabilisation works (42 days)
7.1	2. Compliance of all materials, prior to their incorporation		
8	3. Construction permitted to proceed		
8.3	4. Survey of services, utilities, buildings and drainage		
8.5.2.1	5. Approval of compaction based on a process requirement		
8.5.2.2		1. Construction of trial section (if process standard specified for compaction)	
8.6.2		2. Removal and disposal of material not suitable for stabilisation	
8.6.3		3. Compacting and trimming surface prior to spreading of the stabilising agent	
8.6.5.1		4. Spreading of stabilising agent	
8.6.5.3	6. Slaking (if quicklime is used)		

Clause	Hold Point	Witness Point	Milestone
8.6.6.2		5. Particle size check prior to final moisture incorporation pass	
8.6.6.3		6. Nominating the target depth	
8.7.2.1			Ordered spread rate of stabilising agent (14 days)
9.8		7. Proof rolling test	
9.9	7. Acceptance		

5.2 Construction procedures

5.2.1 General

The Contractor shall prepare documented procedures for all construction processes in accordance with Clause 6 of MRTS50 *Specific Quality System Requirements.*

The construction procedure described in Clause 5.2.2 shall be submitted to the Administrator.

5.2.2 Insitu stabilisation

A construction procedure detailing all work described in this Technical Specification shall be prepared.

The construction procedure shall include, but not be limited to:

a) Details of all plant associated with the work detailed in this Technical Specification.

b) Details of how services, utilities, buildings and drainage components shall be located (refer to Clause 8.3).

c) Details of how services, utilities, buildings, drainage components, plant personnel shall be protected from damage, injury, etc. (refer to Clause 8.3).

d) Daily calibration procedures of stabilising agent spreader and verification of spread rate in the field (refer to Clause 8.6.5.1).

e) A detailed sequence of operations for all aspects of the stabilisation works, including, but not necessarily limited to:

   i. details of excavation (refer Clause 8.6.1)

   ii. details of joint locations

   iii. details of joint overlaps

   iv. the length of each run

   v. the width of each run

   vi. marking-out the extents of each run

   vii. details of procedure for undertaking slaking if quicklime is used (including slaking time, calculated water ratio and rectification of displaced quicklime or slaked lime)

viii. details of procedure for working up to, or against, kerb, kerb and channel and road safety barriers, and structures such as bridges, access chambers, gullies, culverts and concrete medians and any existing pavement cutback point, and

ix. curing methodology.

f) The proposed program of works

g) A testing program which shall include, but not be limited to, the testing methodology that shall be used to assess:

i. stabilising agent spread rate

ii. slaking of quicklime (if quicklime is used)

iii. stabilisation target depth

iv. moisture ratio

v. compaction standard

vi. geometric tolerances

vii. actual stabilised layer, and

viii. strength gain of the stabilised layer with time (UCS test) if required.

The following shall be submitted to the Administrator along with the construction procedure:

a) details of the proposed source(s) of the stabilising agent(s)

b) test results demonstrating compliance of each proposed stabilising agent to MRTS23 *Supply and Delivery of Quicklime and Hydrated Lime for Road Stabilisation* (including a statement of the Available lime index)

c) test results which demonstrating the compliance of each proposed water source, and

d) compliance test results and a representative sample of material from each proposed source to be used to replace material not suitable for stabilisation.

The construction procedure shall be submitted to the Administrator at least 42 days prior to the commencement of stabilisation works. **Milestone**

No stabilisation work shall be commenced until the construction procedure for stabilisation works is acceptable to, and approved by the Administrator. **Hold Point 1**

5.3 Conformance requirements

The conformance requirements which apply to lots of stabilised material covered by this Technical Specification are given in Clause 6 to Clause 9.

5.4 Testing frequencies and lot sizes

The maximum lot sizes shall be as stated in Table A1 of Appendix A or otherwise stated in Clause 1.1 of Annexure MRTS07A.1.

The minimum testing frequencies shall be as stated in Table A2, A3 and A4 of Appendix A or otherwise stated in Clause 1.2 of Annexure MRTS07A.1.

Material compliance testing requirements shall be as specified in Table A2 of Appendix A.

Construction compliance testing requirements shall be as specified in Table A3 of Appendix A.

Geometric and deviation from a straightedge compliance testing requirements shall be as specified in Table A4 of Appendix A.

Certification of the compliance of each stabilising agent with this Technical Specification is required for each source and for each load.

6 Material

6.1 New material to replace material not suitable for stabilisation

New material which is required to replace material not suitable for stabilisation shall comply with the requirements stated in Clause 2 of Annexure MRTS07A.1. Where not so stated in the Annexure, new material shall comply with the requirements for Class C earth fill material as specified in Table 14.2.2 of MRTS04 *General Earthworks*.

The lime demand of any new material, determined in accordance with Test Method Q133, shall be not more than the stabilising agent content nominated for the remainder of the works.

Additionally, any new material incorporated into the works shall not have deleterious materials exceeding the limits specified in Table 6.1.

Table 6.1 – Deleterious materials limits

Property	Test Method	Limit
Sulfate Content (water soluble)	AS 1289.4.2.1	< 0.3%
Organic Content[1]	Q120B	≤ 1.0%
Ferrous Oxide (FeO)[1]	In-house[2]	≤ 2.0%

[1] The limits shown are a guide. Advice should be sought from Director (Pavement Rehabilitation) before stabilising materials with ferrous oxide contents > 2.0%, or organic contents > 1.0%.

[2] Private analytical laboratories will use in-house methods based on classical techniques.

6.2 Stabilising agent

The stabilising agent shall comply with the requirements of MRTS23 *Supply and Delivery of Quicklime and Hydrated Lime for Road Stabilisation*.

At the time of spreading, the stabilising agent shall not be more than six months old, measured from its date of manufacture. The lime shall have an Available lime index of not less than 80% from the time of manufacture up to the time of spreading. The stabilising agent shall be sampled and tested to demonstrate the Available lime index does not fall below 80% at the following times:

- at the time of manufacture, and
- monthly between three to six months from its date of manufacture.

The type, estimated content, and specified spread rate of the stabilising agent to be used at specific locations shall be as stated in Clause 8 of Annexure MRTS07A.1. If the specified spread rate is not stated in Clause 8 of Annexure MRTS07A.1, the specified spread rate shall be 2% higher than the minimum lime content determined from lime demand test results.

The Contractor shall make allowance for the variation in spread rate due to the Available lime index of the stabilising agent(s) supplied. The calculation to convert the hydrated lime content used in the laboratory to the quicklime or hydrated lime content used in construction is shown below.

Converted Quicklime content (%) from laboratory Hydrated Lime content (%)

$$\text{Rate Q} = 0.76 \times (\text{Rate H}) \times \frac{AL_x}{AL_y}$$

where: Rate Q is the content of quicklime to be targeted in the field (% by mass)

Rate H is the content of hydrated lime nominated in the design (% by mass)

AL_x is Available lime index of hydrated lime (%), used in the laboratory mix design testing

AL_y is Available lime index of quicklime (%), used in construction

Converted Hydrated Lime content (%) from laboratory Hydrated Lime content (%)

$$\text{Rate Q} = (\text{Rate H}) \times \frac{AL_x}{AL_y}$$

where: Rate Q is the content of hydrated lime to be targeted in the field (% by mass)

Rate H is the content of hydrated lime nominated in the design (% by mass)

AL_x is Available lime index of hydrated lime (%), used in the laboratory mix design testing

AL_y is Available lime index of hydrated lime (%), used in construction

6.3 Water

Where possible, water used for insitu stabilisation works shall be 'potable water'.

Water sources classified by the relevant water authority as ‘potable water’, shall be exempt from any testing requirements.

Where 'potable water' is not available, the Administrator may consider water from other sources.

Unless otherwise accepted by the Administrator, any ‘non-potable water’ sources shall be tested.

In all cases, the water used shall contain less than 0.05% of sulfates and be free from oil, acids, organic matter, and any other matter that could be deleterious to the mixture.

Marine water and recycled water shall not be used for lime stabilisation.

The source(s) of water shall not be changed without approval from the Administrator.

7 Material compliance testing

7.1 General

No material shall be incorporated into the works unless it has been demonstrated, to the Administrator's satisfaction, that the material to be used complies fully with the requirements of this Technical Specification. **Hold Point 2**

The Contractor is responsible for carrying out sufficient testing to ensure that the material complies with the requirements of this Technical Specification. However, the Contractor's testing program shall be such that the testing frequencies and number of tests are not less than those given in Clause 5.4.

The testing of individual samples shall be carried out in accordance with the test methods described in Table 4. Testing frequencies and lot sizes shall be as per the requirements of Clause 5.4.

The material / sources used in the Contract shall be the same as those for material supplied as samples or for which certificates of compliance with this Technical Specification are provided.

The costs associated with material compliance testing shall be deemed to be included in the related / relevant work items.

7.2 Stabilising agent

Sampling and testing shall be carried out in accordance with the relevant specifications.

A certificate of test results demonstrating compliance of each proposed stabilising agent to MRTS23 *Supply and Delivery of Quicklime and Hydrated Lime for Road Stabilisation* shall be provided for each load, or part thereof, of each stabilising agent.

7.3 Water

A certificate of test results demonstrating the compliance of each proposed water source shall be provided.

7.4 New material to replace material not suitable for stabilisation

Compliance testing of any new material used to replace material not suitable for stabilisation shall be carried out in accordance with the requirements of Clause 5.4.

Class C earth fill material shall comply with the requirements of Table 14.2.2 of MRTS04 *General Earthworks* and Table 6.1.

8 Construction

Prior to acceptance (Clause 9.9), construction shall not proceed until the Administrator is satisfied that the requirements covered from Clause 8.1 to Clause 8.7.5.5.3 have been adhered to by the Contractor. **Hold Point 3**

8.1 General

Construction of the lime stabilised layer shown in the Drawings or otherwise specified in the Contract shall be completed as one layer.

The required design depth shall be stated in Clause 8 of Annexure MRTS07A.1.

The datum for measurement of the design depth (refer to Figure 8.6.6.4) shall be stated in Clause 9 of Annexure MRTS07A.1.

Details of measuring the actual thickness of stabilised layer is described in Clause 8.7.5.3.2.

8.2 Program of works

The Contractor shall submit the proposed program of the stabilisation works to the Administrator at least 42 days prior to the commencement of stabilisation works unless otherwise agreed to by the Administrator.

Stabilisation works shall not commence until the program has been approved by the Administrator (refer to Clause 5.2.2 **Hold Point 1**).

8.3 Site services, utilities, buildings and drainage

A survey of the site to determine the location and depth of services, utilities, buildings and drainage components shall be carried out prior to commencement of construction. The survey shall include details of how these and plant and personnel on site shall be protected and how the stabilisation works shall be completed without any detrimental effects to them. All such details shall be included in the proposed construction procedure (refer to Clause 5.2.2).

Stabilisation works shall not commence until the survey has been completed and a copy of the report provided to the Administrator. **Hold Point 4**

8.4 Allowable working time

Compaction and trimming of the stabilised layer shall be completed within the allowable working time.

The allowable working time is measured from the commencement of the final moisture incorporation pass (refer to Clause 8.6.6.4) of stabilising agent into the insitu material on the second day of the stabilisation operation, to the completion of compaction and trimming of the stabilised material (excluding static multi-tyre rolling).

The maximum allowable working time shall be stated in Clause 8 of Annexure MRTS07A.1. If no such value is given, it shall be 48 hours.

Instances where the compaction and trimming process after the final moisture incorporation cannot be completed within the 48-hour allowable working time due to unforeseeable circumstances, the Administrator may consider the following:

- If the construction can recommence within 48 hours, the process may continue, provided the material prior to compaction meets the requirements of this Technical Specification, particularly Clause 8.7.3.
- If the construction delay exceeds 48 hours, treatment with up to an additional 5 kg/m² of hydrated lime (or equivalent quicklime) could be considered. Any extra lime addition (over 5 kg/m²) should be only considered after extensive investigation and testing.
- Consideration needs to be taken of the prevailing temperature condition. It is noted that a stabilised layer may take longer ‘set up’ in lower temperatures.
- In all cases, any rework shall be performed to the full depth of the stabilised layer.

8.5 Construction process

8.5.1 General

The construction process shall be based on either a process requirement or a product standard. The method for this Contract shall be as stated in Clause 8 of Annexure MRTS07A.1. Where not so stated in the Annexure, product standard shall apply.

8.5.2 Construction based on process requirements

If a process requirement is specified in Clause 8 of Annexure MRTS07A.1, construction shall:

a) incorporate the methodology and construction of trial sections in accordance with the requirements of Clauses 8.5.2.1 and 8.5.2.2

b) comply with the construction requirements stated in Clause 8.6, and

c) comply with the product standards stated in Clause 8.7 except that compaction testing shall not be required on completed works other than trial section provided that the Contractor uses the same construction plant, process and methodology as that used for the trial section.

8.5.2.1 Methodology

Each section of the Works with a unique combination of stabilising agent type, stabilising agent spread rate, material(s) to be stabilised and depths shall be identified as a separate area for construction.

A trial section shall be constructed for each separate area for construction in accordance with the requirements of Clause 8.5.2.2.

The compaction of each trial section shall be tested in accordance with Clause 5.4 and checked for compliance with Clause 8.7.4. If the minimum characteristic value of the relative compaction results for the trial section is not less than the value specified in Clause 8.7.4, no further compaction testing shall be carried out for the balance of the area for construction that is represented by that trial section provided that the same construction plant, processes and methodology is used to construct the remaining area as that used for the construction of the trial section.

If the minimum characteristic value of the relative compaction results for the trial section is less than the value specified in Clause 8.7.4, the trial section shall be rectified so that it complies with this Technical Specification, and an additional trial section shall be constructed and assessed in accordance with this Clause 8.5.

Construction based on a process requirement and a trial shall not be used for the balance of the works without approval of the Administrator. **Hold Point 5**

8.5.2.2 Trial section

A trial section shall be constructed using the same construction plant, processes and methodology that are proposed to be used for the remainder of the works represented by the trial section. **Witness Point 1**

A trial section shall be at least 200 metres long, three metres wide and include a longitudinal joint.

All operations, testing, etc., required by this Technical Specification, including compaction testing, shall be used in the construction and testing of a trial section.

8.5.3 Construction based on product standards

If a product requirement is specified in Clause 8 of Annexure MRTS07A.1, construction shall:

a) comply with the construction requirements stated in Clause 8.6, and

b) comply with the product standards stated in Clause 8.7.

8.6 Construction requirements

8.6.1 Removal and disposal of overlying material (if required)

Material shall be excavated to the shapes, lines, dimensions and other requirements shown on the Drawings or as otherwise specified in Clause 3 of Annexure MRTS07A.1. The typical position of the vertical face of excavation is shown in Figure 8.6.7.2.

Overlying material to be disposed shall be disposed of in accordance with Clause 10 of MRTS01 *Introduction to Technical Specifications*.

8.6.2 Removal and disposal of material not suitable for stabilisation (if required)

Material not suitable for stabilisation shall include:

a) unbound material with:

   i. a plasticity index (AS 1289.3.3.1) less than 10%, and

   ii. less than 25% passing (AS 1289.3.6.1) the 0.425 mm test sieve.

b) any patch which may include:

   i. concrete

   ii. cement treated material, and

   iii. asphalt.

c) any material to be stabilised which contains deleterious materials exceeding the limits specified in Table 6.1, and

d) any additional requirements stated in Clause 4 of Annexure MRTS07A.1.

Where material not suitable for stabilisation is encountered, the volume to be removed shall be agreed with the Administrator prior to commencing removal and replacement of material. **Witness Point 2**

Material that is unsuitable for stabilisation shall be removed and disposed of in accordance with Clause 10 of MRTS01 *Introduction to Technical Specifications*.

New material conforming to the requirements stated in Clause 6.1 shall be used to replace the unsuitable material removed. It shall be spread, compacted and trimmed to a shape in accordance with the Drawings or Contract for the completed work.

Compaction of the new material shall be administrated through either product requirement (Clause 9.3) and/or process requirement (Clause 9.2). This shall be approved by the Administrator.

The minimum characteristic value of the relative compaction results shall not be less than 95%. This compaction testing requirement is not applicable if the layer thickness is less than 100 mm.

8.6.3 Compacting and trimming of the surface prior to spreading of the stabilising agent

Prior to spreading of the stabilising agent, the surface shall be shaped, compacted and trimmed to a degree that is sufficient to facilitate stabilisation specified in the Contract. **Witness Point 3**

8.6.4 Stabilising agent equipment

Stabilising agent shall be transported, stored and spread using equipment that is both waterproof and watertight. Equipment used to transfer the stabilising agent shall also be waterproof during the transfer process. All such equipment shall be emptied, cleaned and dried prior to the introduction of each type of stabilising agent to be used in the stabilisation works.

The stabilising agent shall be spread using a purpose-built calibrated spreader. The stabilising agent and water shall be incorporated into the insitu material using a stabiliser.

Where a stabiliser with a calibrated integrated spreader is nominated (refer to Clause 5 of Annexure MRTS07A.1), the stabilising agent shall be incorporated directly into the material to be stabilised. In this case, quicklime shall not be used as the stabilising agent.

8.6.5 First day of stabilisation

8.6.5.1 Spreading of stabilising agent (first day)

On the first day of the stabilisation process, the stabilising agent shall be spread at a minimum of half up to a maximum of two-thirds of the ordered spread rate (refer to Clause 8.7.2.1). The remaining balance of the ordered spread rate shall be spread on the second day (refer to Clause 8.6.6) after the amelioration period specified in Clause 8.6.5.5.

The stabilising agent shall be uniformly spread over the insitu material at a controlled rate (mass per unit area, kg/m²).

Where quicklime is spread, it shall be slaked in accordance with Clause 8.6.5.3. The longitudinal grade and crossfall of the subgrade level prior to spreading quicklime shall not be greater than 5% to avoid excessive water flow and displacement of quicklime or slaked lime during the slaking process. The fully slaked lime or lime slurry formed from the slaking of quicklime shall then be incorporated into the material in accordance with Clause 8.6.5.4.

The maximum amount of hydrated lime to be spread in one pass shall be 10 kg/m² to avoid wastage. Spread rates greater than 10 kg/m² are generally not recommended. However, a maximum spread rate of 12 kg/m² may be considered by the Administrator provided a successful field trial is carried out. If excessive wastage is seen, a maximum spread rate of 10 kg/m² shall be adopted. The number of passes shall be calculated to comply with this requirement.

The maximum amount of quicklime to be spread in one pass shall be 10 kg/m² to avoid the displacement of the quicklime during the slaking process and the slaking water not being able to penetrate the full depth of the quicklime. Spread rates greater than 10 kg/m² are generally not recommended. However, a maximum spread rate of 12 kg/m² could be considered by the Administrator provided a successful field trial is carried out. If excessive wastage is seen or it does not comply with the slaking requirements of Clause 8.6.5.3, a maximum spread rate of 10 kg/m² shall be adopted. The number of passes shall be calculated to comply with this requirement.

Traffic shall be stopped during spreading of stabilising agent if wind direction is such that airborne lime particles are impeding through traffic.

At the start of each individual spreading run, the surface spread rate of the stabilising agent shall be determined using the surface spread rate Test Method Q719. The surface spread rate test shall be carried out within a distance of 35 m from the start of each individual spreading run. After the purpose-built calibrated spreader / integrated spreader has spread over the mat or tray/s, the spreader shall be

halted, the actual spread rate measured, and this result compared with the allowable tolerances specified in Clause 8.7.2.2. If the spread rate result is within the allowable tolerance, the spreader shall be allowed to complete the run. If the spread rate result is outside the allowable tolerance, additional surface spread rate tests shall be repeated in 35 m intervals until the measured surface spread rate result is within the tolerance stated in Clause 8.7.2.2. The Contractor shall undertake corrective action in the area which has non-conforming surface spread rates. **Witness Point 4**

Additional surface spread rate tests at other locations (for example, middle and/or end of a run) shall be conducted upon the request of the Administrator.

Once the stabilising agent has been spread, no traffic, other than the construction plant employed for the stabilisation work, shall travel over it.

All surface spread rate test results shall be recorded and included in the Contractor's quality records (refer to Clause 9.5).

8.6.5.2 Time between spreading and incorporation of stabilising agent

8.6.5.2.1 Using hydrated lime

The maximum allowable time between spreading hydrated lime and commencement of incorporation into the insitu material shall be one hour.

8.6.5.2.2 Using quicklime

The maximum allowable time between spreading quicklime, slaking quicklime and incorporation into the insitu material shall be two hours.

In all cases, the maximum allowable time between spreading quicklime and commencement of slaking shall be 30 minutes. The Contractor shall ensure that the slaking is completed as per requirements of Clause 8.6.5.3 before commencement of incorporation.

8.6.5.3 Slaking of quicklime

The Principal Contractor shall ensure the slaking of quicklime is completed by a Stabilising Subcontractor. The Stabilising Subcontractor shall be responsible for the provision of water / water carts / operators and associated plant / operators for the purpose of slacking quicklime. This is to ensure the slaking procedures, plant and water is adequate for the purpose of slaking quicklime in accordance with this clause.

Quicklime shall be slaked with sufficient water to allow complete hydration such that the material remains friable after slaking and no further exothermic reaction occurs when additional water is added to the lime.

All through traffic shall be stopped during slaking operations.

Quicklime and/or lime slurry formed from the slaking process shall be evenly placed and contained within the stabilising area at the required spread rate. Where displacement of quicklime and/or lime slurry outside of the stabilising area has occurred, corrective action shall be undertaken by the Contractor prior to commencement of the incorporation. The Contractor shall ensure that no quicklime and/or lime slurry runs into the adjacent table drain or watercourse during the spreading and slaking operations.

The slaked quicklime shall be spot checked with a temperature probe and a shovel to ensure that no pockets of unslaked quicklime remain (refer to Figure 8.6.5.3). Where excessive amounts of quicklime is present (for example, due to poor distribution), additional slaking shall be carried out to ensure complete hydration prior to the incorporation. Where an impervious thin layer (or crust) forms on the top of the quicklime making it difficult for additional water to penetrate for the slaking process, the Contractor shall open-up the crust in a safe manner (with proper personal protective equipment) so further water can access the unslaked quicklime beneath.

The results of the spot checks performed on the slaked quicklime shall be included in the Contractor's quality records (refer Clause 9.5). The frequency of the spot check testing shall be as per Clause 5.4. **Hold Point 6**

Figure 8.6.5.3 – Checking completion of slaking with temperature probe

Process of spot check for slaking:

1. Remove the "crust" formed on the top of quicklime after the initial slaking.
2. Insert temperature probe to cove the full depth of quicklime being slaked.
3. Add water to the area surrounding the temperature probe (water bottle suggested).
4. Note for any rise in temperature and steam.
5. If increase in the temperature (and steam), additional slaking is required and steps 1 to 4 above should be repeated until no temperature rise and further steaming occurs (exothermic reaction).

8.6.5.4 Incorporation of stabilising agent (first day)

Incorporation of stabilising agent shall be achieved using a stabiliser hooked-up to a fully laden water truck.

Where quicklime is used as the stabilising agent, incorporation of stabilising agent shall not be commenced until slaking is completed as per the requirements of Clause 8.6.5.3.

Where more than one pass is required to spread the required amount of stabilising agent, the stabilising agent be incorporated into the material after each spreading pass.

All first day incorporation pass(es) of the stabilising agent shall be mixed 50 mm less than design depth (50 mm above the lower reference level).

Where hydrated lime is used as the stabilising agent, all first day incorporation pass(es) of the stabilising agent shall be undertaken with the incorporation of moisture from the water truck hooked-up to the stabiliser.

> The incorporation of moisture together with the hydrated lime stabilising agent allows the insitu materials to be pre-conditioned (in particular, those insitu materials with higher water absorptions).
>
> Typically, 0.2 – 0.5% moisture rate through the stabiliser for each lime incorporation pass.
>
> Where the insitu materials has a relatively higher moisture content at the time of insitu stabilising, the addition of moisture during the incorporation pass(es) may not be required to pre-condition the materials.

The Contractor shall ensure that no excess lime is spilt into the adjoining section during the spreading and incorporation passes. This shall be achieved by:

a) ensuring the stabiliser slows down as it approaches the limit of the section, and

b) any excess lime which is spilt into the adjoining section is spread by the grader back into the section which is currently being stabilised.

Adequate compaction shall be completed after each application of stabilising agent has been incorporated into the insitu material. This shall be carried out using a roller that is capable of achieving relatively uniform compaction over the depth of the stabilised layer. The compacted surface shall be adequately shaped to the specified crossfall to allow for subsequent spreading of the stabilising agent.

8.6.5.5 Amelioration period

Upon completion of the first day stabilisation process, a minimum 12-hour amelioration period shall be required prior to commencing the second day stabilisation process. Where heavy clays are being stabilised, the amelioration period required may be longer than 12 hours to satisfy the material particle size requirements listed in Clause 8.6.6.2. The maximum amelioration period shall be 72 hours.

The Contractor shall ensure that the lime treated layer from the first day stabilisation process shall be compacted with an adequate roller to minimise evaporation loss or excessive wetting from possible rains during the amelioration period.

8.6.6 Second day of stabilisation

8.6.6.1 Spreading of stabilising agent (second day)

Spreading of stabilising agent shall be undertaken in accordance with Clause 8.6.5.1.

Time between spreading and incorporation pass shall be in accordance with Clause 8.6.5.2.

Slaking, if quicklime is used, shall be undertaken in accordance with Clause 8.6.5.3.

8.6.6.2 Incorporation of stabilising agent (second day)

All second day incorporation of stabilising agent (including slaked quicklime) shall be in accordance with Clause 8.6.5.4 and mixed 30 mm less than design depth (30 mm above the lower reference level).

Where hydrated lime is used as the stabilising agent, all second day incorporation pass(es) of the stabilising agent shall be undertaken with the incorporation of moisture from the water truck hooked-up to the stabiliser.

> The incorporation of moisture together with the hydrated stabilising agent allows the insitu materials to be pre-conditioned (in particular, those insitu materials with higher water absorptions).
>
> Typically, 0.2 – 0.5% moisture rate through the stabiliser for each lime incorporation pass.
>
> The Contractor should take care not to incorporate too much moisture during the incorporation pass(es) that will result in exceeding the specified moisture ratio (refer to Clause 8.7.3) during the final moisture incorporation pass (refer to Clause 8.6.6.4).
>
> Where the insitu materials has a relatively higher moisture content at the time of insitu stabilising, the addition of moisture during the incorporation pass(es) may not be required to pre-condition the materials.

Prior to the final moisture incorporation pass (refer to Clause 8.6.6.4), the Contractor shall ensure the following **Witness Point 5**:

a) all material (other than stones) can pass a 19 mm test sieve

b) at least 60% of such material can pass a 9.5 mm test sieve, and

c) the stabilising agent is uniformly mixed through the material.

> Typically, this particle size check is carried out onsite. The Soil Testing Subcontractor shall be equipped with a 19 mm and 9.5 mm test sieves, and a field balance.

Where test results or visual inspection by the Administrator indicates that the mixing requirements stated in this clause have not been met, additional mixing pass(es) shall be carried out to improve the uniformity of:

a) the materials to be stabilised so as to adhere to the particle size requirements stated in this clause, and

b) the distribution of the stabilising agents.

No additional or separate payment shall be made for any additional passes ordered by the Administrator.

8.6.6.3 Compaction and trimming of surface prior to the final moisture incorporation pass

Prior to the final moisture incorporation pass, the surface level shall be compacted and shaped to the specified crossfall. Surface level heights higher than specified in the Drawings or Contract after compaction and shaping due to the effects of ‘bulking’ shall be uniform and shall be identified. In this

case, the difference in height between that specified in the Drawings or Contract and attained (bulking) shall be added to the design depth to determine the stabilising target depth for the final moisture incorporation pass (refer to Figure 8.6.6.4). **Witness Point 6**

8.6.6.4 Final moisture incorporation pass

The distribution of the stabilising agent and water shall be uniform throughout the entire layer depth for the area stabilisation. The moisture content shall be adjusted as necessary during the wet incorporation pass to achieve the moisture ratio stated in Clause 8.7.3. The target depth shall ensure mixing to the lower reference level whereby meeting the requirements of Clause 8.7.5.3.1.

Unless otherwise approved by the Administrator, water shall be added by means of a controlled pressure feed distribution system located inside the mixing chamber of the stabiliser. This system shall be capable of spraying varying rates across its width.

Where test results or visual inspection by the Administrator indicates that any of the requirements stated in this clause have not been met, additional mixing passes shall be carried out to improve the uniformity of the:

a) materials to be stabilised

b) distribution of the stabilising agent, and

c) distribution of water.

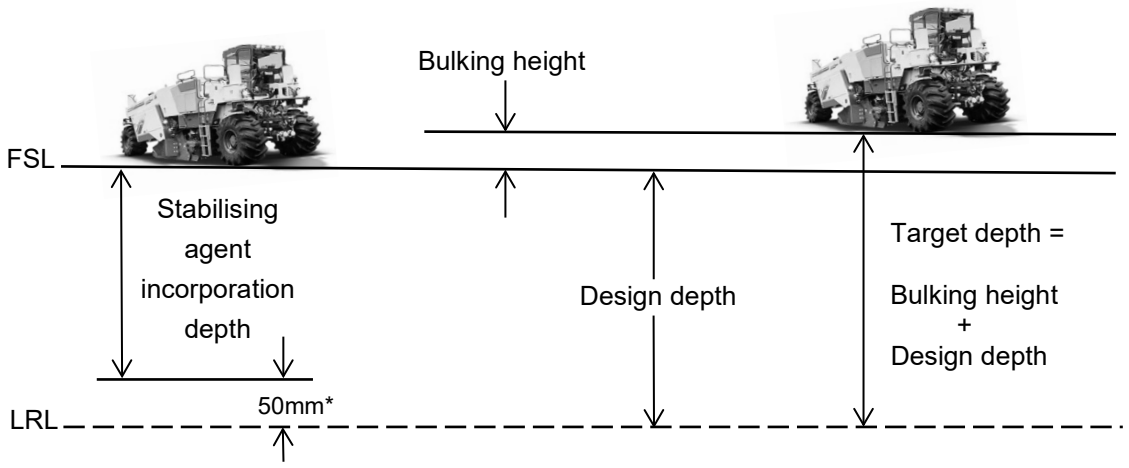
No additional or separate payment shall be made for any additional passes ordered by the Administrator.

Typically, the final moisture incorporation pass occurs on the second day of stabilisation immediately after the incorporation of the stabilising agent provided the insitu material complies with the particle size requirements specified in Clause 8.6.6.2.

Should the situation arise where the wet incorporation cannot occur on the second day of stabilisation, the wet incorporation should be undertaken the following day.

If the delay for the wet incorporation exceeds 48 hours, treatment with up to an additional 5 kg/m² of hydrated lime (or equivalent quicklime) could be considered. Any extra lime addition (over 5 kg/m²) should be only considered after extensive investigation and testing.

Figure 8.6.6.4 – Target depth sketch



Design depth – as specified in the construction drawings and contract documents.
FSL : Finish Surface Level
LRL : Lower Reference Level

Incorporation of stabilising agent	Bulking after incorporation of stabilising agent	Target depth on the final moisture incorporation pass
Incorporation of stabilising agent shall be 50 mm less than the design depth (first day), and *30 mm less than the design depth (second day).	After surface compaction and trimming, the materials will change in volume due to incorporation of the stabilising agent. The bulking height above FSL needs to be identified and added to the design depth.	Mixing depth required on the final pass by the stabiliser to reach the LRL shall account for the additional bulking above the FSL.

8.6.6.5 Compaction and trimming after final moisture incorporation pass

Immediately after wet incorporation pass, the stabilised area shall be compacted with adequate rollers (refer Clause 8.6.10) to achieve the compaction stated in Clause 8.7.4.

For layer thicknesses 200 – 350 mm which are being compacted using a pad foot roller (refer to Clause 8.6.10), pad foot marks shall be removed to prevent differential compaction and the pad foot marks reflecting to the surface. The Contractor shall ensure that no marks caused by a pad foot roller remain on the surface. A minimum cut to -100 mm from the Finished Surface Level (FSL) of the stabilised layer is required to completely remove the influence of the pad foot marks and not create a thin false layer when the stabilised material is reinstated.

Removing (or cutting out) of the pad foot marks can be undertaken using a grader or stabiliser.

In both cases, a minimum cut to -100 mm from the Finished Surface Level (FSL) of the stabilised layer is required.

Where a grader is used to remove the pad foot marks, the stabilised material shall not be wasted. Once the pad foot marks have been completely removed, the stabilised material can be reinstated to allow the completion of compaction and trimming.

Where a stabiliser is used to remove the pad foot marks, the upper 'loose' stabilised materials can be compacted and trimmed in place to complete the stabilised layer. The stabiliser's tyre tread marks (or ruts) must be removed to prevent differential compaction and the tyre tread marks reflecting to the surface. A sufficiently deep cut with the grader is required to completely remove the influence of the tyre tread marks and not create a thin false layer when the stabilised material is reinstated.

For layer thicknesses <200 mm which are being compacted using smooth drum and multi-tyre rollers (refer to Clause 8.6.10), removal of pad foot marks is not required. However, the stabiliser's tyre tread marks (or ruts) shall be removed to prevent differential compaction and the tyre tread marks reflecting to the surface. The Contractor shall ensure that no marks caused by the stabiliser's tyre tread marks remain on the surface. A sufficiently deep cut with the grader is required to completely remove the influence of the tyre tread marks and not create a thin false layer when the stabilised material is reinstated.

Initial shaping of the stabilised surface shall be carried out after the stabilised layer has been compacted.

The trimmed surface shall be free from loose pockets, holes, bumps and lenses of materials. The identified depressions shall be filled with additional stabilised material that is mixed and placed within its allowable working time as specified in Clause 8.4.

No marks caused by any roller or stabilisation plant shall be left on the surface of the stabilised layer.

All final trimming shall involve cutting to waste. All material cut to waste shall be disposed of in accordance with Clause 10 of MRTS01 *Introduction to Technical Specifications*. No separate payment shall be made for the disposal of material cut to waste. The cost of all activities associated with the disposal of material cut to waste shall be deemed to be incorporated into the relevant work items.

Compaction and trimming (excluding static multi-tyre rolling) shall be completed within the allowable working time as specified in Clause 8.4.

When finishing compaction using the vibrating smooth drum roller, adequate care and attention must be undertaken to avoid “over-compacting” the stabilised layer (also commonly referred to a “de-compacting” or “shattering”). Over-compaction can commonly occur when the smooth drum roller is operated on high amplitude vibration mode.

To avoid over-compaction and damaging to the stabilised layer’s surface, typical best practise is low amplitude vibration mode for the forward direction, and static (or no vibration) for the backwards direction.

The following guide may be considered in the construction process where a stabilised layer may take longer 'set up' in lower temperatures.

- Initial compaction is required to be carried out immediately after the wet incorporation pass.
- Final trim can be carried out within 48 hours of the completion of the wet incorporation pass.
- Back-rolling using a combination of static smooth drum and multi-tyre rollers has been found to be very effective in achieving the required compaction.
- Bulking which has resulted from the stabilisation process can remain until final trim.
- Where possible, water curing (especially initial water curing) should be performed without the water truck travelling over the stabilised surface.
- In cases of boxed excavations, adequate over excavation of the crown is required to accommodate for machine mixing offsets / capabilities and compliance with the longitudinal joint requirements of this Technical Specification. In addition, compliance of longitudinal joint requirements for subsequent pavement layers shall be considered.

8.6.7 Construction joints

8.6.7.1 General

Joints shall be constructed such that the material at the joints complies with the requirements of this Technical Specification.

A construction joint (longitudinal or transverse) shall be deemed fresh when the material on each side of the joint has been stabilised, placed and compacted within the allowable working time (refer to Clause 8.4) of the stabilised material constructed first.

8.6.7.2 Longitudinal joints

Longitudinal joints shall not be located in the through traffic wheel paths.

Where a fresh longitudinal joint between adjacent runs is to be compacted, the outside 300 mm of material from the first run shall be left uncompacted until the adjacent material is ready for compaction. The joint shall be water cured during this period. When the fresh joint is compacted the roller shall be partially supported on the portion of the first run that has been previously compacted.

For longitudinal joints that are not fresh, to ensure complete stabilisation across the full width of the pavement, the minimum distance for cutting back / overlapping into previously stabilised material shall be the greater of 75 mm or the distance to a point where the stabilised material complies with this Technical Specification.

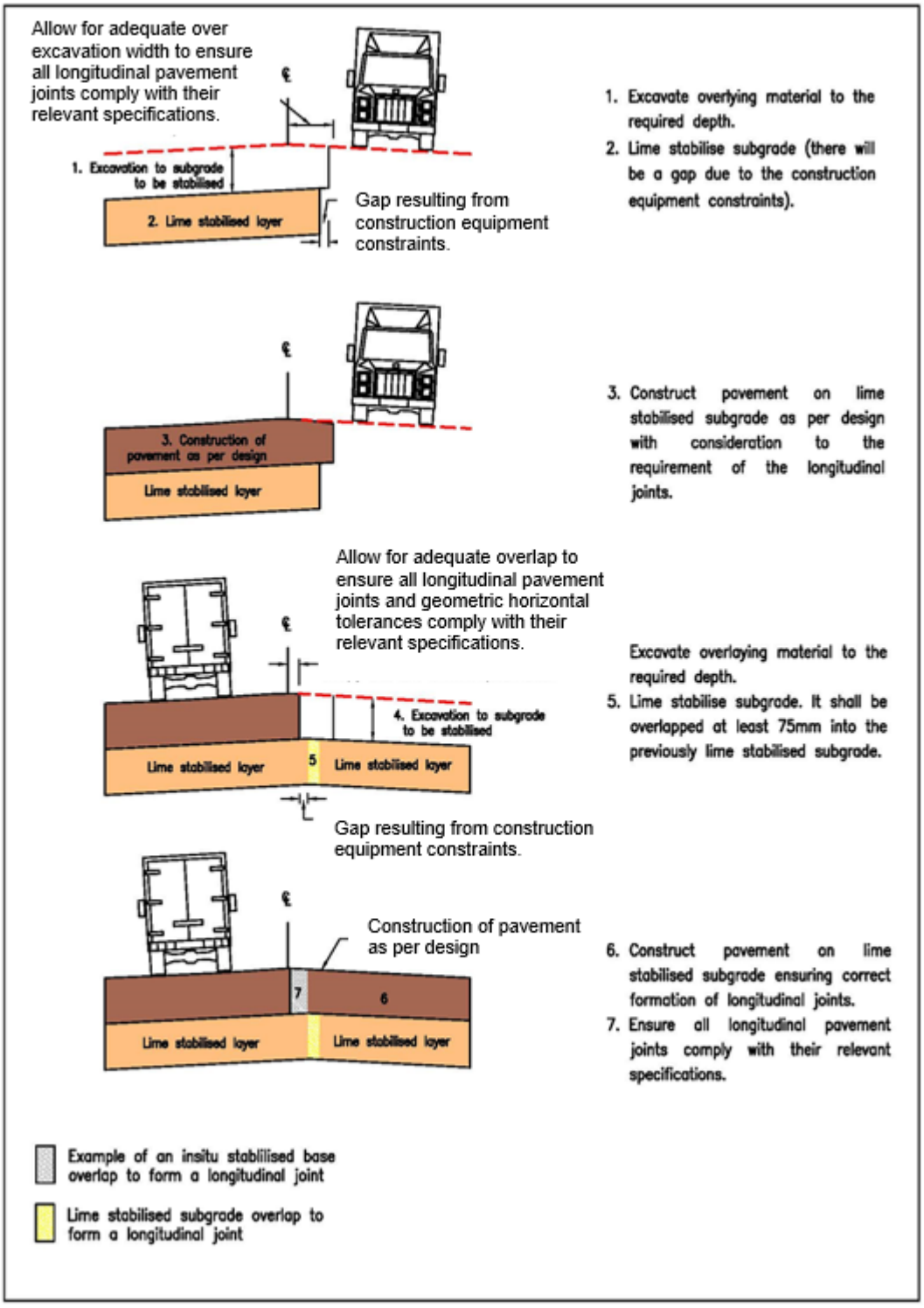
The overlap at a change of crossfall or crown will need to be carefully considered to comply with the longitudinal joint requirements of this clause and Clause 8.7.5.

Where the existing pavement is boxed to subgrade level, the Contractor shall ensure that the subgrade material is fully stabilised to the full width specified in the Drawings or Contract. The offset between the mixing equipment and the vertical face of the excavation to allow correctly formed longitudinal joints conforming to this clause shall be considered.

Likewise, the Contractor shall ensure that any pavement layers which overlay the lime stabilised layer have correctly formed longitudinal joints in accordance with their relevant specification. A typical construction process for a boxed pavement is shown in Figure 8.6.7.2.

No separate payment shall be made for the disposal of material cut to waste. The cost of all activities associated with the disposal of material cut to waste shall be deemed to be incorporated into the relevant works items.

Figure 8.6.7.2 – Typical construction process



8.6.7.3 Traverse joints

For transverse joints that are not fresh, the adjoining stabilised section shall be remixed using a stabiliser by the greater of 1.5 m or the length ordered by the Administrator.

8.6.8 Curing

A curing operation shall commence immediately after the completion of compaction. Curing operations shall be carried out with extreme care to avoid damaging the stabilised layer.

The stabilised layer shall be cured using water by maintaining the layer surface and edges in a continuously damp condition, using a uniformly applied fine mist, until the stabilised layer is covered by an overlying pavement layer or a sprayed bituminous surfacing with cover aggregate.

Water shall be applied in a manner such that slurring of the surface, pavement instability and erosion and/or leaching of the stabilising agent are all avoided. During the water curing process, no heavy construction equipment shall be allowed on the stabilised layer.

8.6.9 Maintenance of the stabilised layer

The stabilised layer shall be maintained by the Contractor until a bituminous surfacing with a cover aggregate is applied, or until the stabilised layer is covered by another pavement layer, or until the Administrator accepts and takes responsibility for that area (whichever is the longer).

The surface of the stabilised layer shall be kept moist, in good order, in good condition and free from contamination. Construction and other traffic shall not traverse the stabilised layer where damage to the surface may occur.

No separate or additional payment shall be made for maintenance of the stabilised layer. The cost of all activities associated with maintenance of the stabilised layer shall be deemed to be incorporated into the relevant work items for the stabilised layer.

Unless otherwise approved by the Administrator, placement and compaction of any subsequent layer shall be carried out within 48 hours after the stabilised layer is accepted by Administrator (refer to Clause 9.9).

Where the insitu stabilised layer is to be overlaid with another pavement layer, consideration needs to be given on how to adequately prepare the surface to maximise the bond between pavement layers.

If the insitu stabilised layer is to be overlaid with another insitu stabilised layer, it is recommended that the overlying layer be insitu stabilised to a depth which will 'tuck in' to the underlying layer. The 'tuck in' details shall be provided in the Contract documents.

If the insitu stabilised layer is to be overlaid with a plant-mixed stabilised or granular layer, it is recommended that the finished surface be hard-cut and/or broomed to produce a roughly textured surface before placing the next layer.

8.6.10 Minimum requirements and numbers of particular plant

The minimum requirements and numbers of particular plant that shall be on Site at all times during the stabilisation works shall be as stated in Clause 5 of Annexure MRTS07A.1.

Where not so stated in the Annexure, the minimum requirements and numbers of particular plant that shall be on Site at all times during the stabilisation works shall be as stated in Table 8.6.10.

Table 8.6.10 – Minimum requirements and numbers of particular plant

Description	Minimum Requirement for each Piece of Plant		Minimum Number of Units
Stabiliser or Integrated spreader stabiliser	a) Minimum power capacity of 155 kW/m of the drum width. b) Capable of mixing to the specified depth. c) Capable of supplying water such that incorporation rates can be varied across the full width of the stabilising box and incrementally across the box. d) Calibrated and capable of uniformly spreading stabilising agent to varying widths (if integrated spreader stabiliser).		1
Purpose built spreader	Calibrated with load cells and capable of uniformly spreading stabilising agent using a fixed bulk bin feeding a mechanical or hydraulic driven spreading rotor to varying widths.		1
Vibrating pad foot roller	For layer thickness < 200 mm: not required	For layer thickness 200 – 350 mm: 21 tonnes	1
Vibrating smooth drum roller	For layer thickness < 200 mm: 16 tonnes	For layer thickness 200 – 350 mm: 16 tonnes	1
Multi-tyre roller	12 tonnes		1
Water truck	Minimum capacity of 6000 litres.		2
Grader	Manned by final trim Operator.		1

The Contractor shall utilise adequate roller sizes and rolling patterns to achieve the specified relative compaction.

When compacting an insitu stabilised layer thickness of 200 – 350 mm a padfoot roller is required for initial compaction. After the removal of padfoot marks (refer to Clause 8.6.6.5), care needs to be taken by the Contractor to ensure that the final smooth drum rolling does not de-compact (or crack) the stabilised layer.

Typically, insitu stabilised layer thicknesses are not less than 200 mm. However, for layer thickness <200 mm, the Contractor shall use a combination of smooth drum and multi-tyre rollers which has demonstrated it will achieve the specified relative compaction. After the removal of the stabiliser's tyre tread marks (refer to Clause 8.6.6.5), care needs to be taken by the Contractor to ensure that the final smooth drum rolling does not de-compact (or crack) the stabilised layer.

8.6.11 Conditions under which stabilisation shall not proceed

The entire stabilisation process shall not proceed in any of the following situations:

a) during rainfall

b) when rainfall appears to be imminent

c) during periods when the wind is strong enough to cause particles of the stabilising agent to become airborne

d) during conditions that may result in the work causing nuisance or danger to people, property, the environment, or livestock

e) when the pavement temperature, measured 50 mm below the surface, drops below 10ºC, or

f) when the air temperature, measured in the shade, exceeds 40ºC.

8.7 Product standards

8.7.1 General

Compliance testing of the stabilised layer shall be undertaken for each lot. Where a process standard is specified (refer to Clause 8.5.1), the compaction requirements in Clause 8.7.4 shall apply to the trial sections but not to other sections. Where a product standard is specified (refer to Clause 8.5.1), the compaction requirements in Clause 8.7.4 shall apply to all lots.

8.7.2 Stabilising agent spread rate

8.7.2.1 Ordered spread rate

At least 14 days prior to the commencement of stabilisation works, the specified stabilising agent spread rate stated in Clause 8 of Annexure MRTS07A.1 will be confirmed or adjusted by the Administrator.

The confirmed or adjusted stabilising agent spread rate shall be the ordered spread rate of stabilising agent. **Milestone**

8.7.2.2 Actual spread rate

The actual spread rate shall be represented by the average of the surface spread rate results of the stabilising agent for each lot.

The actual stabilising agent spread rate shall be within ± 10% of the ordered spread rate as specified in Clause 8.7.2.1.

8.7.3 Moisture ratio

The moisture ratio of the uncompacted materials during the final moisture incorporation pass shall be determined in accordance with Clause 9.7, and shall comply with the requirements specified in Table 8.7.3.

Table 8.7.3 – Moisture ratio requirements

Property	Minimum value (%)	Maximum value (%)
Moisture ratio (uncompacted) (MR_u) during the final moisture incorporation pass	95	105

8.7.4 Compaction standard

The minimum characteristic value of the relative compaction results for the full thickness of the stabilised layer shall be determined in accordance with Clause 9.6, and shall comply with the requirements specified in Table 8.7.4.

Table 8.7.4 – Compaction requirements

Layer	Minimum relative compaction value
Lime stabilised layer	97% (standard compaction)

8.7.5 Geometrics

8.7.5.1 General

The stabilised layer shall be constructed so as not to depart from the alignment, widths, thicknesses, lengths, heights and shapes specified in the Drawings or Contract by more than the tolerances stated in Clause 8.7.5.2 to Clause 8.7.5.5.

When constructing the stabilised layer, the Contractor shall consider the geometric tolerances of any overlaying layer(s) and shall prepare the stabilised layer in such a manner that will permit the geometric conformance of the stabilised layer, and any overlying layer(s).

8.7.5.2 Geometrics, vertical tolerances

8.7.5.2.1 Primary tolerance

A primary tolerance shall apply to the height of any point on the finished surface of the stabilised layer.

The primary tolerance shall be as stated in Clause 6.1 of Annexure MRTS07A.1 and be one of the alternatives given in Table 8.7.5.2.1. If no such indication is given, the primary tolerance shall be Alternative B (-5 and +15 mm).

Table 8.7.5.2.1 – Primary tolerance for the height of any point on the surface of the stabilised layer

Alternative	Primary tolerance (mm)
A	-5 and +10
B	-5 and +15
C	-5 and +25
D	Thickness only

Alternative A primary tolerance (-5 +10 mm) is recommended for an insitu stabilised layer when the subsequent overlying layer is an insitu stabilised layer that ‘tucks in’.

In all cases the primary tolerance shall also apply for the thickness of the completed stabilised layer (refer to Clause 8.7.5.3.1).

Where Alternative D (thickness only) has been specified in Clause 6.1 of Annexure MRTS07A.1, the following shall apply:

a) height of collimation (also known as a 'dumpy level' technique) shall be used to determine the actual stabilised layer thickness

b) minimum testing frequency for determining the actual stabilised layer thickness shall be at each compaction test location (refer Clause 9.6), and

c) at any point of the completed stabilised layer, the measured thickness shall be within -5 mm and +15 mm of the design depth stated in Clause 8 of Annexure MRTS07A.1.

8.7.5.3 Geometrics, thickness tolerances

8.7.5.3.1 General

At any point of the completed stabilised layer, the measured actual stabilised layer thickness (refer to Clause 8.7.5.3.2) shall be within the primary tolerance nominated in Clause 8.7.5.2.1 of the design depth specified in Clause 8 of Annexure MRTS07A.1.

8.7.5.3.2 Measuring actual stabilised layer thickness

During each final moisture incorporation pass and prior to compaction, depth checks shall be undertaken to determine the lower reference level at the bottom of the stabilised layer. The frequency of the depth checks shall be stated in Clause 5.4. Depth checks shall be undertaken by a Surveyor in accordance with the limits of accuracy defined in MRTS56 *Construction Surveying*.

Following compaction and final trim, levels shall be obtained from the top of the finished stabilised layer. They shall be recovered in the horizontal plane to an accuracy of ± 50 mm of the same location as those from which the lower reference levels were obtained. The difference between the finished surface level and lower reference level shall be recorded as the actual stabilised layer thickness.

The actual stabilised layer thickness shall be recorded by the Contractor and reported to the Administrator. The record for each thickness determination shall include:

a) the position and measurement of the lower reference level at each depth check location

b) the position and measurement of the finished surface level at each depth check location.

c) the actual stabilised layer thickness result obtained by subtracting the finish surface level measurement from the lower reference level measurement for each test location (rounded to the nearest 1 mm), and

d) the minimum characteristic value calculated in accordance with Clause 12 of MRTS01 *Introduction to Technical Specifications*, of all stabilised layer thickness measurements for each lot.

As an alternative to measuring the finished surface level recovered in the horizontal plane to an accuracy of ±50 mm of the same location as the lower reference level measurements, a Triangular Irregular Networks (TIN) surveyed surface may be used by the Contractor.

The Contractor shall submit to the Administrator the proposed reporting positions (grid pattern and offsets) for the finished surface level survey capture. The use of TIN shall not be accepted until the Administrator has approved the Contractor’s methodology.

In some locations, the finished surface level design geometry may be sub-optimal in crossfall and/or longitudinal grade and therefore not suitable for TIN surface creation. In these locations, the use of TIN shall not be accepted by the Administrator.

A Surveyor shall undertake the as-constructed survey capture of the finished stabilised layer in accordance with the geometrics conformance requirements of this Specification, and the As Constructed Survey requirements of MRTS56 *Construction Surveying*. From the as-constructed

survey capture, a TIN surface can be developed and used to represent the finished surface level of the stabilised layer.

The actual stabilised layer can be measured and reported to the Administrator using this TIN surface as per the requirements of this Clause.

In all cases,

- the reported positions must be recovered within the bounds of the developed TIN surface, and
- the finished surface level and lower reference level measurements are recovered in the as-constructed survey to an accuracy of ±1,000 mm.

8.7.5.4 Geometrics, horizontal tolerances

The horizontal position of any point on the pavement shall not differ from the corresponding point shown on the Drawings or otherwise specified in the Contract by more than ± 50 mm.

8.7.5.5 Additional tolerances

8.7.5.5.1 General

Where required by Clauses 8.7.5.5.2 and 8.7.5.5.3, additional tolerances shall apply to the stabilised layer.

Additional work shall be carried out by the Contractor where necessary to achieve these additional tolerances. Payment for any such work shall be deemed to be included in the Contractor's scheduled rate for the relevant work items.

8.7.5.5.2 Deviation from a straightedge

Clause 6.2.1 of Annexure MRTS07A.1 specifies whether a deviation from a straightedge tolerance is to be applied. If no indication is given, deviation from a straightedge tolerance shall apply.

The deviation from a 3 m long straightedge placed anywhere on the surface of a layer shall not exceed the limits stated in Clause 6.2.2 of Annexure MRTS07A.1, due allowance being made for design shape, where relevant.

The limit stated in Clause 6.2.2 of Annexure MRTS07A.1 shall be one of the alternatives given in Table 8.7.5.5.2. If no limit is given, it shall be Alternative F (15 mm).

Table 8.7.5.5.2 – Tolerance for deviation from a straightedge

Alternative	Maximum value (mm)
E	8
F	15
G	25

Alternative E tolerance (8 mm) is recommended for an insitu stabilised layer when the subsequent overlying layer is an insitu stabilised layer that 'tucks in'.

8.7.5.5.3 Crossfall

Clause 6.3 of Annexure MRTS07A.1 specifies whether a crossfall tolerance is to be applied. If no indication is given, crossfall tolerance shall apply.

The crossfall shall not depart from the corresponding crossfall shown in the Drawings or Contract by more than 0.5% absolute.

The crossfall shall be measured:

a) between any two points more than two metres apart except where a pavement verge is less than two metres wide. For pavement verges less than two metres wide, the measurement shall be made between the extreme edges of the pavement verge on each side of the pavement

b) transverse to the centre line of the carriageway, and

c) within the boundaries of a cross-section element that has a constant crossfall.

9 Construction compliance testing

9.1 General

Unless otherwise stated in this Technical Specification, the selection of sampling or test locations shall be carried out using random stratified sampling. Exceptions include testing of:

a) geometrics (Clause 9.4)

b) the stabilising agent spread rate (Clause 9.5), and

c) proof rolling of pavement layers (Clause 9.8).

The Contractor is responsible for performing sufficient tests to ensure that the pavement complies with the standards and requirements of this Technical Specification. However, the Contractor's testing program shall be such that the testing frequencies and number of tests are not less than those specified in Clause 5.4.

9.2 Process requirements

Where construction has been carried out using process requirements, checking for compliance with the specified requirements shall be carried out during and after the construction operation, as relevant. Except for compaction, compliance checking shall be carried out in accordance with Clause 5.4. If a process requirement is specified for compaction, the minimum testing frequencies and minimum number of tests for compaction specified in Clause 5.4 applies to the trial sections and do not apply to other sections.

Notwithstanding this, the requirements of Clause 8.5.2 shall apply.

9.3 Product standards

Where construction has been carried out using product standards, compliance testing of the stabilised layer shall be undertaken for each lot. If a product standard is specified, the minimum testing frequencies and minimum number of tests for compaction specified in Clause 5.4 shall apply.

Notwithstanding this, the requirements of Clause 8.5.3 shall apply.

9.4 Geometrics

All geometric tolerances shall be checked at regular intervals not greater than those specified in Clause 5.4.

9.5 Stabilising agent spread rate

The stabilising agent spread rate shall be determined by Test Method Q719. The stabilising agent spread rate shall be within the allowable tolerance specified in Clause 8.7.2.2 in all cases.

The results of all surface spread rate tests shall be recorded, included in the quality records and reported to the Administrator. The record and report for each surface spread rate test shall include:

a) the position, date and time

b) all values and calculations, including ordered spread rate and assumptions, used to calculate the surface spread rate, and

c) the calculated surface spread rate.

The testing program shall be discussed and agreed with the Administrator prior to commencement of stabilising operations (refer to Clause 5.2.2 **Hold Point 1**).

In addition, the tonnage of stabilising agent placed during each spreading run shall be recorded and reported. The record and report for each spreading run shall include:

a) the start position, date and time

b) the end position, date and time

c) the length of the run

d) the width of the run

e) the tonnage of stabilising agent in the spreader at the start of the run

f) the tonnage of stabilising agent at 500 m intervals (if the length of the run exceeds 500 m)

g) the tonnage of stabilising agent in the spreader at the end of the run

h) the tonnage of stabilising agent spread for each 500 m interval (if the length of the run exceeds 500 m)

i) the tonnage of stabilising agent spread for the entire run, and

j) if quicklime is used, the results of the slaking spot checks.

9.6 Compaction

The compaction standard for each lot shall be represented by the minimum characteristic value of the compaction results. The characteristic value shall be calculated as stated in Clause 12 of MRTS01 *Introduction to Technical Specifications* or Test Method Q020 using the individual relative compaction results determined from testing each lot.

Where the minimum characteristic value of a lot's compaction results does not comply with the requirements of this specification, the Contractor shall raise a suitable non-conformance report.

The Administrator should review each individual compaction result. The review may necessitate the need for additional investigation to identify the underlying cause(s) for the noncompliance.

The Administrator should also review the homogeneity of the works.

The locations of all tests undertaken for the determination of insitu dry density and relative compaction shall be at the same locations of samples taken to determine the corresponding laboratory MDR.

Sampling of stabilised materials to determine the laboratory MDR as detailed in Test Method Q142A shall take place immediately after the final moisture incorporation pass (second day), but prior to the commencement of compaction of the stabilised material.

The relative compaction of the stabilised material as detailed in Test Method Q140A shall be determined for the entire thickness of the stabilised layer.

Inherently, the insitu stabilisation process involves the mixing of existing materials whose properties can be unpredictable and may also vary within the Project limits. Therefore, caution must be applied when seeking to determine nuclear gauge biases (refer to Nuclear Gauge Testing Manual (NGTM) Test Method N01), and/or, attempting to establish and monitor assigned values (refer to Test Method Q144A).

9.6.1 Time limits for MDR laboratory compaction

Following sampling, the MDR testing shall be completed to a stage where laboratory compaction has been completed within three hours of the commencement of the final moisture incorporation pass (second day) for the corresponding lot.

To comply with the above requirements, the Contractor may need to consider the establishment of an annex laboratory facility onsite.

Additionally, following sampling, oven drying of all specimens used to determine the moisture content shall commence within the same work shift as the stabilisation works for the corresponding lot.

9.6.2 Time limits for the determination of compacted density

Unless otherwise approved by the Administrator, the determination of compacted density using Test Method Q141A or Test Method Q141B shall be completed to a stage where the wet density has been determined within 24 hours after the end of the work shift where stabilisation works were completed for the corresponding lot.

Additionally, any moisture sub-sample is being oven dried within the same work shift as the compacted density testing for Test Method Q141A or Test Method Q141B is being undertaken.

9.6.3 Time limits for the determination of material biases

For the determination of material biases for Test Method Q141A, compacted density testing using Test Method Q141B shall be completed to a stage where the wet density has been determined within

24 hours after the end of the work shift where stabilisation works were completed for the corresponding lot.

Additionally, any moisture sub-sample is being oven dried within the same work shift as the compacted density testing for Test Method Q141B is being undertaken.

9.7 Moisture ratio

The moisture ratio of the uncompacted material (MR_u) shall be determined in accordance with Test Method Q250.

The moisture sample locations shall be identical to the MDR sampling locations for compaction testing (refer to Clause 9.6). The moisture samples shall be extracted immediately after the final moisture incorporation pass by the stabiliser and prior to the addition of any additional moisture for the purposes of compaction and trimming.

Following sampling, oven drying of all specimens used to determine the moisture content shall commence within the same work shift as the stabilisation works for the corresponding lot.

The moisture ratio shall be calculated using the individual moisture content compared to the optimum moisture content for each corresponding location (refer to Clause 9.6). As a minimum frequency, the moisture ratio of the uncompacted materials shall be assessed at each test location for compaction. The results shall be reported to the Administrator as soon as it is available.

9.8 Proof rolling

The proof rolling test specified in this clause shall apply to a completed stabilised layer unless stated otherwise in Clause 7 of Annexure MRTS07A.1. If no indication is given, the proof rolling test shall apply.

Each stabilised layer shall be tested for perceptible surface deformation by ‘proof rolling’ the stabilised layer, in the presence of the Administrator. **Witness Point 7** All areas of the stabilised layers shall be proof rolled, including all trafficked lanes, shoulders and other areas.

Testing shall be in accordance with Test Method Q723 unless otherwise approved by the Administrator. Testing for perceptible surface deformation is exempt from the requirement for NATA accreditation or Construction Material Testing (CMT) registration.

Where the surface of any section of a stabilised layer displays perceptible surface deformation under proof rolling, the Administrator may require the Contractor to undertake additional compliance testing to ensure that the affected section of the stabilised layer complies with Clauses 8.7.1, 8.7.2 and 8.7.3. No additional payment shall be made by the Principal for such additional testing.

Where the surface of any section of a stabilised layer displays perceptible surface deformation under proof rolling, the construction of any overlying pavement layer shall not proceed until the Administrator grants the Contractor permission to proceed in accordance with Clause 9.9.

The proof rolling result reported for any stabilised layer lot shall be representative of the condition of the lot immediately prior to it being covered by another pavement layer. If the stabilised layer lot has been subjected to rainfall or moisture ingress in any way since proof rolling was undertaken, the Administrator may direct the Contractor to retest the lot to prove conformance. If the retested results do not comply with the requirements of this Technical Specification, the Contractor shall rectify the stabilised layer such that it complies with the requirements of this Technical Specification. No additional payment will be made by the Principal for any such additional efforts.

Test Method Q723 provides a method for using a loaded water tanker for proof rolling.

9.9 Acceptance

For any completed stabilised subgrade lot, the Contractor shall submit to the Administrator all compliance testing relevant to that lot within 96 hours after the completion of the lot's final moisture incorporation pass (refer Clause 8.6.6.4). Construction shall not proceed until the Administrator has received these compliance test results. The Contractor shall allow at least one working day for a response from the Administrator.

Compliance test results need to be provided by the Contractor to the Administrator in a timely manner (within 96 hours after the completion of the lot's final moisture incorporation pass). This will allow the Contractor and Administrator to monitor the progress and quality of the works and address any non-conformances promptly.

No stabilised subgrade lot shall be covered by a subsequent layer until all compliance testing has been completed and the layer has been presented to the Administrator for permission to proceed. **Hold Point 7**

No stabilised subgrade lot shall be covered by a subsequent layer until the As Constructed Survey requirements for the stabilised subgrade lot have been met as specified in MRTS56 *Construction Surveying* and notice of such works has been provided to the Administrator.

10 Supplementary requirements

The supplementary requirements given in Clause 10 of Annexure MRTS07A.1 shall apply.

Appendix A: Maximum lot sizes and minimum testing frequencies

Table A1 – Maximum lot sizes requirements

Construction Activity	Maximum Lot Size
Supply of additional material to replace unsuitable material	1,000 m³
Construction of a stabilised layer using Quicklime or Hydrated lime	The area (in m²) of production, of completed stabilised layer, achieved during the first and second day work periods for that layer, provided the material is, in the opinion of the Administrator, essentially uniform.

Table A2 – New material to replace unsuitable material – product compliance testing requirements

Property	Test Method	Normal Testing Level		Reduced Testing Level	
		Minimum Testing Frequency	**Minimum No. of Tests**	**Minimum Testing Frequency**	**Minimum No. of Tests**
Particle size distribution (grading)	AS 1289.3.6.1	1 test per 500 m³	2 tests per lot	1 test per 1000 m³	1 test per lot
Plastic limit and plasticity index	AS 1289.3.2.1, AS 1289.3.3.1				
Liquid limit	AS 1289.3.1.1				
Linear shrinkage	AS 1289.3.4.1				
California Bearing Ratio	AS 1289.6.1.1				
Sulfate content	AS 1289.4.2.1	1 test per material source			
Organic content	Q120B				
Ferric oxide FeO content	In-house*				
Lime demand	Q133				
Sulfate content (water)	AS 1289.4.2.1#	1 test per water source			

Notes:

* Private analytical laboratories will use in-house methods based on classical techniques.

Or other published or validated classical chemistry technique or instrumentation technique.

Table A3 –Construction compliance testing requirements

Property	Test Method	Normal Testing Level		Reduced Testing Level	
		Minimum Testing Frequency	**Minimum No. of Tests**	**Minimum Testing Frequency**	**Minimum No. of Tests**
Compaction	Q140A	1 test per 500 m²	4 tests per lot	1 test per 1000 m²	2 tests per lot
Moisture ratio (uncompacted) (MR_u)	Q250	1 test per 500 m²	4 tests per lot	1 test per 1000 m²	2 tests per lot
Surface spread rate of stabilising agent	Q719^	Minimum 1 per spreading run			
Slaking spot checks (quicklime)	Clause 8.6.5.3	1 per 25 linear m (selecting the thickest area)			
Depth checks	Survey	a) 1 per 5 linear m within the first 20 m of each final moisture incorporation pass, and b) 1 per 20 linear m for the remaining length of each final moisture incorporation pass		a) 1 per 5 m within the first 20 m of each final moisture incorporation pass, and b) 1 per 50 m for the remaining length of each final moisture incorporation pass.	
Proof Rolling	Q723	Refer to Clause 9.8			

Note:

^ For Q719, the requirement for the test to be carried out by a registered NATA and Construction Materials Testing (CMT) Supplier in accordance with MRTS50 *Specific Quality System Requirements*, shall be relaxed.

Table A4 –Geometrics compliance testing requirements

Construction Activity	Test Method	Normal Testing Level		Reduced Testing Level	
		Minimum Testing Frequency	**Minimum No. of Tests**	**Minimum Testing Frequency**	**Minimum No. of Tests**
Geometrics horizontal position	Survey	Each 20 linear metres – measured at all shoulder edges, lane lines and other changes in grade across the subgrade			
Geometrics vertical levels	Survey				
Geometrics layer thickness	Survey	1 per 20 linear m		1 per 50 linear m	
Deviation from a straightedge	Q712	a) **within lane:** 1 per 20 linear metres along each stabilising run, unless otherwise approved by the Administrator. Measurements shall be taken in both the transverse and longitudinal directions. b) **longitudinal joint:** 1 per 20 linear metres along each joint, unless otherwise approved by the Administrator. c) **transverse joint:** 1 measurement per joint in each wheel path in each lane. For the measurement of joints, place the straightedge on the completed layer, perpendicular to the joint. With the end of the straightedge directly over the joint, gradually move the straightedge across the joint for its full length and identify the point on the layer that produces the largest deviation under the straightedge (between two points of contact). Record the deviation at this point.			
Crossfall	Survey	1 per 20 linear metres – measured for all crossfalls shown in the design documentation at the point of testing			