SPECIFICATION 515

IN SITU STABILISATION OF PAVEMENT MATERIALS

REVISION REGISTER			
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SPECIFICATION 515

IN SITU STABILISATION OF PAVEMENT MATERIALS

GENERAL

515.01 SCOPE

1. The work under this specification consists of the supply and application of in situ stabilisation of granular pavement layers. This includes using one or a combination of chemical and bituminous stabilising agents, by means of a rotary drum stabilising machine. This specification shall apply to the stabilisation of sub-base and basecourse.

2. The work under this specification covers the following elements:

    a. supply of pavement materials;

    b. supply of bituminous stabilising agents, chemical stabilising agents and water required for the in situ stabilising process;

    c. the in situ stabilisation process;

    d. compaction and finishing of the stabilised layer(s); and

    e. acceptance of the stabilised pavement layer(s).

515.02 REFERENCES

1. Australian Acts and Standards, MAIN ROADS Western Australia Standards, Test Methods and publications, and other State Road Authority test methods are referred to in abbreviated form (e.g. AS 1234, MRS 67-08-43 or WA 123). For convenience, the full titles are shown below:

Acts and Regulations

Dangerous Goods Safety (Storage and Handling of Non-Explosives) Regulations 2007 (WA)

Australian Standards

AS 1141	Methods for Sampling and Testing Aggregates
AS 1160	Bituminous emulsions for the construction and maintenance of pavements
AS 1289	Methods of Testing Soils for Engineering Purposes
AS 1672	Limes and Limestones for Building
AS 2008	Residual Bitumen for Pavements
AS 2350	Methods of Testing Portland and Blended Cements
AS 3972	Portland and Blended Cement

AS 2809.5	Road tank vehicles for dangerous goods Part 5: Tankers for bitumen-based products
AS 1742.3	Traffic Control Devices for Works on Roads

MAIN ROADS WA Publications

Engineering Road Note No 5	Interim Guide to Prediction of Pavement Moisture for Strength Assessment of Granular Basecourse and Sub-Base Materials
Engineering Road Note No 8	Statistically Based Quality Control for Density in Road Construction
Engineering Road Note No 9	Procedure for the Design of Flexible Pavements
6706-02-133	Water to be used in Pavement Construction

MAIN ROADS WA Test Methods

A complete list of Main Roads Test Methods is available on Main Roads' website at: https://www.mainroads.wa.gov.au/technical-commercial/technical-library/?q=&take=20&filter=&type=&node=Materials%20Engineering,Test%20Methods&page=1&sectionFilter=731

MAIN ROADS WA Specifications

A number of Specifications form part of the Contract and are referenced in this specification. The Contractor must refer to the Contract for details of such Specifications.

Austroads Publications

TP 1903	Bituminous Materials Safety Guide

Australian Technical Infrastructure Committee (ATIC) Specification

SP43	CEMENTITIOUS MATERIALS FOR CONCRETE

515.03 DEFINITIONS

1. "Pavement" means the portion of the road placed above the design Subgrade level including shoulders. ***Pavement***

2. "In situ mixing" means the mixing of the material with the stabilising agents and water using in situ stabilisation equipment as described in this specification. ***In situ mixing***

3. "Half-life" means the time, measured in seconds, in which the foamed bitumen collapses from the maximum expansion to half of the maximum expansion. ***Half-life***

4. "Stabilising Agents" can mean foamed bitumen, bitumen emulsion, lime or cement except where the context of any particular passage indicates otherwise. ***Stabilising Agents***

5. "CMRS" shall mean the Cementitious Material Registration Scheme ***CMRS***

515.04 NOT USED

515.05 SUSTAINABILITY CONSIDERATIONS

1. Materials for road pavements shall be managed under the sustainability hierarchy of REDUCE, REUSE and RECYCLE.

2. Unless defined otherwise, the materials described in this specification shall be sourced from pits or quarries of natural materials, and shall be blended, crushed, or processed as applicable to produce a homogenous material. These materials are a finite resource and waste shall be reduced to a minimum. ***Reduce***

3. Where practical, redundant pavement materials should be recovered and reused, or otherwise recycled to the highest level use practical. Reused materials shall be processed to produce a homogenous material and shall meet the specified applicable requirements for sub-base or basecourse. ***Reuse***

4. Recycled materials for pavement construction shall be blended, crushed, or processed as applicable to produce a homogenous material. ***Recycle***

PRODUCTS AND MATERIALS

515.06 WATER

Water

1. The Contractor is responsible for ensuring that the water for stabilisation, construction and curing of stabilised layers is free from impurities that may deleteriously affect the setting, hardening or strength of the stabilised material. Water used in the construction of road pavements shall contain no more than 3000 mg/L of Total Soluble Salts (TSS). This is to be measured in accordance with Test Method WA 910.1.

2. Where water is drawn from natural sources, an efficient filter shall be provided on the suction pipe to ensure freedom from weeds, roots, etc., which could cause blockage of the water nozzles in the stabiliser.

515.07 GRANULAR MATERIALS

515.07.01 GENERAL

1. Additional granular pavement material must be incorporated in accordance with Annexure 515A using materials listed in Annexure 515C.

515.07.02 RECLAIMED ASPHALT PROFILINGS

RAP

1. Reclaimed asphalt pavement (RAP) may be imported and used as a supplementary pavement material up to a maximum of 10% of the volume of stabilised layer. It must be granulated asphalt obtained from the profiling of asphalt pavements or by crushing to a graded material with a maximum particle size of 26.5 mm.

515.08 STABILISING AGENTS

515.08.01 GENERAL

1. Stabilising agents must be either one, or a combination, of the materials detailed below.

2. No other chemicals or substances are permitted to be added to the materials unless approved by the Superintendent.

515.08.02 LIME

Lime

1. Lime must comply with AS 1672 and must be incorporated in accordance with Annexure 515A.

515.08.03 CEMENT

Cement

1. Cement must be incorporated in accordance with Annexure 515A. Any sampling and testing of cement must be in accordance with AS 2350. The cement must be sufficiently dry to flow freely during application.

2. High-early strength cement, type HE, must not be used as a stabilising agent.

3. Cement for stabilisation of any pavement layer must comply with the requirements of AS 3972 and the ATIC Specification SP43. The CMRS must be used to confirm that the cement complies to ATIC SP43. The standard application form for CMRS registration is shown in Annexure 515B.

4. **Prior to commencing cement stabilisation the Contractor must confirm that the cement complies with ATIC SP43 and must provide the CMRS registration number for the cement to the Superintendent for approval.** ***HOLD POINT***

5. The Contractor must use cement in approximately the chronological order in which it is delivered from the manufacturer. Transportation units and storage bins for bulk cement must be weatherproof and must be constructed so that there is no dead storage. Cement delivered in bags must be stored in weatherproof structures having floors raised above the ground. Cement that is more than three months old must not be used.

515.08.04 BITUMEN EMULSION

1. Bitumen Emulsion must comply with the requirements of Specification 511.

515.08.05 FOAMED BITUMEN

1. Foamed Bitumen must be produced from Class 170 bitumen complying with the requirements of Specification 511. Cutback or modified bitumen is not permitted to be used to produce Foamed Bitumen. The bitumen must achieve a minimum expansion of 10 times its original volume and a minimum half-life of six seconds when foamed.

2. All bituminous stabilising agents must be heated, stored, and handled strictly in accordance with the D*angerous Goods Safety (Storage and Handling of Non-Explosives) Regulations 2007* (WA) in respect to the transport of Dangerous Goods including Flammable Liquids.

515.09 – 515.19 NOT USED

PLANT AND EQUIPMENT

515.20 PLANT FOR SUPPLY OF STABILISING AGENTS

1. Stabilising agents must be delivered in spreader trucks or in a transfer trailer attached to the stabilising plant.
2. All plant must be clean and free of any residual product, including where materials are delivered in bulk for transfer to the site plant. Bulk tankers must be equipped with a dipstick or other mechanism whereby used volumes can be monitored and verified.
3. When stabilising with foamed bitumen, the bulk delivery tanker must, in addition to the above, include the following features:

    a. comply with the requirements of AS 2809.5-2001 Road tank vehicles for dangerous goods Part 5: Tankers for bitumen-based products, and the Australian Dangerous Goods Code;

    b. have lagging and calibrated thermometers located at the top, middle and bottom thirds of the product tank;

    c. have heating tubes and pipework to allow circulation of the product during heating;

    d. have a permanent sampling cock that is safe and easy to use to obtain samples of the product.

515.21 PLANT FOR SPREADING CHEMICAL STABILISING AGENTS

1. The spreading equipment must be a stabilising agent spreader, which has been specifically designed for such work. The spreader must be capable of uniformly distributing cement and lime and accurately controlling the spread rate such that when mixing is complete; the cement or lime content can be measured in accordance with the requirements of Clause 515.33. The spreader must be equipped with gates to vary the width of spread and with electronic weigh scales to provide quantities of product used.
2. The spreading equipment must:

    a. be capable of varying the spread width to cater for different stabilising widths;

    b. be equipped with dust curtains to minimise the dust;

    c. be fitted with release filters in the case of pressurised lime or cement powder;

    d. be designed specifically for the work described in this specification and is capable of spreading the chemical stabilising agent uniformly within the specified range;

    e. have electronic scales, calibrated within the last 12 months in accordance with the manufacturer’s requirements, to verify spreads on individual Lots (or part there-of) and daily totals; and

f. be capable of varying the spread rate depending upon the forward speed of the spreader.

515.22 PLANT FOR STABILISATION (MIXING PROCESS)

Stabilising Machine

1. The stabilising machine must be specifically designed for cutting, pulverising, mixing, adding water and placing of mixed material in situ. Mixing using graders, profilers, or asphalt milling machines and agricultural type implements, is not be permitted for work forming part of this specification.

2. The stabilising machine must have a capacity to maintain a constant rotor and forward speed, and a capability of producing a uniformly mixed material to the specified depth. Where the stabiliser is utilised to mix any asphalt layers or bituminous seal into the pavement, the requirements detailed in Table 515.01 must be satisfied.

TABLE 515.01: STABILISER MINIMUM PERFORMANCE REQUIREMENTS

In Situ Pavement Composition	Minimum Power Output to Mixing Drum Width Ratio (kW/m)
Thin Asphalt or Sprayed Seal Pavements (less than 100 mm)	130
Thick Asphalt (greater than 100 mm) or Stabilised Layers	175

3. As a minimum, the stabilising machine must have the following features:

   a. a stabilising drum that rotates upwards into the direction of advance fitted with bullet teeth cutting tips. The drum must be located between the axles and must achieve at least 2.0 m of cut width in a single pass, unless otherwise specified in the Contract;

   b. a mixing chamber capable of stabilising to the required depth with an effective volume that can accommodate additional material generated by increasing the depth of cut. The stabilising mixing drum must be independent of the mixing chamber housing;

   c. a level control system capable of controlling the stabilising depth to within a tolerance of ±10 mm of the required depth during continuous operation. The control system must be equipped for monitoring and verification of actual milled depths;

   d. a provision for adding water automatically through a controlled pumping and metering system capable of increments of +0.1 litres in relation to travel speed and mass of material being stabilised. The pumping systems must have the capacity to supply up to 1500 litres per minute and be calibrated annually and verified regularly to deliver within a tolerance of ±0.1 litres;

   e. a system of nozzles that promotes a uniform application of water and/or fluid stabilising agent(s) across the full width of treatment. The application systems must be capable of adjustments for varying widths of treatments; and

   f. an adjustable exit gate.

4. When stabilising with bitumen (or other fluid stabilising agents) the mixing equipment must, in addition to the above, include:

    a. a bitumen injection system and flow meter capable of determining the amount of bitumen added in relation to the forward speed and mass of material being stabilised to the tolerances set out in Table 515.04.

5. When stabilising with foamed bitumen the mixing equipment must, in addition to the above, include the following features:

    a. a test nozzle capable of producing a replicate sample of the foamed bitumen being injected into the stabilised material to ensure that the required expansion and half-life qualities of the bitumen are being achieved;

    b. an electrically heated, self-cleaning nozzle system that promotes a uniform application of foamed bitumen across the full width of treatment; and

    c. a bitumen pumping and transfer system capable of sucking bitumen from the tanker to the stabiliser, and fitted with a non-return valve (or similar) to prevent pumping bitumen back into the tanker for safety reasons.

515.23 – 515.29 NOT USED

CONSTRUCTION

515.30 GENERAL

1. The pavement layer must be constructed in accordance with the levels, grades and cross-sections shown in the Drawings and Specifications.

2. Pavement construction includes the supply, placing, compacting and finishing of pavement materials, including in situ stabilisation, in accordance with the Specifications and Drawings.

3. In situ stabilised natural gravels, must not be used as Basecourse material for freeway pavements. ***Gravel & Restrictions***

4. Where a drainage layer has been constructed on the prepared Subgrade surface, the drainage layer must be the foundation for the subsequent Pavement Layer(s). ***Drainage Layers***

5. **Prior to the construction of any pavement layer, the Contractor must certify to the Superintendent that the underlying layer has been constructed as specified.** ***HOLD POINT***

6. Transverse joints must be offset from one layer to the next by not less than five metres. ***Transverse Joints***

7. Longitudinal joints must not be located in the wheel paths. ***Longitudinal Joints***

8. Unless specified otherwise final trim must be completed while the basecourse layer is still “green”, prior to dry back. Final trim is limited to removing no more than 20 mm of material at any point. If more than 20 mm is to be removed the lot must be reworked. ***Final Trim***

9. If more than 20 mm is to be removed the lot must be reworked. If a completed layer of stabilised pavement does not satisfy all of the requirements of the Specification and has to be reworked, the Contractor shall repeat all the requirements for Stabilisation without the addition of additional binder at no cost to the Principal. ***Rework***

515.31 LIMITATIONS

515.31.01 ENVIRONMENTAL LIMITATIONS ***Environment***

1. Transfer of all stabilising agents into the spreading equipment must be undertaken in such a manner to avoid contamination of the environment in accordance with Specification 204 – Environmental Management.

515.31.02 WEATHER LIMITATIONS

1. Spreading of powdered chemical stabilising agents on the road ahead of the stabilising machine must not continue in windy conditions if the chemical stabilising agent may become airborne. ***Wind***

2. No spreading of stabilising agents shall commence if it is raining or if rain is likely before the stabilising agent(s) can be mixed into the granular materials. ***Rain***

515.31.03 TIME LIMITATIONS

1. Mixing must commence as soon as practicable after spreading of the stabilising agent(s) on the granular materials, and mixing and compaction must be completed within the maximum working times in TABLE 515.02. ***Working Time***

TABLE 515.02: WORKING TIME FOR THE STABILISING PROCESS

Stabilising Agent	Maximum Working Time
GP Cement	6 hours
LH Cement	7 hours
Lime	8 hours
Foamed Bitumen	12 hours
Bitumen Emulsion	12 hours

2. Where two or more stabilising agents are used, the time limitation must be that of the shorter of the individual agents.

515.32 PRE-STABILISATION ACTIVITIES

515.32.01 PRELIMINARY TREATMENT

1. Pre-ripping the in situ pavement or multiple passes of the stabilising machine is not permitted if degradation of the material is likely. If pre-ripping is necessary then the ripping depth must not exceed the depth to be stabilised. ***Pre-Ripping***

515.32.02 TRIAL

1. The Contractor must carry out a preliminary trial of the proposed stabilising operations for each of the stabilising agents and materials. The trial must determine:

    a. the effectiveness of the plant and equipment;

    b. whether a single pass of the stabilising machine is adequate to achieve the specified mixing or whether pre-ripping or multiple passes are required;

    c. the bulking factor for trimming to spoil and level tolerances;

    d. the additional moisture required to achieve specified compaction; and

    e. the rolling pattern required to achieve specified compaction.

2. The trial section must be located within the first relevant pavement stabilisation Lot of the Works.

3. **Prior to commencing any trial, the Superintendent must approve the location, length, width, and depth of trial section(s) within the Works.** ***HOLD POINT***

4. **Prior to commencing construction of any pavement stabilisation Lot beyond the trial, the Contractor must submit the successful methodology from the trial to the Superintendent for approval.** ***HOLD POINT***

5. The Contractor must not change the approved method without the approval of the Superintendent.

515.32.03 SURFACE PREPARATION

1. Before stabilising commences:

    a. the surface of the area to be stabilised must be suitable to achieve final longitudinal and transverse shape (i.e., no excessive shoving, rutting, high spots, or low spots);

    b. the work area shall be accurately pre-marked to the proposed longitudinal cut lines on the existing road surface;

    c. level control must be installed if required by the Contract; and

    d. if not detailed in the Drawings or Specifications, the Contractor must accurately record the location of all road markings that will be removed in the stabilising process, through the installation of off-set pegs (or similar) or survey pick-up.

2. If there are excessive high spots, such spots may be corrected by pulverising or pre-milling, with excess material removed to spoil, as directed by the Superintendent.

3. If material is required to be imported for the purpose of shape correction, the material must be spread such that it will achieve the design longitudinal and transverse shape.

4. If material is required to be imported for the purpose of modifying the quality of the final stabilised material or modifying the longitudinal profile or overall pavement thickness, the material must be spread evenly as a layer of uniform thickness to achieve the design levels.

5. **Prior to the importing of material, the Contractor must certify to the Superintendent that the imported material complies with the requirements of 515.07.** ***HOLD POINT***

515.32.04 SUPPLY OF STABILISING AGENTS TO SITE

1. **Prior to commencing stabilising the Contractor must provide the Superintendent with certificates of compliance for the stabilising agents for each batch of materials that contains the following information:** ***HOLD POINT***

    a. Batch identification details including certification number;

    b. Product identification;

    c. Name of the supplier;

    d. Batch number and date of manufacture;

    e. Date, time, and place of loading;

    f. For cementitious materials, the registration pro-forma as per Annexure 515B.

515.33 SPREADING OF LIME AND/OR CEMENT

1. Where the Pavement Layer involves the incorporation of lime and/or cement, the stabilised Pavement Layer must contain the proportion of lime or cement as a percentage of the dry mass of pavement material as shown in Annexure 515A. The cement or lime must be spread uniformly at a controlled rate over the area to be stabilised using a suitable spreader truck meeting the requirements of clause 515.21.

2. The percentage lime or cement applied must be determined by either

    a. placing a canvas mat of one square metre on the area to be stabilised in front of the spreader truck, and measuring the mass of lime or cement deposited on the mat for each Lot; or

    b. by use of an on-board calibrated electronic weight scale system.

3. The percentage cement or lime (P%) shall be calculated using the following formula:

$$P = \frac{M \times 100}{A \times T \times MDD}$$

Where:

M = total mass of lime or cement (kg) as determined by one of the methods outlined at clause 515.33(2), being:

method a): on each mat
method b): on-board calibrated electronic weight scale system.

A = method a): total area of the mat (m²)
method b): total measured area spread (m²)

T = Thickness to be stabilised (m) (including allowances for tolerances and trimming)

MDD = Maximum Dry Density of the pavement material without the addition of cement (kg/m³)

4. The use of method (b) in determining the values 'M' and 'A' is subject to satisfactory calibration of the measuring device and the production of associated certification in accordance with the Contractor's Quality System. Audits on this method must be carried out using method (a).

5. The percentage lime or cement applied must be maintained within the tolerances set out in Table 515.03.

TABLE 515.03: TOLERANCE FOR SPREADING LIME AND/OR CEMENT

Test	Frequency	Tolerance
Mat test: (1 m^2 canvas)	At the start of each shift or every 2000 m^2, whichever is the lesser	Within ± 10% of the specified application rate
Tanker reconciliation test: Total tonnes used (from delivery docket) over total mass of stabilised material	Upon emptying the spreader and bulk tanker	Within ± 10 % of the specified application rate

6. Once the lime or cement has been spread, no plant other than that needed for stabilisation, is permitted to travel over the area to be stabilised.

7. **The Contractor must provide to the Superintendent daily records of the amounts of cement or lime used and actual spread rates per section treated, using the stabilisation pro-forma in Annexure 515D.** ***HOLD POINT***

515.33.01 SLAKING OF QUICKLIME

1. If using quicklime, the slaking must be achieved using a purpose-fitted pressurised spray bar on a water tanker to ensure thorough water penetration. Slaking must continue until no further reaction with additional water is visible and the slaked lime is completely converted to powdered form.

2. Slaking produces considerable volumes of steam which can limit the visibility of passing traffic. When the wind is such that steam will be blown towards passing traffic, all traffic movement must be stopped before commencing slaking.

515.33.02 PREVENTATION OF CONTAMINATION

1. Spreading of stabilising agents must be undertaken in such a manner to avoid contamination of the environment in accordance with Specification 204 – Environmental Management. ***Contamination***

515.34 ADDITION OF FOAM BITUMEN OR BITUMEN EMULSION

1. Foam bitumen and bitumen emulsion are referred to as bitumen in this clause 515.34.

2. Bitumen must be sucked from the mobile bulk tankers during the stabilising process. A system that controls the addition of bitumen in relation to the continuously calculated weight of the stabilised material must be used.

3. The percentage bitumen applied must be maintained within the tolerances set out in Table 515.04.

TABLE 515.04: TOLERANCES FOR ADDING BITUMEN

Test	Frequency	Tolerance
Flow meter	Continuous by operator	Within ± 0.2% of the specified application rate
Microprocessor output Total volume of bitumen for each run	At the end of each run	Within ± 0.1% of the specified application rate
Tanker reconciliation test: Total mass of bulk tanker used over total mass of stabilised area	Upon emptying the bulk tanker	Within ± 0.1% of the specified application rate

4. **Prior to the use of the plant proposed to be used for the modification process, the Contractor shall certify to the Superintendent that the plant is capable of meeting the requirements of Table 515.04.** ***HOLD POINT***

5. The Contractor must provide to the Superintendent daily records of the amounts of bitumen used and actual application rates per section treated, using the stabilisation pro-forma in Annexure 515D. ***Daily records***

6. Bitumen must not be heated above the maximum temperatures set out in TABLE 515.05. Any bitumen that does not comply must not be used and shall be removed from Site.

TABLE 515.05: TEMPERATURE LIMITS FOR STORAGE AND APPLICATION OF BITUMEN

Material	Maximum storage temperature (°C)		Application temperature (°C) (within 2 hours of use)	
	> 24 hours	< 24 hours	Minimum	Maximum
C170	125	175	175	195

7. For foamed bitumen stabilisation, the foaming characteristics of expansion and half-life, must be checked at the test nozzle of the stabilising machine within five minutes of starting with each new bitumen tanker load. The minimum expansion and the minimum half-life shall be as specified in Clause 515.08.05.

515.35 IN SITU MIXING

1. For in-situ mixing, the stabilising equipment shall be set up and operated to ensure that the requirements of this clause 515.35 are met.

515.35.01 CONTROL OF CUT DEPTH

1. Stabilisation must be undertaken to the depth specified in Annexure 515A with a maximum variation from the specified depth of -5 mm and +15 mm. The actual depth of the cut must be physically measured at both sides of the stabilised pavement at 20 m intervals.

2. In cases where both the sub-base and basecourse layers are stabilised, mixing of the basecourse layer must incorporate the upper 15 mm of the sub-base layer.

515.35.02 LAYER WIDTH

1. The outer top edge of any layer of the pavement must be no closer to the road centreline and no more than 100 mm further from the road centreline than the positions shown in the Drawings and/or Specifications.

515.35.03 LONGITUDINAL JOINTS

1. To ensure complete stabilisation across the full width of the area to be stabilised, longitudinal joints between successive cuts shall overlap by a minimum of 100 mm or half the layer thickness, whichever is greater, taking care to control water and binder addition along the joints.

2. All joints must be mixed, compacted and finished satisfactorily so that the final surface does not have permeable or loose patches.

3. Longitudinal construction joints between stabilised pavement and unstabilised pavement must not be located in the wheel paths.

515.35.04 CONTINUITY OF STABILISED LAYER

1. The exact location of the end of the cut must be carefully marked. This mark must coincide with the position of the centre of the mixing drum at the point at which the supply of stabilising agent ceased. To ensure continuity of the stabilised layer, the next cut must be started 1 m behind this mark.

2. Double application of bituminous stabilising agents is not permitted.

515.36 – 515.38 NOT USED

515.39 BINDER CONTENT

1. When stabilising with bitumen, a sample of stabilised material is to be taken after the mixing process and prior to compaction for determination of Binder Content and Particle Size Distribution in accordance with Test Method WA 730.1.

2. The binder content of the stabilised material must be within -0.1% to +0.3% of the dry mass of the design binder content. ***Binder Content***

515.40 CONSTRUCTION MOISTURE

515.40.01 CONTROL OF MOISTURE CONTENT

1. The moisture content of the stabilised material must be maintained in accordance with Table 515.06.

2. Sufficient water must be added during the stabilising process to achieve and maintain the construction moisture content at any point in the Lot within the range (of the stabilised material) set out in Table 515.06 to enable compaction. Care must be taken to prevent any portion of the work from excessive wetting.

3. The optimum moisture content (OMC) of the stabilised materials must be determined in accordance with Test Methods WA 133.1 or WA 133.2, as applicable. The field moisture content of the stabilised material must be determined in accordance with Test Methods WA110.1 or WA110.2 to confirm compliance with Table 515.06.

TABLE 515.06: CONSTRUCTION MOISTURE CONTENT

Stabilising Agent	% of OMC
Cement/Lime	90 - 110
Foamed Bitumen	85 - 100
Bitumen Emulsion	70 – 85 (excluding emulsion) 85 – 100 (including emulsion)

4. The Contractor is responsible for achieving and maintaining the construction moisture content by controlling the amount of water added during the mixing process. This must include the use of an experienced operator following the stabiliser during mixing.

ACCEPTANCE

515.41 GENERAL

1. Each stabilised Pavement Layer must be constructed to the dimensions and details shown on the Drawings or Specifications and must be constructed in accordance with this specification to satisfy the criteria shown in Annexure 501A.

2. Where a pavement material has been supplied by the Contractor, the Contractor must undertake required testing of that material sampled from the stockpiles, in accordance with Specification 201 – Quality Management, to demonstrate that the material complies in all respects with the specified requirements. ***Stockpile Material***

3. **Prior to the construction of any Pavement Layer, the Contractor must certify to the Superintendent that the pavement material supplied by the Contractor complies in all respects with the specified requirements.** ***HOLD POINT***

515.42 COMPACTION

1. Each Pavement Layer must be compacted to the Characteristic Dry Density Ratio shown in Annexure 515A(1) or greater. ***General***

2. The Characteristic Dry Density Ratio must be determined in accordance with Specification 20 – Quality Management. ***Characteristic Dry Density Ratio***

3. Where the pavement material contains more than 20% by mass of material retained on a 37.5 mm sieve, the Maximum Dry Density must be determined on that portion of the material that passes a 37.5 mm sieve. ***Oversize Material***

4. After each pass of the stabiliser, the mixed area must be initially compacted to eliminate the height differential between the bulked material, and any wheel ruts left by the stabiliser.

5. Compaction of all materials must be completed within the allowable working time specified in Table 515.02.

6. Stabilised layers must be compacted using equipment that achieves the compaction requirements in the most efficient manner without causing damage to adjacent structures.

7. Each stabilised layer must be constructed to the dimensions and details shown on the Drawings or Specifications and to the requirements of this specification.

8. Stabilised material trimmed from one Lot may be incorporated into another Lot provided it is uniformly spread and comprises no more than approximately 5% of the material. ***Trimmings***

515.43 LAYER WIDTH

1. The outer top edge of any layer of the pavement must be no closer to the road centreline and no more than 100 mm further away from the road centreline than the positions shown in the Drawings or Specifications.

515.44 SURFACE SHAPE

1. Surface shape of Sub-Base and Basecourse must be tested in accordance with Test Method WA 313.2.

515.44.01 SUB-BASE

1. The shape of the sub-base will be judged to be acceptable when the maximum deviation from a 3-metre straight edge placed in any position on the surface does not exceed 10 mm. ***Max Deviation 10mm***

2. The shape of the Sub-Base under Full Depth Asphalt will be judged to be acceptable when the maximum deviation from a 3-metre straight edge placed in any position on the surface does not exceed 15 mm. ***Max Deviation 15mm***

3. Additionally, for pavement widening work, the crossfall at any position on the new surface measured at right angles to the centreline must be within 0.5% of the existing crossfall on the outer 2 metres of the adjacent traffic lane at that location. ***Widening***

515.44.02 BASECOURSE

1. The shape of the basecourse will be judged to be acceptable when the maximum deviation from a 3-metre straight edge placed in any position on the surface does not exceed 6 mm. ***Max Deviation 6mm***

2. Additionally, for pavement widening work, the crossfall at any position on the new surface measured at right angles to the centreline must be within 0.5% of the existing crossfall on the outer 2 metres of the adjacent traffic lane at that location. ***Widening***

3. All transition zones must be matched to the adjoining pavement shape.

515.45 SURFACE LEVELS

515.45.01 SUB-BASE

1. The level of the completed sub-base surface will be deemed to be conforming when the level measured at any point on the surface is within +5 mm, -25 mm of the sub-base level at that point as determined from the Drawings or Specifications. ***Construction Sections***

2. The level of the completed sub-base surface will be deemed to be conforming when the levels of the sub-base at its junction with the existing pavement are within +5 mm, -25 mm of the levels as determined from the basecourse depth making due allowances for the effect of the existing crossfall of the pavement. ***Widening Sections***

515.45.02 BASECOURSE

1. The level of the completed stabilised basecourse surface will be judged to be acceptable when the level measured at any point on the surface is within the following tolerances for the basecourse level for that point as determined from the drawings or works specifications. ***Construction Sections***

    a. Where final surface is asphalt: -5 mm, +10 mm

b. Sprayed Seal areas: -5 mm, +20 mm

2. The depth of stabilisation will be deemed to be acceptable when the actual depth of the stabilised material after compaction does not depart from the specified depth by more than -0 mm, +25 mm in any location. ***Depth***

3. For pavement widening sections the level of the completed basecourse surface will be judged to be acceptable when the levels of the basecourse at its junction with the existing seal are within -0 mm, +5 mm of the top cut edge level of the existing seal. ***Widening Sections***

515.46 SURFACE FINISH

1. Completed Pavement Layers must be in a homogeneous, uniformly bonded condition with no evidence of layering, cracking, disintegration, or surface tearing. ***Pavement***

2. The finished surface must appear as a stone mosaic interlocked with fine material and shall be dense, even textured and tightly bonded. Slurrying of fines to the surface must be avoided.

3. Basecourse must retain the above characteristics after rotary brooming and be suitable to receive bituminous surfacing.

4. Prior to the application of a bituminous surfacing the surface of the Basecourse must be uniformly dry.

515.47 MAINTENANCE OF COMPACTED LAYERS

1. The surface of any compacted Pavement Layer or prepared Subgrade must be maintained in such a way as to minimise dust, prevent ravelling, erosion, deformation or any other damage to the layer resulting from environment conditions, traffic or construction activities. The layer must be kept free from contamination until any subsequent pavement work under the Contract is commenced. ***General***

2. Completed Subgrade and Pavement Layers must be maintained to the specified standards of surface shape, level, dryback and compaction up to the time of construction of the subsequent Pavement Layer or application of the bituminous surfacing. ***Shape, Level, Dryback, Compaction***

3. Watering must be continued as necessary to prevent, dusting or loosening of the surface. ***Watering***

4. Bituminous stabilised basecourse must not be sealed within three days of construction.

515.48 – 515.80 NOT USED

AS BUILT AND HANDOVER REQUIREMENTS

515.81 – 515.90 NOT USED

CONTRACT SPECIFIC REQUIREMENTS

515.91 – 515.99 NOT USED

ANNEXURE 515A

CONSTRUCTION REQUIREMENTS

1. COMPACTION REQUIREMENTS

1.1 Characteristic Dry Density Ratio shall be determined in accordance with Specification 201 – Quality Management.

TABLE 515A1: COMPACTION VALUES

Pavement Layer	Minimum Characteristic Dry Density Ratio % (Rc)
Stabilised Sub-base	94-96% (Select appropriate value then delete this note. Refer to Guidance Notes)
Stabilised Basecourse	96-98% (Select appropriate value then delete this note. Refer to Guidance Notes)
Foam Bitumen Stabilised Basecourse	98%

2. DRYBACK

2.1 Dryback Characteristic Moisture Content shall be determined in accordance with Specification 201 – Quality Management. Where the sub-base material contains more than 20% by mass of material retained on a 37.5 mm sieve, the Optimum Moisture Content must be determined on that portion of the material that passes a 37.5mm sieve.

TABLE 515A2: DRYBACK

Pavement Layer	Minimum Characteristic Dry Density Ratio % (Rc)
Stabilised Sub-base	85%
Stabilised Basecourse	85%

See Guidance Notes and delete this note

2.2 Bitumen stabilised basecourse requires a minimum 72 hours curing prior to sealing. This may require the pavement to be constructed up to 20 mm proud of final level while cured, if constructed under traffic, to allow for trimming. Once the basecourse has cured for 72 hours and satisfies the dry back requirement sealing may proceed or sealing preparation commence for basecourse constructed under traffic.

3. ADDITIONAL GRANULAR MATERIALS

3.1 Granular materials must be constructed with the parameters as shown in Table 515A3:

TABLE 515A3: ADDITIONAL GRANULAR MATERIALS

Section		Thickness of lift (mm)	Width of spread (m)
From	To		
Basecourse Layers			

4. LIME STABILISED PAVEMENTS

4.1 Lime stabilised Pavement Layers must be constructed with the parameters as shown in Table 515A4:

TABLE 515A4: LIME STABILISED PAVEMENTS

Type of Lime				
Section		Depth of Stabilisation (mm)	Width of Stabilisation (m)	Equivalent Lime Content (% by dry mass of Pavement Layer)
From	To			
Sub-Base Layers				
Basecourse Layers				

5. CEMENT STABILISED

5.1 Cement stabilised Pavement Layers must be constructed at the locations and with the parameters as shown in Table 515A5:

TABLE 515A5: CEMENT STABILISED PAVEMENTS

Type of Cement:				
Section		**Depth of Stabilisation (mm)**	**Width of Stabilisation (m)**	**Cement Content (% by dry mass of Pavement Layer)**
From	**To**			
Sub-Base Layers				
Basecourse Layers				

6. BITUMEN EMULSION STABILISED PAVEMENTS

6.1 Bitumen Emulsion stabilised Pavement Layers must be constructed with the parameters as shown in Table 515A6:

TABLE 515A6: BITUMEN EMULSION STABILISED PAVEMENTS

Bitumen Emulsion Type						
Section		**Depth of Stabilisation (mm)**	**Width of Stabilisation (m)**	**Bitumen Content (% by dry mass of Pavement Layer)**	**Supplementary Stabilising Agent (% lime by dry mass of Pavement Layer)**	**Supplementary Stabilising Agent (% cement by dry mass of Pavement Layer)**
From	**To**					
Sub-Base Layers						
Basecourse Layers						

7. FOAMED BITUMEN STABILISED PAVEMENTS

7.1 Foamed Bitumen stabilised Pavement Layers must be constructed with the parameters as shown in Table 515A7:

TABLE 515A7: FOAMED BITUMEN STABILISED PAVEMENTS

Section		Depth of Stabilisation (mm)	Width of Stabilisation (m)	Bitumen Content (% by dry mass of Pavement Layer)	Supplementary Stabilising Agent (% lime by dry mass of Pavement Layer)	Supplementary Stabilising Agent (% cement by dry mass of Pavement Layer)
From	To					
Sub-Base Layers						
Basecourse Layers						

ANNEXURE 515B

CEMENTITIOUS MATERIALS

REQUEST FOR REGISTRATION OF CEMENTITIOUS MATERIALS

Product Details	
Product Name	
Type	
Proportions (if blend)	
Manufacturer	
Place of Manufacture	
Source of Constituent Materials	
Cement Clinker	
Fly Ash	
Slag	
Limestone	
Grinding Aids	
Supply Details	
Supplier Name	
Dispatch Centre (Address in Australia)	
Contact Name	
Contact Phone No.	
Contact Address	
Suppliers ABN	

Send this form with the sample to:

Transport for NSW

Att: CMRS Administrator

Level 3 Pod H, 110 George Street Parramatta NSW 2150

Email: cmrs@transport.nsw.gov.au

For Transport for NSW Use Only:

Date of Registration:

Registration No:

ANNEXURE 515C

IMPORTED PAVEMENT MATERIALS

1. LOCATION OF PRINCIPAL SUPPLIED MATERIAL

1.1 Location of Principal supplied material are recorded in Table 515C1 :

TABLE 515C1: PRINCIPAL SUPPLIED MATERIAL

ROAD		
SLK		
OFFSET		
MATERIAL DESCRIPTION		
VOLUME (m^3)		

2. CONTRACTOR SUPPLIED MATERIALS SPECIFICATIONS

TABLE 515C2: Contractor supplied materials

MATERIALS SPCIFICATION (ex Specification 501)

ANNEXURE 515D

DAILY APPLICATION RECORD SHEET

DATE: _____

CONTRACT NO: _____

PAVEMENT LAYER: _____

TIE IN POINTS:

FROM _____ **TO** _____

MAT TEST REF. NO (S). _____

STABILISING COMPONENTS

		Type	Design appl. Rate	Source	Batch No.
No.1	**Granular**				
No.2	**Lime**				
No.3	**Cement**				
No.4	**Emulsion**				
No.5	**Foam**				

Distribution No.	DISTANCE		SIDE OF ROAD	STABILISED AREA				TIME		AMBIENT TEMPERATURE	STABILISER QUANTITY USED			ACTUAL APPLICATION RATES	ACTUAL % APPLICATION RATES
	From	To	Left Right Full Width	Length	Width	Depth	Area	Start time of mixing	End time of compaction		Dip Before	Dip After	Quantity spread		
	m	m		m	m	m	m^2			ºC	l or kg	l or kg	l or kg	l /m^2 or kg/m^2	%
			TOTALS												

Remarks:

CONTRACTORS REPRESENTATIVE: _____ SIGNATURE

SUPERINTENDENT: _____ SIGNATURE

GUIDANCE NOTES

To be completed and finalised after general acceptance of the specifications

FOR REFERENCE ONLY – DELETE GUIDANCE NOTES FROM FINAL DOCUMENT

1. All edits to downloaded Specifications shall be made using *Track Changes*, to clearly show added/deleted text.

2. If **all** information relating to a clause is deleted, the clause number should be retained and the words **"NOT USED"** should be inserted.

3. The proposed documents with tracked changes shall be submitted to the Project Manager for review, prior to printing the final batch of documents. When this final printing is carried out, the tracked changes option is to be turned off.

4. Before printing accept all changes in the document, turn off *Track Changes* and refresh the Table of Contents.

5. The Custodian of this specification is the Manager Materials Engineering.

1 GENERAL

1.1 Additional granular pavement material may be incorporated to:

a. Modify the particle size distribution of the final stabilised material;

b. Modify the quality of the final stabilised material;

c. Modify the profile (cross fall or longitudinal ride) of the road; or

d. Increase the overall pavement thickness above the subgrade.

1.2 Lime shall comply with AS 1672 and must be incorporated in accordance with Annexure 515A:

a. Hydrated lime in the form of Calcium Hydroxide ($Ca(OH)_2$); and

b. Quicklime in the form of Calcium Oxide (CaO).

1.3 Low Heat strength cement, type LH, shall be used unless otherwise specified by the Principal.

2 CEMENT STABILISED PAVEMENTS (refer Clause 515.33)

2.1 Cement stabilisation can be applied to any Pavement Layer, but typically only to the Basecourse layer.

2.2 If cement stabilisation of the Basecourse is specified (e.g. at floodways), determine the following and insert into Annexure 515A (in addition to required Compaction):

a. Depth of stabilisation - typically 150 mm to 200 mm.

b. Cement content - typical values are 1.0%, 1.5% or 2% by dry mass of the Basecourse material.

c. The cement content required, will be determined by the unconfined compressive strength (UCS) of the material when tested in accordance with WA 143.1. The UCS

specimens shall be compacted using General Purpose (Type GP) cement, cured for seven (7) days in a controlled environment and immersed in water for four (4) hours prior to compression testing. The specimens are to be compacted at the specified density and 100% of OMC. The 7-day UCS must be in the range of 0.6 – 1.0 MPa.

2.3 The minimum practical spread rate that can be achieved by most cement spreaders is 3 kg/m^2, which equates to approximately 1% cement for a laterite gravel stabilised to a depth of 150 mm.

2.4 It is recommended that a rework trial is carried out in the laboratory to determine the % binder addition required to achieve a UCS of 0.6 MPa – 1.0 MPa when a test specimen is reprocessed. The testing will help to refine cement content required, if any, in rework in clause 515.30.

3 LIME STABILISATION (refer Clause 515.33)

3.1 If lime modification is specified, determine the following and insert into Annexure 515A (in addition to required compaction):

a. Depth of stabilisation – (typically 150 mm to 250 mm).

b. Lime content is determined by laboratory testing. Because lime varies in purity (depending on manufacture) and strength (depending on whether it is quicklime or hydrated lime), the optimum lime content must be expressed as a percentage of equivalent pure hydrated lime (calcium hydroxide) by dry mass of the pavement material

3.2 The process for determining whether Lime modification is appropriate and the required % of pure hydrated Lime for pavement modification is;

a. Refer to section 4.9 Preliminary Binder Selection of the Austroads Guide to Pavement Technology- Part - 4D: Stabilised Materials to determine if Lime is a suitable additive for the selected pavement material.

b. Determine the UCS of the modified material in accordance with Main Roads Test Method WA 143.1. The test specimens are to be compacted at the specified density and 100% of OMC and must be 28 day cured.

c. The optimum Lime content of the soil for modification produces a 28-day UCS in the range 0.6 MPa to 1.0 MPa.

3.3 The minimum practical spread rate that can be achieved by most lime spreaders is 3 kg/m^2, which equates to approximately 1% lime for a laterite gravel stabilised to a depth of 150 mm.

4 BITUMINOUS STABILISATION (refer Clause 515.34)

4.1 Bituminous stabilisation can be undertaken using three types of bituminous products;

a. Foamed Bitumen

b. Anionic Bitumen Emulsion

c. Cationic Bitumen Emulsion

4.2 Refer to Austroads Guide to Pavement Technology Part 4D: Stabilised Materials, for further information.

4.3 Selection of Bituminous Emulsion type.

a. Cationic bitumen emulsions are predominantly used for stabilisation with non-calcareous pavement materials. These cationic emulsions (positively charged particles) react particularly well with acid-based mineral pavement materials derived from granite and quartzite and can be formulated to break at different times after mixing with pavement materials and cement (if applicable).

b. Anionic bitumen emulsions (negatively charged bitumen particles) is recommended for stabilising pavement materials comprised of limestone.

c. Both types of bitumen emulsions enable mixing to be carried out with damp mineral aggregates.

4.4 If Bitumen modification is specified, determine the following and insert into Annexure 515A (in addition to required compaction):

a. Depth of stabilisation – (typically 150 mm to 300 mm).

b. Bitumen content may be determined in accordance with Austroads Guide to Pavement Technology Part 4D: Stabilised Materials

5 SUPPLY OF PAVEMENT MATERIALS TO SITE (refer to Clause 515.32.03)

5.1 The source(s) of Principal supplied Pavement Materials to be imported shall be outlined in ANNEXURE 515C. In the case of Contractor supplied materials, the relevant material specification in Specification 501 PAVEMENTS shall be specified. Specification 501 Annexures include a range of regional pavement material specifications to select from as appropriate.

6 STABILISING MIXING PROCESS (refer to Clause 515.22)

6.1 A conventional sized stabiliser is recommended to run at not more than 18 m/min to ensure the binder and water is mixed thoroughly through the pavement.

7 COMPACTION AFTER COMPLETION OF MIXING (refer to clause 515.41)

1.1 The mandatory use of padfoot rollers for initial compaction is recommended in the following circumstances:

a. When the section length is 100 m or more.

b. The depth of material to be stabilised is 200 mm or more.

7.1 Pad foot rollers are more efficient in achieving density but trimming out the pad foot marks is difficult in short sections. Smooth drums should be used for final compaction to prevent padfoot marks reflecting through to the seal.

8 SUITABILITY OF MATERIALS (refer to clause 515.07.01)

8.1 Guide to Pavement Technology Part 4D: Stabilised Materials describes the design criteria for granular stabilisation. The grading and plasticity are the key inputs in determining suitable stabilising agents.

9 SUPPLEMENTARY BINDER (refer to clause 515.34)

Option 1: existing pavement materials are slightly plastic or non plastic (< 2% LS)

Mixing of the supplementary binder shall be undertaken in the same pass as the addition of bitumen. A separate pass will not be required.

Option 2: existing materials with higher plasticity (> 2% LS)

The lime shall be mixed into the pavement at 90% of the specified depth of stabilisation whilst adding sufficient water as required bringing the material to approximately 85% to 100% of the Optimum Moisture Content. The water shall only be applied through the mixing chamber to meet the moisture content.

After the lime mixing pass has been completed, the entire area shall be lightly compacted and shaped to the design finished level and left to cure for a period of at least 6 hours, but not more than 36 hours.

10 DRYBACK (refer to Table 515A2)

10.1 Consideration may be given to reducing the specified dryback moisture ratio to less than 85% OMC for heavily trafficked roads.

11 SURFACE PREPARATION (515.32.03)

11.1 Identify in Annexures sections where the depth of existing surfacing is greater than 25% of the proposed final stabilising depth and where that surfacing is required to be removed and disposed of at an approved location and replaced with suitable top-up material.

11.2 If any longitudinal or transverse mixing of material is required to obtain homogeneity, that shall be specified prior to stabilisation commencing.

12 CONTRACT SPECIFIC REQUIREMENTS

12.1 Required clauses are to be added under CONTRACT SPECIFIC REQUIREMENTS, as required. After inserting the clause, change the clause number and heading to style “H2 SP” so it appears in the Table of Contents.

AMENDMENT CHECKLIST

Specification No. **515** Title: **IN SITU STABILISATION OF PAVEMENTS** Revision No: _____

Project Manager: _____ Signature: _____ Date: _____

Checked by: _____ Signature: _____ Date: _____

Contract No: _____ Contract Description: _____

ITEM	DESCRIPTION	SIGN OFF
Note: All changes/amendments must be shown in Tracked Changes mode until approved.		
6.	Project Manager has reviewed Specification and identified Additions and Amendments.	
7.	**CONTRACT SPECIFIC REQUIREMENTS** addressed? Contract specific materials, products, clauses added? (Refer Specification Guidance Notes for guidance).	
8.	Any unlisted materials/products proposed and approved by the Project Manager? If "Yes" provide details at 16.	
9.	Standard clauses amended? **MUST SEEK** approval from Manager Contracts.	
10.	Clause deletes shows as **"NOT USED"**.	
11.	Appropriate **INSPECTION AND TESTING** parameters included in Spec 201 (Text Methods, Minimum Testing Frequencies verified).	
12.	**ANNEXURES** completed (refer Specification Guidance Notes).	
13.	**HANDOVER** and **AS BUILT** requirements addressed.	
14.	Main Roads QS has approved changes to **SMM**.	
15.	Project Manager certifies completed Specification reflects intent of the design.	
16.	Completed Specification – independent verification arranged by Project Manager.	
17.	Project Manager's review completed.	
18.	**SPECIFICATION GUIDANCE NOTES** deleted.	
19.	**TABLE OF CONTENTS** updated.	
20.	**FOOTER** updated with Document No., Contract No. and Contract Name.	
21.	Supporting information prepared and submitted to Project Manager.	
Further action necessary:		

Signed: _____ *(Project Manager)* Date: _____