

TRANSPORT FOR NSW (TfNSW)

SPECIFICATION D&C 3051

GRANULAR PAVEMENT BASE AND SUBBASE MATERIALS

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REVISION REGISTER

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Ed 2/Rev 1	Global	References to “Roads and Maritime Services” or “RMS” changed to “Transport for NSW” or “TfNSW” respectively. References to “RMS Representative” changed to “Principal”.	DCS	22.06.20

GUIDE NOTES

(Not Part of the Deed)

RELATIONSHIP TO OTHER SPECIFICATIONS

Depending on the type of pavement being constructed, D&C 3051 is used in conjunction with one of the following Specifications:

- D&C R71 “Construction of Unbound and Modified Pavement Course”
- D&C R73 “Construction of Plant Mixed Heavily Bound Pavement Course”
- D&C R75 “Insitu Pavement Stabilisation Using Slow Setting Binders”
- D&C R76 “Insitu Pavement Stabilisation Using Foamed Bitumen”

The relationship between these Specifications is illustrated in Table GN.1 below.

Table GN.1 – Relationship Between D&C 3051 and D&C R71, D&C R73, D&C R75 and D&C R76

Specification D&C 3051 “Granular Pavement Base and Subbase Materials”			
<i>Covers the requirements for the granular material comprising coarse and fine aggregate particles (the Proposed Mix)</i>			
Specification D&C R71 “Construction of Unbound and Modified Pavement Course” <i>Covers the transport, delivery, sampling and testing, placement, compaction and acceptance of unbound and modified materials in the pavement course.</i>	Specification D&C R73 “Construction of Plant Mixed Heavily Bound Pavement Course” <i>Covers the transport, delivery, sampling and testing, manufacture, placement and compaction of materials and acceptance of plant mixed stabilised pavement course.</i>	Specification D&C R75 “Insitu Pavement Stabilisation Using Slow Setting Binders” <i>Covers the transport, delivery, sampling and testing, placement, and compaction of materials and acceptance of insitu stabilised pavement course.</i>	Specification D&C R76 “Insitu Pavement Stabilisation Using Foamed Bitumen” <i>Covers the transport, delivery, sampling and testing, placement, and compaction of materials and acceptance of insitu stabilised pavement course.</i>

COMMENTS ON SPECIFICATION CLAUSES

3 Definitions

Fly ash is either classified or unclassified in accordance with AS 3582.1:1998.

Fly ash for use as a binder must be classified in accordance with Specification D&C 3211; for other uses, fly ash may be unclassified.

5.1 Material Designation

For each material designation, there is a further classification based on the Traffic Category.

For the pavement to perform satisfactorily, the material used must meet the minimum criteria for the applicable Traffic Category. Higher standard materials are acceptable as a substitute for lower standard materials.

Hence, where a specified material is not available at the time of construction or within the region, it may be substituted by a higher Traffic Category material, or a Subbase material may be substituted by a Base material. However, higher standard materials can be expected to be more expensive.

Note that higher standard materials, or materials with higher plasticity, will generally have lower permeability, and the substitution of a lower standard material in the subbase with a higher standard material (of lower permeability) may give rise to permeability reversals at shallow depth.

In such instances, the pavement designer must be consulted to verify that the pavement drainage characteristics will not be compromised, through an examination of the permeability profile within the pavement structure.

6.2.1 Traffic Category

The intent is to specify an appropriate standard of material for the design traffic environment as indicated by the Traffic Category; i.e. the highest standard of material is specified for the heaviest trafficked roads. However, specifying a higher standard material than necessary for the required application will increase the project cost, as well as depleting good quality material sources that are better used elsewhere.

Annexure A1 must be completed for each deed stating the applicable Traffic Category for the material. The Traffic Categories are based on the traffic loading over a 20 year design life and would be provided by the pavement designer in the pavement design report.

6.2.2 Unbound Material or Material To Be Modified

It is preferable that all materials, regardless of traffic category, conform to the requirements of Clause 8.1. Only Class 2 DGB and DGS material (Traffic Categories C and D material) may be assessed in accordance with the shear strength requirements in Clause 8.2.1.

Compliance with shear requirements is based on test criteria as well as acceptable field compaction and in-service performance of the material (refer to Clause 8.2.1).

Pavements constructed from materials that continue to break down while in service, particularly in relation to particle size distribution and plasticity, have been observed to fail prematurely and have required earlier than anticipated maintenance/rehabilitation.

This may occur through the use of material obtained from weathered overburden as an additive to crushed rock to satisfy plasticity requirements.

Such weathered overburden material that has the potential to break down should not be used as an additive. These materials can be assessed for their potential to break down by examining the particle size distribution and plasticity before and after a series of cycles of T102 and T103 pretreatment.

6.2.3 Material To Be Bound

It is preferable that all materials, regardless of traffic category, conform to the requirements of Clause 8.1. Additional requirements based on shear strength are detailed in Clause 8.2.2.

6.2.4 Graded Macadam and Macadam Material

Macadam-type materials are generally porous and can be difficult to compact. They should be used only where specified by the pavement designer. Applications would generally be where a high permeability layer is required, or where mechanical stabilisation of an excessively fine base course material is proposed.

6.4.1 Pretreatment – General

Some materials are susceptible to breakdown during handling, placing and compaction. Pretreatment is the process used to bring the sampled material, prior to testing, to a state similar to that during

service by simulating the handling, placing and compaction process that occurs during pavement construction.

Pretreatment is required prior to all testing of Unbound Materials, with the exception of TfNSW Test Method T215 “Wet/Dry Strength Variation”, as the test itself is a measure of the resistance to breakdown of a rock source.

Refer to the notes under Annexure 3051/A2 for further details.

Where the permeability criteria is satisfied for a non-pretreated material, it would be expected that the pretreated material would also satisfy the permeability requirement.

6.4.2 Exemptions for Pretreatment

In order for an exemption to be granted, the following should be established:

- conformity to the limits stated in Clause 6.4.2;
- a history of satisfactory performance;
- uniformity of material produced.

The exemptions should be reviewed at regular intervals of between 6 to 12 months, depending on the history of the quarry and the volume of material extracted. The properties of the quarried material may change as the quarry is further mined.

7.1 Submission of Proposed Mix Details

Supporting information specified, in addition to test results, must be supplied under this Clause. This information may be used when considering the applicability of test results that are affected by a blended mix or mix containing recycled materials. The source location for each component of a blended material is required.

For recycled demolition materials, the source location is the location of each recycling depot or processing facility established for the production of the recycled material or component material.

The fractions of a mix that are required to be evaluated for wet/dry strength variation will vary depending on the particle size distribution of the blended aggregate or recycled material included.

7.2 Variation to Proposed Materials

As an example, a blend of crushed rock with 10% added fines may vary between 9% and 11% added fines without requiring submission for acceptance of a new Proposed Mix.

8 Material Property Requirements for Densely Graded Materials

The material property requirements are shown in Tables 3051.1 to 3051.4. Some key aspects of the criteria and limits are highlighted as follows:

Table 3051.1:

- The particle size distribution limits are specified to ensure a mix has a suitable density, compacted strength and is workable during construction.
- The A, B, C ratio requirements in previous versions of the specification have been replaced by the fine particle size limits.
- The percentage retained limits are specified to control gap grading of a mix and achieve an even distribution of particle sizes.

- Both the particle size distribution and the percentage retained limits must be met for a material to be conforming.
- The contractor or supplier needs to demonstrate the effectiveness of alternative mixing systems by sampling and testing to establish the uniformity of the mixing process.

Table 3051.2:

- Susceptibility to the effect of moisture is generally controlled by specifying a maximum PI.
- A minimum PI is specified for Class 1 DGB material to aid workability, provide a tight cohesive surface suitable for sprayed sealing and to provide resistance to ravelling due to traffic effects during dryback prior to sealing.
- A permeability limit has been specified for Class 1 DGB material when used under Traffic Category A condition to ensure the pavement has resistance to water ingress.

Table 3051.3

- Materials of low plasticity lack internal cohesion. A minimum dry compressive strength is specified for non-plastic material as a measure of its ability to hold together. Limits apply to Class 1 DGB material where the addition of fly ash permits the use of a non-plastic material.
- A maximum UCS value is specified to prevent the use of materials that have the potential to gain significant tensile strength through a self-cementing action. This assessment may also be used to supplement information gained from the free lime test specified in Table 3051.6. Granular pavements are designed to transfer load through mechanical interlock and high shear strength, rather than by a beam action which can lead to fatigue cracking.
- The grading of material subject to wet/dry strength analysis must be carefully considered for non-uniform materials, blended materials and recycled materials. As a minimum, non-uniform materials should have the component with the largest fraction assessed.

8.2 Requirements Based on Shear Strength

While this Clause permits material to be assessed by shear strength, this will be at the Principal's discretion and materials compliant with Clause 8.1 are preferred.

The Hold Point applies to all materials assessed on the basis of shear strength.

9 Unique Material

This Clause provides for acceptance of Unique Materials under the TfNSW Innovative Technologies Scheme and requires a substantial history of satisfactory performance to be established. It is not intended to be applied to traditional materials that essentially comply with the specification, but do not meet one or more acceptance criteria.

A list of accepted Unique Materials, their applications and conditions for use can be obtained from: <http://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/tenders-contracts/unique-granular-materials.pdf>.

If the contractor or supplier wishes to propose new Unique Materials for acceptance, contact Pavement Manager (Flexible Pavements), Tel: (02) 8837 0970, of Pavement and Geotechnical Section, Engineering Services Branch.

10 Recycled and Manufactured Constituent Materials

Steel furnace slag is known to exhibit expansive characteristics particularly in warm moist conditions. The expansive nature may not be evident for some time after placement. Blast furnace slag does not appear to expand when placed in pavement layers.

Additional controls on the sourcing of recycled concrete may be required to ensure that low strength concrete from sources that include kerbs or other non-structural concrete is not included in a mix for Class 1 DGB.

Recycled asphalt pavement material containing coal tar is not permitted to be used as pavement and formation materials.

The free lime content test may not measure all forms of lime that contributes to the cementing action in all types of material. The UCS assessment can be used to assist in the assessment of unacceptable materials.

Test Method T276 only assesses material retained on the 4.75 mm sieve. Where material passing the 4.75 mm sieve is expected to contain a significant proportion of undesirable material, an alternative method of assessment may be warranted.

12.1 Particle Size Distribution

A statistical analysis to identify test outliers has been introduced. The “maximum permitted deviation from the nominated particle size distribution” and “defect weighting system” no longer applies.

12.2 All Other Specified Criteria

Acceptance limits apply to individual test results, not the average test result for a Lot.

Annexure 3051/A1

The pavement designer is to specify the traffic category applicable to each material to be supplied under this specification. The design traffic loading used for setting the Traffic Category is that for the design traffic lane, and not for the road.

Purchasers should be familiar with the granular material being supplied and are to ensure the material meets the specification requirements for the traffic category specified.

Annexure 3051/A2

For all materials regardless of its susceptibility to breakdown, pretreatment to three cycles of repeated compaction (Test Method T102) is required.

For materials that have been shown to, or are expected to continue to break down under further pretreatment, or to undergo significant additional handling processes over and above what is normal, such as repeated stabilisation processes, pretreatment to six cycles of repeated compaction (Test Method T102) is required.

For shales and other aggregates containing minerals susceptible to breakdown due to cyclic wetting and drying cycles, pretreatment by artificial weathering (Test Method T103) is required.

Annexure 3051/A3

The limits included in Table 3051.3 are appropriate for the majority of materials. This annexure only needs to be completed in rare instances. No relaxation in limits should be made unless supported by a proven “in service” record for the particular material.



Transport
for NSW

SPECIFICATION D&C 3051

GRANULAR PAVEMENT BASE AND SUBBASE MATERIALS

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VERSION FOR: DATE:

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FOREWORD

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BASE SPECIFICATION

This document is based on Specification TfNSW 3051 Edition 7 Revision 1.

TfNSW SPECIFICATION D&C 3051

GRANULAR PAVEMENT BASE AND SUBBASE MATERIALS

1 SCOPE

This Specification sets out the requirements for granular materials used as Unbound Material, Material To Be Modified, and Material To Be Bound in the base and subbase courses of surfaced pavements. These materials can be naturally occurring, manufactured or recycled materials.

This Specification does not cover the requirements for the transport, placing, compaction, sampling and testing of the placed materials in the construction of the pavement. It also does not cover the requirements for the properties of the Bound Material or the binder.

2 STRUCTURE OF THE SPECIFICATION

This Specification includes a series of annexures that detail additional requirements.

2.1 PROJECT SPECIFIC REQUIREMENTS

Project specific requirements are shown in Annexure 3051/A.

2.2 SCHEDULES OF HOLD POINTS

The schedule in Annexure 3051/C list the **HOLD POINTS** that must be observed. Refer to Specification TfNSW D&C Q6 for the definition of **HOLD POINT**.

2.3 FREQUENCY OF SAMPLING AND TESTING

The minimum frequency of sampling and testing is shown in Annexure 3051/L.

2.4 REFERENCED DOCUMENTS

Standards, specifications and test methods are referred to in abbreviated form (e.g. AS 1234). For convenience, the full titles are given in Annexure 3051/M.

3 DEFINITIONS

The terms “you” and “your” mean respectively “the Contractor” and “the Contractor’s”, or “the Supplier” and “the Supplier’s”, as appropriate.

The term “the Supplier” means the supplier of the product covered by the scope of this Specification.

The following definitions apply to this Specification:

Base material	Material designated for use in the pavement base layer. A wearing surface comprising either a sprayed bituminous seal or asphalt layer is placed over the base layer.
Binder	Hydraulic stabilising agent, such as lime, cement or ground granulated blast furnace slag used singly or in combination, to which may be added pozzolanic materials such as fly ash or other additives and which sets when mixed with pavement materials and water, or, a non-hydraulic stabilising agent such as bitumen.
Blended material	Material formed by combining and mixing materials from different sources or rock types or recycled materials (such as recycled asphalt pavement and crushed concrete, bricks, terracotta tiles or glass), in order to obtain a blended product with specific properties.
Bound material	Material with significant tensile strength produced from Material To Be Bound after mixing with a binder. Bound material is also referred to as stabilised material.
Brick	Block of ceramic material used in masonry construction.
Ceramic material	Material with a glazed or unglazed body of crystalline or partly crystalline structure, or of glass, which is produced from essentially inorganic, non-metallic substances and either is formed from a molten mass which solidifies on cooling, or is formed and simultaneously or subsequently matured by the action of the heat.
Class 1 DGB	A cohesive pavement base material for unbound granular pavements for Traffic Category A and B roads. It has a minimum and maximum plasticity index and (for Traffic Category A only) a maximum permeability requirement.
Class 2 DGB	A pavement base material for unbound granular pavements for Traffic Category C and D roads. It does not have a minimum plasticity index or a maximum permeability requirement.
Coarse aggregate	Material composed of discrete mineral particles of specified size or size distribution, produced from gravel, rock, metallurgical slag or recycled material, using one or more of the following processes: selective extraction, screening, blasting or crushing, with nominal size greater than 4.75mm. Coarse aggregate particles must consist of clean, hard, durable, angular fragments of uniform quality.
Constituent material	Material from a distinct source that is combined with other materials to form the Proposed Mix.
Fly ash	Fine grain, dust-like material removed from the flue gases of a coal combustion furnace by electrostatic precipitators or bag filters. Fly ash consists essentially of the oxides of silicon, aluminium, iron and some calcium.
Furnace bottom ash	Fine to coarse sand size substance with some dust and coarse grain particles from the ash removal systems of dry bottom coal combustion furnaces. The ash is handled in a solid form as the ash particles cool in suspension and some settle to the furnace floor.

Material To Be Bound	The unbound material prior to stabilisation (“heavily bound”) with a binder.
Material To Be Modified	The unbound material prior to the addition of a small amount of binder.
Modified Material	Material To Be Modified mixed with small amounts of binder to improve its properties (e.g. to adjust plasticity or prevent material breakdown) without significantly increasing its tensile strength.
Proposed Mix	A granular mix design of constituent materials for assessment under this Specification.
Reclaimed Asphalt Pavement	Material reclaimed from an asphalt pavement by cold-milling.
Recycled material	Material manufactured from recycled material such as crushed concrete, RAP, bricks, terracotta tiles or glass.
Self-cementing material	A granular material that, without the addition of any chemical binders and in the absence of premature loading or high stress levels, increases in modulus and compressive strength with time due to the chemical reaction of its fines in the presence of water. These materials may behave as “modified”, “lightly bound” or “heavily bound” pavement materials depending on the long term stiffness and compressive strength developed.
Slag	Granular by-product of the steel making process from a blast furnace, steel furnace or electric arc furnace.
Subbase material	Material designated as subbase requiring a covering layer(s) of base material.
Traffic Category	Refer to Annexure 3051/A.
Unbound Material	Natural, manufactured or recycled mineral blends of graded particles which have not been modified or bound.

4 QUALITY MANAGEMENT SYSTEM

The Supplier must have in place a Quality Management System conforming to AS/NZS ISO 9001 as a means of ensuring that the product(s) conform to this Specification. The Principal may audit the system for compliance.

Where the Proposed Mix contains more than one constituent material, include in the Quality Management System a Stockpile Management Plan for constituent materials, and the blending methodology to ensure delivery of uniform material.

5 MATERIAL DESIGNATION AND SELECTION

5.1 MATERIAL DESIGNATION

Granular pavement base and subbase materials are designated as follows:

Class 1 DGB ⁽¹⁾	20 mm nominal size Densely Graded Base (Class 1)
Class 2 DGB ⁽¹⁾	20 mm nominal size Densely Graded Base (Class 2)
DGS20 ⁽¹⁾	20 mm nominal size Densely Graded Subbase
DGS40 ⁽¹⁾	40 mm nominal size Densely Graded Subbase
MB20	20 mm nominal size Material To Be Bound
MB40	40 mm nominal size Material To Be Bound
GMB20 ⁽²⁾	20 mm nominal size Graded Macadam Base
GMS40 ⁽²⁾	40 mm nominal size Graded Macadam Subbase
GMS60 ⁽²⁾	60 mm nominal size Graded Macadam Subbase
MS50 ⁽²⁾	50 mm nominal size Macadam Subbase
MS75 ⁽²⁾	75 mm nominal size Macadam Subbase

Notes:

⁽¹⁾ Either as Unbound Material or Material To Be Modified.

⁽²⁾ Must be from a single quarry source.

5.2 MATERIAL SELECTION

The actual designated material required will be specified in Annexure 3051/A, or in Specifications TfNSW D&C R71, D&C R73, D&C R75 and D&C R76 as applicable, or shown on the Design Documentation drawings.

Unbound Material for use in a base course under Traffic Categories A and B must be Class 1 DGB material.

Unbound Material for use in a base course that is constructed under traffic and is to receive a sprayed seal surfacing must be either Class 1 DGB, or for Traffic Category C and D roads Class 2 DGB with a Plasticity Index (PI) ≥ 2 , so that the surface does not ravel under traffic prior to the placing of the sprayed seal.

6 ACCEPTANCE OF PROPOSED MATERIALS

6.1 EVALUATION PROCESS

Materials proposed for use as granular pavement base and subbase material, termed the “Proposed Mix”, will be evaluated for conformity in one of the following two ways,

either

- (i) based on particle size distribution and other material properties, as specified in Clause 8 for densely graded materials and Annexure 3051/E for Macadam-type materials;

or

- (ii) as a Unique Material that does not meet the criteria stated in item (i) above but has been granted conditional use under the TfNSW Innovative Technologies Scheme (refer Clause 9).

The process for acceptance is shown in Figure 3051.1.

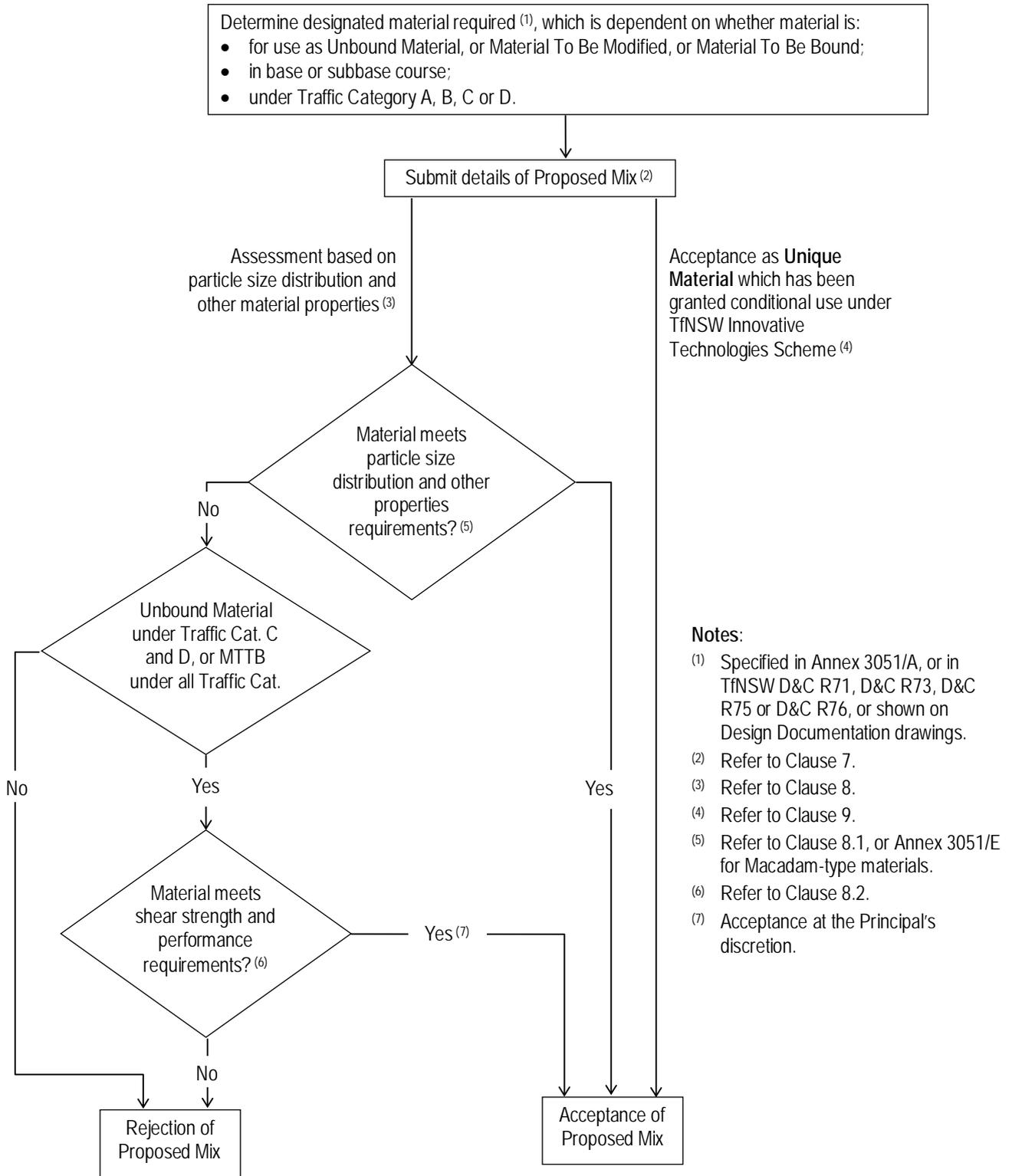


Figure 3051.1 – Evaluation Process for Acceptance of Proposed Mix

6.2 BASIS FOR ACCEPTANCE

6.2.1 Traffic Category

The material property requirements for each material are different for different Traffic Categories, which itself is a function of the Design Traffic for the pavement being constructed. The relationship between the Design Traffic and the Traffic Category is given in Table 3051/A.N1.

The applicable Traffic Category is specified in Annexure 3051/A, or in TfNSW D&C R71, D&C R73, D&C R75 or D&C R76 as applicable, or shown on the Design Documentation drawings.

6.2.2 Unbound Material or Material To Be Modified

Class 1 DGB material for use as Unbound Material or Material To Be Modified must meet the requirements of Clause 8.1 for particle size distribution, plasticity, permeability (Traffic Category A only), cohesion, soundness, shape and strength.

Class 2 DGB material for use as Unbound Material or Material To Be Modified must meet the requirements of Clause 8.1, or alternatively may be accepted at the Principal's discretion if it meet the requirements of Clause 8.2 for shear strength.

6.2.3 Material To Be Bound

Material To Be Bound under any Traffic Category must meet the requirements of either Clause 8.1 or Clause 8.2 for acceptance.

6.2.4 Graded Macadam and Macadam Material

Graded Macadam and Macadam Materials may only be used if agreed by the Principal in Annexure 3051/A.

These materials under any Traffic Category must meet the requirements of Annexure 3051/E for acceptance.

6.2.5 Unique Material

Unique Materials which have been assessed and granted conditional use under the TfNSW Innovative Technologies Scheme will be accepted under their respective Conditions of Approval (refer Clause 9).

6.3 MATERIAL FROM STOCKPILES

Acceptance of material is on the basis of conformity of samples taken from stockpiles.

Each stockpile will be regarded as one Lot for the purpose of testing for conformity.

The Principal may accept material using alternative production and/or delivery methods if you can demonstrate that production and quality control procedures for verifying conformity to the specification are in place.

6.4 PRETREATMENT

6.4.1 General

Pretreatment of sampled materials prior to acceptance testing is mandatory unless exempted by the Principal (refer Clause 6.4.2).

The acceptance values stated in this Specification are for samples that have undergone the specified pretreatment.

The minimum level required is 3 cycles of repeated compaction in accordance with Test Method TfNSW T102.

The Designer may also specify further cycles of repeated compaction (see Annexure 3051/A), and/or pretreatment of materials by artificial weathering in accordance with Test Method TfNSW T103.

6.4.2 Exemptions for Pretreatment

The Principal may grant exemptions for pretreatment (using Test Method TfNSW T102) for specified tests where you can demonstrate from the test results, to the satisfaction of the Principal, that the material in the Proposed Mix does not exhibit unacceptable breakdown under the pretreatment regime specified.

Circumstances that would constitute unacceptable breakdown are:

- (i) the percentage passing any sieve increase by more than 3 from that of the sample prior to pretreatment, or exceed the upper value of the ranges listed in Table 3051.1;
- (ii) the PI increase by more than 3 from that of the sample prior to pretreatment, or exceed the values listed in Table 3051.2.

Where a change in plasticity or particle size distribution is detected, the Principal may request additional cycles of pretreatment to assess the material's sensitivity to further cycles of compaction.

6.5 EXEMPTIONS FOR OTHER TESTS

The Principal may also grant exemptions for tests for free lime content (Test Method TfNSW T134), fractured faces (Test Method TfNSW T239), and acid soluble sulfate content (Test Method TfNSW T219), where you can demonstrate over a significant period that the test results consistently meet the specified criteria.

The Principal may request that verification checks be carried out on production material to ensure that the properties of the material on which the exemption was granted have not changed. The Principal reserves the right to withdraw an exemption at any time.

7 PROPOSED MIX

7.1 SUBMISSION OF PROPOSED MIX DETAILS

Provide the Principal with details of the Proposed Mix and each proposed constituent material, together with a signed statement of conformity that matches representative test results for current or most recent production against specification requirements, verifying that the Proposed Mix meets the requirements of this Specification.

Provide evidence from quality records to demonstrate that:

- (i) each of the constituent materials can be supplied from a source of consistent quality; and
- (ii) the Proposed Mix can be delivered at a consistent quality.

The documentation must include a copy of a checklist verifying conformity of each of the relevant properties stated in (a), (b), (c) and (d) below, supported by NATA endorsed test results.

The following details are required:

(a) For all Proposed Mixes

- (i) Description (or material designation).
- (ii) Particle size distribution of the material, known as the “Proposed Particle Size Distribution” as detailed in Table 3051.1 (using Test Methods TfNSW T106 and T107).
- (iii) Maximum Dry Density (t/m^3) using Test Methods TfNSW T111 or T112 as applicable.
- (iv) Source(s) of all constituent materials.
- (v) Blend proportions for blended materials.
- (vi) Method of producing the Proposed Mix.
- (vii) Evidence of the Principal granted exemption from specified cycles of pretreatment, if applicable.
- (viii) Test results demonstrating compliance with any resource recovery exemption applicable to a mix constituent.

(b) For materials complying with Clause 8 of this Specification

- (i) Test results for a sample of the Proposed Mix to verify that the material complies with Tables 3051.1, 3051.2 and 3051.3 for densely graded materials, or Tables 3051/E.1, 3051/E.2 and 3051/E.3 for Macadam Materials.
- (ii) For materials for which compliance assessment under Clause 8.2 criteria is sought, the nominated particle size distribution, test results for a sample of the Proposed Mix demonstrating compliance with Table 3051.4, and evidence of acceptable compaction characteristics and field performance.

(c) For Unique Materials granted conditional acceptance under TfNSW Innovative Technologies Scheme

Test results for a sample of the Proposed Mix to verify that the material complies with the specific acceptance requirements under the Innovative Technologies Scheme.

(d) For recycled materials

Test results for a sample of the proposed recycled constituent material to verify that the limits of undesirable material comply with Table 3051.6.

7.2 VARIATION TO PROPOSED MATERIALS

If you wish to change the source of supply, blend proportions or method of production, re-submit the information in accordance with Clause 7.1. Minor variations in blend proportions in the range 0.9 to 1.1 times blend proportion are acceptable provided that the Lot still meets all the requirements of this Specification.

8 MATERIAL PROPERTY REQUIREMENTS FOR DENSELY GRADED MATERIALS

The requirements under this clause apply only to densely graded materials. The requirements for Macadam-type materials are given in Annexure 3051/E.

All material supplied under the deed must be within the blend proportions accepted under Clause 7 and meet all other requirements in this Specification when tested at the frequency specified in Annexure 3051/L.

For each delivery of material, provide to the Project Verifier statements of conformity, together with relevant test certificates, prior to delivery.

8.1 REQUIREMENTS BASED ON PARTICLE SIZE DISTRIBUTION AND OTHER PARTICLE PROPERTIES**Table 3051.1 – Particle Size Distribution Requirements**

Property and Test Method	Unbound Material or Material To Be Modified				Material To Be Bound	
	Base		Subbase		Base/Subbase	
	Class 1 DGB ^(3, 5)	Class 2 DGB ^(4, 5)	DGS20 ⁽⁵⁾	DGS40 ⁽⁵⁾	MB20 ⁽⁶⁾	MB40 ⁽⁶⁾
Particle Size Distribution ^(1, 2) ; TfNSW T106 and TfNSW T107, AS 1289.3.6.1						
% passing AS Sieve (by mass)						
75.0 mm	–	–	–	–	–	–
53.0 mm	–	–	–	100	–	100
37.5 mm	–	–	–	95 – 100	–	–
26.5 mm	100	100	100	75 – 95	100	–
19.0 mm	95 – 100	95 – 100	95 – 100	64 – 90	95 – 100	55 – 80
13.2 mm	78 – 92	78 – 92	70 – 90	–	70 – 90	–
9.5 mm	63 – 83	63 – 83	58 – 80	42 – 78	60 – 80	30 – 55
4.75 mm	44 – 64	44 – 64	43 – 65	27 – 64	–	–
2.36 mm	33 – 49	33 – 49	30 – 55	20 – 50	30 – 50 ⁽⁶⁾	20 – 40
425 µm	14 – 23	14 – 23	10 – 30	10 – 23	10 – 25 ⁽⁶⁾	8 – 25
75 µm	7 – 14	7 – 14	4 – 17	4 – 12	4 – 12 ⁽⁶⁾	3 – 10
13.5 µm ⁽⁷⁾	3 – 7	3 – 7	2 – 10	2 – 7	–	–
% retained between AS Sieves (by mass) ⁽⁸⁾						
37.5 mm						
	–	–	–	–	–	–
26.5 mm						
	–	–	–	–	–	–
19.0 mm						
	7 – 17	6 – 21	–	–	–	–
13.2 mm						
	8 – 16	6 – 19	–	–	–	–
9.5 mm						
	14 – 24	10 – 25	–	–	–	–
4.75 mm						
	8 – 18	5 – 23	–	–	–	–
2.36 mm						
	14 – 28	12 – 33	–	–	–	–
425 µm						
	6 – 13	4 – 15	–	–	–	–
75 µm						
	3 – 7 ⁽⁷⁾	1 – 9 ⁽⁷⁾	–	–	–	–
13.5 µm						

Notes:

(1) After pretreatment as stated in Annexure 3051/A.

(2) For Unbound Material or Material To Be Modified, determination of Particle Size Distribution is by T106 and T107 only. For Material To Be Bound either AS 1289.3.6.1 or T106 and T107 may be used to determine the Particle Size Distribution.

(3) For Traffic Categories A and B.

- (4) For Traffic Categories C and D.
- (5) Filler (i.e. material finer than 75 μm) may be incorporated into the material to improve its particle size distribution and cohesion and/or to reduce its permeability. Submit to the Principal details of the proposed source and the amount and type of filler prior to use. The filler must be uniformly mixed with the coarse aggregate by use of a pugmill, or an alternative mixing system approved by the Principal.
- (6) For materials with the addition of classified fly ash as an additive to generate a pozzolanic reaction, the following % passing (by mass) limits apply:
 - 2.36 mm sieve 35 – 55
 - 425 μm sieve 15 – 30
 - 75 μm sieve 4 – 15
- (7) Determination of “% passing 13.5 μm sieve” is not required for materials containing 5% or more by mass of fly ash.
- (8) Purpose of the “% retained” requirement is to provide a well graded product to improve constructability and performance requirements. Variations up to 2% on the % retained criteria for Class 2 DGB may be considered by the Principal, provided the limits are not exceeded on more than two retained sieve sizes.

Table 3051.2(a) – Plasticity and Permeability Requirements for Unbound Material or Material To Be Modified

Property and Test Method	Unbound Material or Material To Be Modified			
	Base		Subbase	
	Class 1 DGB	Class 2 DGB	DGS20	DGS40
Plasticity Index (PI) ⁽¹⁾ : TfNSW T109				
- For Traffic Categories A and B	max 6 min 2 ⁽²⁾	–	max 10	max 10
- For Traffic Categories C and D	–	max 6 ⁽³⁾ (min 2) ⁽⁴⁾	max 10	max 10
Liquid Limit (if non-plastic) ⁽¹⁾ : TfNSW T108				
For natural or manufactured materials				
- For Traffic Categories A and B	max 20 ⁽⁵⁾	–	max 23	max 23
- For Traffic Categories C and D	–	max 23	max 23	max 23
For recycled material	max 27	max 27	max 27	max 27
Plastic Limit (if plastic) ⁽¹⁾ : TfNSW T109				
For all materials	max 20	max 20	max 20	max 20
Permeability ⁽¹⁾ (m/sec): AS 1289.6.7.2				
- For Traffic Category A ⁽⁶⁾	max 5 x 10 ⁻⁸	–	–	–

Table 3051.2(b) – Plasticity Requirements for Material To Be Bound

Property and Test Method	Material To Be Bound	
	Base/Subbase	
	MB20	MB40
Plasticity Index (PI) ⁽¹⁾ : TfNSW T109		
- For Traffic Category A	max 2	max 2
- For Traffic Category B and C	max 6	max 6
- For Traffic Category D	max 10	max 10

Notes to Table 3051.2(a) and Table 3051.2(b):

- (1) After pretreatment as stated in Annexure 3051/A.
- (2) PI may be reduced to zero when fly ash comprises 5% or more by mass of the total blended material, or for Material To Be Bound. Where filler(s) other than fly ash are proposed, and sufficient data is available to demonstrate adequate workability of the Proposed Mix, the Principal may also allow the reduction of PI to zero for those filler(s).
- (3) Materials with a maximum PI of 8 for Traffic Category C, and 10 for Traffic Category D, may be considered for acceptance by the Principal as "Material To Be Modified" for the respective traffic category. After modification, PI must not exceed 6 for Traffic Category C and 8 for Traffic Category D.
- (4) Applicable only when so specified for Unbound Material for use in base course that is constructed under traffic and is to receive a sprayed seal surfacing. Refer Clause 5.2.
- (5) The maximum value of the Liquid Limit may be increased to 23 for non-plastic crushed rock, provided that the value determined is not influenced by the presence of adverse constituents (e.g. mica).
- (6) For material compacted to 98% of Maximum Dry Density (Modified Compaction) in accordance with TfNSW T112.

Table 3051.3 - Soundness and Strength/Cohesion Requirements

Property and Test Method	Unbound Material or Material To Be Modified				Material To Be Bound	
	Base		Subbase		Base/Subbase	
	Class 1 DGB	Class 2 DGB	DGS20	DGS40	MB20	MB40
Particle Shape by Proportional Calliper: TfNSW T213						
% mis-shapen (2:1) ⁽¹⁾	max 35	max 35	max 35	max 35	max 35	max 35
Two or more fractured faces^(1,2) (%): TfNSW T239						
- For Traffic Categories A and B	min 85	–	min 75	min 75	min 75	min 75
- For Traffic Categories C and D	–	min 75	min 75	min 75	min 75	min 75
Maximum Dry Compressive Strength on fraction passing 19 mm sieve^(1,3) (MPa): TfNSW T114						
- For Traffic Categories A, B, C and D	min 1.7	min 1.7	min 1.0	min 1.0	–	–
Unconfined Compressive Strength^(1,4,5) (MPa): TfNSW T116	max 1.0	max 1.0	–	–	–	–
Aggregate Wet Strength⁽⁶⁾ (kN): TfNSW T215 ⁽⁹⁾						
- For Traffic Categories A and B	min 100 ⁽⁷⁾	–	min 70	min 70	min 70	min 70
- For Traffic Categories C and D	–	min 70	min 70	min 70	min 70	min 70
Wet/Dry Strength Variation^(6,8) (%): TfNSW T215 ⁽⁹⁾						
- For Traffic Categories A and B	max 35	–	max 35	max 35	max 35	max 35
- For Traffic Categories C and D ⁽¹⁰⁾	–	max 35	max 40	max 40	max 35	max 35
Acid Soluble Sulfate Content in road construction materials^(1,10,11): TfNSW T219	max 0.3%	max 0.3%	max 0.3%	max 0.3%	max 0.3%	max 0.3%

Notes:

- (1) After pretreatment as stated in Annexure 3051/A.
- (2) Material that has been drilled, blasted and crushed and material listed in Table 3051.5 is exempt from this requirement.
- (3) Requirement applicable only if PI < 2.
- (4) For all Proposed Mixes containing recycled concrete, bricks, fly ash, bottom ash, or slag as constituent materials.
- (5) Prior to testing in accordance with TfNSW T116, compact the material within one hour on the completion of pretreatment.
- (6) The fraction 19.0 mm to 9.5 mm must be tested. In the case of blended materials, where material from the overburden is added or aggregate from multiple sources are blended together, the fraction 9.5 mm to 4.75 mm must also be tested. For recycled materials for Traffic Categories C and D applications, and where sufficient data is provided to demonstrate acceptable performance, the Principal may allow lower Aggregate Wet Strength, and higher Wet/Dry Strength Variation limits.
- (7) For slag, the Minimum Aggregate Wet Strength is 70 kN.
- (8) The fraction with the highest Wet/Dry Strength Variation is the value for determining conformity with the Specification.
- (9) Pretreatment is not required for this test.
- (10) Where sufficient data is provided, the Principal may allow higher values for local or recycled materials of known acceptable performance.
- (11) Limit is applicable for Bound and Modified Material.

8.2 REQUIREMENTS BASED ON SHEAR STRENGTH

8.2.1 Unbound Materials

Unbound Materials which do not meet any one of the following:

- (a) “% retained” requirements of Table 3051.1 (using Test Methods TfNSW T106 and T107); or
- (b) “% mis-shapen (2:1)” particle requirements of Table 3051.3 (using Test Method TfNSW T213);
or
- (c) “fractured faces” requirements of Table 3051.3 (using Test Method TfNSW T239);

but meet all other Specification requirements, may be considered for acceptance for Traffic Category C and D pavements.

To obtain acceptance of these materials, provide evidence of:

- (i) acceptable compaction characteristics and field performance;
- (ii) test results verifying conformity with the specified criteria for the Modified Texas Triaxial Test (Test Method TfNSW T171); and
- (iii) maximum permitted deviation from the Nominated Particle Size Distribution detailed in Table 3051.4.

8.2.2 Materials To Be Bound

Materials To Be Bound which do not meet any one of the following:

- (a) particle size distribution requirements of Table 3051.1 (using Test Methods TfNSW T106 and T107); or
- (b) “% mis-shapen (2:1)” particle requirements of Table 3051.3 (using Test Method TfNSW T213);
or
- (c) “fractured faces” requirements of Table 3051.3 (using Test Method TfNSW T239);

but meet:

- (i) maximum size and “% passing 2.36 mm sieve” requirements of Table 3051.1; and
- (ii) requirements of Table 3051.4; and
- (iii) additional testing procedures and specification limits for Bound Materials contained in TfNSW D&C R73, D&C R75 and D&C R76;

will be accepted for all Traffic Categories.

Table 3051.4 – Shear Strength Requirements

Property and Test Method	Unbound Material			Material To Be Bound	
	Base	Subbase		Base/Subbase	
	Class 2 DGB	DGS20	DGS40	MB20	MB40
Modified Texas Triaxial Compression Test ^(1, 2, 3, 4) ; TfNSW T171					
Texas Classification Number for					
Traffic Category A materials	–	–	–	max 2.2	max 2.2
Traffic Category B materials	–	–	–	max 2.5	max 2.5
Traffic Category C materials	max 2.2	max 3.2	max 3.2	max 3.0	max 3.0
Traffic Category D materials	max 2.5	max 3.2	max 3.2	max 3.0	max 3.0
Maximum Deviation from Nominated Particle Size Distribution ⁽¹⁾ ; TfNSW T106 and TfNSW T107, AS 1289.3.6.1					
% passing 53.0 mm	–	–	± 0	–	± 0
% passing 26.5 mm	± 0	± 0	± 8	–	–
% passing 19.0 mm	± 3	± 3	± 8	± 3	± 8
% passing 13.2 mm	± 7	± 8	–	± 8	–
% passing 9.5 mm	± 6	± 6	± 8	± 6	± 8
% passing 4.75 mm	± 6	± 6	± 6	± 6	–
% passing 2.36 mm	± 6	± 6	± 6	± 6	± 6
% passing 425 µm	± 4	± 4	± 4	± 4	± 4
% passing 75 µm	± 2	± 2	± 2	± 2	± 2

Notes:

- (1) After pretreatment as stated in Annexure 3051/A.
- (2) When tested at 85% ± 2% of Optimum Moisture Content and 100% ± 1% of Maximum Dry Density as determined by TfNSW T111 (Standard Compaction).
- (3) Where the material is sufficiently open graded that the moisture content after testing is less than 85% of Optimum Moisture Content, owing to water bleeding from the sample, the material must be moulded at Optimum Moisture Content and Maximum Dry Density (as determined by TfNSW T111), and tested immediately. The Texas Classification Number so obtained must be used for comparison with the Specification requirements.
- (4) Testing procedure and specification limits for modified materials are specified in TfNSW D&C R71.

8.2.3 Hold Point – Acceptance As Shear Strength Based Material

HOLD POINT

Process Held:	Acceptance of a Proposed Mix as a shear strength based material.
Submission Details:	Representative Modified Texas Triaxial Compression Test and particle size distribution results of samples taken from production Lots, demonstrating compliance with Table 3051.4, together with supporting information on the material's field performance, compaction characteristics and consistency of production control. Where the Proposed Mix does not meet the grading criteria (using Test Methods TfNSW T106 and T107), include in the submission the nominated particles size distribution.
Release of Hold Point:	The Nominated Authority will consider the submission prior to authorising the release of the Hold Point.

9 UNIQUE MATERIAL (UNDER TfNSW INNOVATIVE TECHNOLOGIES SCHEME)

Unique Materials are those materials that do not conform to the requirements of Clause 8 of this Specification but have a proven performance history.

These materials are acceptable to the TfNSW if they have been evaluated and granted conditional use approval under the TfNSW Innovative Technologies Scheme and are utilised under the Conditions of Approval. Some Unique Materials may require specific construction techniques and these form part of the Conditions of Approval in order to gain satisfactory performance.

A list of accepted Unique Materials, their applications and conditions for use can be obtained from: <http://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/tenders-contracts/unique-granular-materials.pdf>

10 RECYCLED AND MANUFACTURED CONSTITUENT MATERIALS

10.1 GENERAL

Provide evidence that the sources and proposed methods of production of the recycled or manufactured constituent materials are suitable for the quality and quantity required.

Individual recycled or manufactured materials may be blended with either virgin materials or other recycled materials.

10.2 RESOURCE RECOVERY EXEMPTION

For recycled materials that are the subject of "resource recovery exemptions" granted by the NSW Environment Protection Authority, comply with the conditions attached to any exemption as a

“consumer”, “processor” or a “producer”, as appropriate, and provide evidence demonstrating such compliance including all record keeping requirements.

10.3 PERMISSIBLE RECYCLED AND MANUFACTURED MATERIALS AND LIMITS

Permissible types of recycled and manufactured constituent materials, and the permissible proportion for each individual type are stated in Table 3051.5. The total proportion of recycled and manufactured constituent materials, other than slag or crushed concrete, must not exceed 40% of the mix, unless otherwise approved by the Principal.

Table 3051.5 - Limits on Use of Recycled and Manufactured Materials as Constituent Materials

Material	Unbound or Modified Base and Subbase	Bound Base and Subbase
Slag ⁽¹⁾	100%	100%
Crushed Concrete ⁽²⁾	100%	100%
Crushed Brick ⁽³⁾	20%	10%
Recycled Asphalt Pavement (RAP) ⁽⁴⁾	40%	40%
Fly Ash ⁽⁵⁾	10%	10%
Furnace Bottom Ash ⁽⁵⁾	10%	10%
Crushed Glass Fines ⁽⁶⁾	10%	10%

Notes:

- (1) Refer Clause 10.5 on use of slag.
- (2) For unbound or modified base materials for Traffic Categories A and B, crushed concrete must be sourced from recycled structural concrete. (Structural concrete is defined as concrete containing reinforcement or from rigid pavements). For unbound or modified base materials for Traffic Categories C and D and unbound subbase, bound base and bound subbase for all Traffic Categories, crushed concrete from structural and non-structural sources and concrete washouts is acceptable.
- (3) Crushed bricks, excluding cement masonry bricks, are acceptable provided that they are uniform in quality and any adhering mortar or cement render does not produce any binding reaction in the base or subbase mix.
- (4) Only RAP material obtained from cold milling (profiling) of asphalt pavements is acceptable for use in unbound or modified base material for Traffic Categories A and B. For unbound or modified base materials in Traffic Categories C and D and unbound subbase, bound base and bound subbase for all Traffic Categories, asphalt from other sources, such as slab asphalt, may be included. Refer to Specification TfNSW D&C 3153.
- (5) The addition of fly ash or furnace bottom ash may not be acceptable if modification is to be carried out.
- (6) Crushed glass fines must be clean and washed to ensure the sand is free of any sugar, paper or other contaminants. Refer to Specification TfNSW D&C 3154.

10.4 UNDESIRABLE MATERIALS AND LIMITS

Undesirable materials and the maximum limits of these materials within the constituent materials in a Proposed Mix are stated in Table 3051.6.

Table 3051.6 - Limits of Undesirable Materials Within Recycled and Manufactured Materials

Undesirable Constituent Material Type and Test Method	Traffic Category	Maximum Limit by Mass of each Constituent Material (Test Method TfNSW T276)	
		Base	Subbase
Metal, unprocessed glass, and ceramic material (excluding bricks)	A	1%	2%
	B	1%	2%
	C and D	2%	3%
Plaster, clay lumps and other friable material	A	0.1%	0.5%
	B	0.2%	0.5%
	C and D	0.5%	0.5%
Rubber, plastic, paper, cloth, paint, wood and other vegetable matter	A	0.1%	0.2%
	B	0.1%	0.2%
	C and D	0.2%	0.2%
Free lime content TfNSW T134	All	0.6%	0.6%
Tar (including coal tar)	All	0%	0%

10.5 EXPANSIVE MATERIALS

Steel furnace slag (SFS), also known as basic oxygen steel making (BOS) slag, is not permitted for use under this Specification.

Use of electric arc furnace slag (EAFS) requires assessment by the Principal before it is permitted for use.

Implement measures to ensure that materials supplied for the Works do not exhibit any expansive reactions resulting from the presence of free Calcium Oxide, Magnesium Oxide or other expansive materials.

10.6 HOLD POINT – ACCEPTANCE OF RECYCLED AND/OR MANUFACTURED MATERIALS

HOLD POINT

Process Held: Acceptance of recycled and/or manufactured constituent materials.

Submission Details: (i) Evidence such as stockpile management plans and test results where applicable, to verify that the constituent material has been weathered, cured and managed to exclude any reactivity that may cause the material to expand after it has been placed in the pavement, and meets the requirements of Table 3051.6.

(ii) Test results demonstrating compliance with any applicable resource recovery exemption.

Release of Hold Point: The Nominated Authority will consider the submission prior to authorising the release of the Hold Point.

11 SAMPLING AND TESTING

11.1 GENERAL

Sampling and testing must be undertaken by a laboratory accredited by the National Association of Testing Authorities Australia (NATA) for the relevant tests and the test results provided by the laboratory must be issued on NATA endorsed certificates.

Carry out the sampling in accordance with Test Method TfNSW T100 and state this on the relevant NATA endorsed test certificate. Sample preparation must be in accordance with Test Method TfNSW T105.

11.2 TIME OF SAMPLING

Obtain samples of material from stockpiles within three days of completing the stockpile unless otherwise approved by the Project Verifier.

Take any samples of Material To Be Modified and Material To Be Bound prior to addition of binder(s), except for Test Method TfNSW T116 or as otherwise required by TfNSW D&C R73.

11.3 FREQUENCY OF SAMPLING

The minimum frequency of sampling and testing must be in accordance with Annexure 3051/L. Take further samples for testing as required.

12 CONFORMITY

12.1 PARTICLE SIZE DISTRIBUTION

12.1.1 General

The particle size distribution (PSD) of the material must satisfy both the “% passing” and “% retained” requirements of Tables 3051.1 and/or 3051/E.1 as applicable, when assessed in accordance with Clauses 12.1.2 and 12.1.3.

12.1.2 Three or More Samples per Lot

Conformity of a Lot based on all test results for samples representing the Lot is assessed as follows:

- (a) Where all test results are conforming, the Lot is conforming.
- (b) Where one or more test results for any PSD requirement is outside the specified limit, the sample mean (\bar{X}) and standard deviation (σ_{n-1}) are determined.

If the sample mean is conforming, the test results are checked for outliers.

- (c) **Outlier Value**

To determine if the lowest value (X_1) or highest value (X_n) of the Lot is low or high purely by chance, or is caused by material not being uniform throughout the Lot, carry out the following steps (ref: ASTM E178-16).

Calculate the values for either:

$$T_1 = (\bar{X} - X_1) / \sigma_{n-1} \quad \text{or} \quad T_n = (X_n - \bar{X}) / \sigma_{n-1}$$

depending on which value is under question and compare it with the critical values in Table 3051.7.

Table 3051.7 – Critical Values of T^(a)

No of Tests	3	4	5	6	7	8	9	10	11	12
Value	1.15	1.46	1.67	1.82	1.94	2.03	2.11	2.18	2.23	2.29

If the value of T_1 or T_n is less than the critical value of T , the Lot is conforming.

If the value of T_1 or T_n exceeds the critical value of T , the low value or high value or both is treated as an outlier. A nonconformity report on the test result is to be issued and further assessment of the conformity of the Lot suspended, pending approval of the disposition by the Principal.

- (d) Where the sample mean for any PSD requirement is nonconforming, the Lot is nonconforming.

12.1.3 One or Two Samples per Lot

- (a) Where all test result(s) are conforming, the Lot is conforming.
- (b) Where two results are available and their mean is conforming, the Lot is conforming. If one result is nonconforming, and the Lot has been produced under a reduced frequency of testing regime, reinstate the full frequency of sampling and testing.
- (c) Where the single test result or mean of two test results is nonconforming, the Lot is nonconforming.

12.2 ALL OTHER SPECIFIED CRITERIA

For the Lot to be conforming, all test results for all criteria other than PSD must be conforming.

^(a) Extracted with permission from ASTM E178-16 Standard Practice for Dealing with Outlying Observations, copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

ANNEXURE 3051/A – PROJECT SPECIFIC REQUIREMENTS

Refer to Clause 2.1.

*NOTES TO TENDER DOCUMENTER: (Delete this boxed text after customising Annexure 3051/A)**Complete the tables below by deleting whichever option is not applicable, and filling in the required details. Insert additional rows as required.***A1 GENERAL***NOTES TO TENDER DOCUMENTER: (Delete this boxed text after customising Annexure 3051/A1)**In the table below, “Material Use Category” (Column 1) may be:*

- *Unbound Material;*
- *Material To Be Modified;*
- *Material To Be Bound;*

*and “Designated Material” (Column 4) may be any of that listed under Clause 5.1. Where Class 2 DGB is specified, state whether a minimum PI of 2 applies.**Columns 1, 2 and 3 together are used to determine the Designated Material required (Column 4), and Columns 1 and 2 may be left blank if the Designated Material has been pre-determined. Column 3 must always be filled in.*

Material Use Category	Base or Subbase Course	Traffic Category⁽¹⁾	Designated Material⁽²⁾

Notes:

⁽¹⁾ Applicable Traffic Category derived from Design Traffic, as shown in Table 3051/A.N1 below. DESA in the table is based on a 20 year design period for the design lane.

Table 3051/A.N1 - Relationship Between Design Traffic and Traffic Category

Design Traffic, N (Design Equivalent Standard Axle loading, DESA)	Traffic Category
$N \geq 10^7$	A
$10^7 > N \geq 4 \times 10^6$	B
$4 \times 10^6 > N \geq 10^6$	C
$N < 10^6$	D

⁽²⁾ Material conforming to Traffic Category specified is the lowest acceptable, but may be substituted by materials suitable for higher Design Traffic loading.

A2 PRETREATMENT

Refer to Clause 6.4.

Pretreatment is required prior to the commencement of the following specified tests: TfNSW T106, T107, T108, T109, T114, T116, T117, T131, T171, T213, T219, T239, AS 1289.6.7.2, and AS 1289.3.6.1.

Description	Test Method	Requirement
Pretreatment required:		
to 3 cycles of repeated compaction	TfNSW T102	Yes ⁽¹⁾
to 6 cycles of repeated compaction	TfNSW T102	Yes / No
by artificial weathering	TfNSW T103	Yes / No

Note:

⁽¹⁾ Pretreatment to 3 cycles of repeated compaction is always required.

A3 WET/DRY STRENGTH VARIATION

Refer to Table 3051.3.

Local Material/Recycled Material	Maximum Wet/Dry Strength Variation⁽¹⁾ (%)

Note:

⁽¹⁾ Determined in accordance with TfNSW T215.

ANNEXURE 3051/B – (NOT USED)

ANNEXURE 3051/C – SCHEDULE OF HOLD POINTS

Refer to Clause 2.2.

C1 SCHEDULE OF HOLD POINTS

Clause	Description
8.2.3	Acceptance of Proposed Mix as a shear strength based material
10.6	Acceptance of recycled and/or manufactured constituent materials

ANNEXURE 3051/D – (NOT USED)

ANNEXURE 3051/E – MATERIAL PROPERTY REQUIREMENTS FOR MACADAM-TYPE MATERIALS

**Table 3051/E.1 - Particle Size Distribution Requirements
for Macadam-type Materials**

Property and Test Method	Unbound Material				
	Base	Subbase			
	GMB20	GMS40	GMS60	MS50	MS75
Particle Size Distribution⁽¹⁾: TfNSW T106 and TfNSW T107					
% passing AS Sieve (by mass)					
75.0 mm	-	-	100	-	100
53.0 mm	-	100	-	100	-
37.5 mm	-	-	40 – 70	-	55 – 70
26.5 mm	100	-	-	55 – 70	-
19.0 mm	95 – 100	50 – 75	20 – 50	-	10 – 20
13.2 mm	50 – 70	-	-	10 – 20	-
9.5 mm	30 – 55	15 – 35	-	-	-
4.75 mm	-	-	-	-	-
2.36 mm	20 – 30	5 – 15	5 – 15	0 – 2	0 – 2
425 µm	6 – 15	1 – 8	-	-	-
75 µm	2 – 8	0 – 4	-	-	-

Note:

⁽¹⁾ After pretreatment as stated in Annexure 3051/A.

Table 3051/E.2 - Plasticity Requirements for Macadam-type Materials

Property and Test Method	Unbound Material				
	Base	Subbase			
	GMB20	GMS40	GMS60	MS50	MS75
Plasticity Index (PI)⁽¹⁾: TfNSW T109					
- For Traffic Category A	max 6	max 10	max 10	-	-
- For Traffic Categories B and C	max 8	max 10	max 10	-	-
- For Traffic Category D	max 8	max 10	max 10	-	-
Liquid Limit (if non-plastic)⁽²⁾: TfNSW T108					
Natural or manufactured materials					
- For Traffic Categories A and B	max 20	-	-	-	-
- For Traffic Categories C and D	max 23	-	-	-	-
Recycled materials	max 27	-	-	-	-
Plastic Limit (if plastic)⁽³⁾: TfNSW T109	max 20	-	-	-	-

Notes:

⁽¹⁾ After pretreatment, as specified in Annexure 3051/A, the Plasticity Index must not increase by more than 3 from that of the sample prior to pretreatment nor exceed the values of Table 3051/E.2.

⁽²⁾ The maximum value of the Liquid Limit may be increased to 23 for non-plastic crushed rock products, provided that the value determined is not influenced by the presence of adverse constituents e.g. mica.

⁽³⁾ After pretreatment as per Annexure 3051/A.

**Table 3051/E.3 - Soundness and Strength/Cohesion Requirements
for Macadam-type Materials**

Property and Test Method	Unbound Material				
	Base	Subbase			
	GMB20	GMS40	GMS60	MS50	MS75
Particle Shape by Proportional Calliper: TfNSW T213					
% mis-shapen (2:1) ⁽¹⁾	max 35	max 35	max 35	max 35	max 35
Two or more fractured faces⁽¹⁾ (%): TfNSW T239					
- For Traffic Categories A, B and C	min 85	min 75	-	-	-
Aggregate Wet Strength^(2, 3) (kN): TfNSW T215					
(a) Base materials					
- For Traffic Category A	min 150	-	-	-	-
- For Traffic Categories B and C	min 130	-	-	-	-
- For Traffic Category D	min 130	-	-	-	-
(b) Subbase materials	-	min 130	min 130	min 200	min 200
Wet/Dry Strength Variation⁽⁴⁾ (%): TfNSW T215					
For all Traffic Categories	max 30	max 30	max 30	max 30	max 30
California Bearing Ratio (CBR)⁽¹⁾: TfNSW T117	-	min 30	min 30	-	-

Notes:

- (1) After pretreatment as per Annexure 3051/A.
- (2) All fractions of the sample must meet the requirements of this Specification. The fraction 19.0 mm to 9.5 mm must be tested. In the case of blended materials, the fraction 9.5 mm to 4.75 mm must also be tested. Any fraction at risk of failing must also be tested.
- (3) For slag aggregate, the minimum Aggregate Wet Strength is 70 kN.
- (4) The fraction with the highest Wet/Dry Strength Variation is the value for determining conformity with this Specification.

ANNEXURES 3051/F TO 3051/K – (NOT USED)

ANNEXURE 3051/L – FREQUENCY OF SAMPLING AND TESTING

Minimum sampling and testing requirements are shown in Table 3051/L.1. The maximum Lot size is 4,000 tonnes.

Where process control has achieved a consistent product as demonstrated by six consecutive Lots conforming to specification requirements, or two consecutive Lots for permeability testing to AS 1289.6.7.2, the Project Verifier may allow a reduced frequency of testing as specified in Table 3051/L.1.

Table 3051/L.1 - Minimum Sampling and Testing Requirements

MINIMUM NUMBER OF SAMPLES TO BE TAKEN					
Total Size of Lot Represented (tonnes)		1 – 500	501 – 1000	1001 – 2000	2001 – 4000
Minimum Number of Bulk Samples per Lot		2	3	4	5
MINIMUM TOTAL NUMBER OF TESTS TO BE CARRIED OUT ON EACH LOT					
Property and Test Method		No of Tests			
Coarse Particle Distribution	TfNSW T106	2	3	4	5
Fine Particle Distribution	TfNSW T107	2	3	4	5
Particle Size Distribution	AS 1289.3.6.1	2	3	4	5
Permeability - Falling Head Method ⁽ⁱ⁾	AS 1289.6.7.2	1 (φ)	1 (φ)	1 (φ)	1 (φ)
Liquid Limit	TfNSW T108	2 (1)	3 (2)	4 (2)	5 (2)
Plasticity Index (PI)	TfNSW T109	2 (1)	3 (2)	4 (2)	5 (2)
Maximum Dry Compressive Strength ⁽ⁱⁱ⁾	TfNSW T114	1 (φ)	1 (φ)	2 (φ)	3 (φ)
Unconfined Compression Strength	TfNSW T116	2	3	4	5
Texas Triaxial Compression Test ⁽ⁱⁱⁱ⁾	TfNSW T171	1 (φ)	1 (φ)	2 (φ)	3 (1)
Particle Shape ⁽ⁱⁱⁱ⁾	TfNSW T213	1 (φ)	1 (φ)	2 (1)	3 (1)
Aggregate Wet Strength ⁽ⁱⁱⁱ⁾	TfNSW T215	1 (φ)	1 (φ)	2 (1)	3 (1)
Wet/Dry Strength Variation ⁽ⁱⁱⁱ⁾	TfNSW T215	1 (φ)	1 (φ)	2 (1)	3 (1)
Acid Soluble Sulphate ^{(iv), (v)}	TfNSW T219	1 (φ)	1 (φ)	1 (φ)	1
Fractured Faces of Coarse Aggregate ^{(iii), (v)}	TfNSW T239	1 (φ)	1 (φ)	2 (φ)	3 (1)
Foreign Materials Content ⁽ⁱⁱ⁾	TfNSW T276	1 (φ)	1 (φ)	2 (1)	3 (1)

Notes:

The number or symbol φ shown within brackets “()” in the second part of the table represents the permitted reduced frequency of testing.

Where the minimum total number of tests for each Lot is the same as the minimum number of samples to be taken, then each test must be done on a different sample.

Where the reduced rate of testing under Table 3051/L.1 is shown as (φ), then, regardless of Lot size, the following minimum frequencies of testing apply:

- (i) for AS 1289.6.7.2 Permeability of a Soil - Falling Head Method: 1 per 8,000 tonnes
- (ii) for Test Methods TfNSW T114, T171, T213, T239, T276: 1 per 4,000 tonnes
- (iii) for Test Method TfNSW T215, provided that for the six previous Lots actually tested, all tests have met specification requirements for both Wet Strength and Wet/Dry Strength Variation, then:
 - where all Wet/Dry Strength Variation results are < 25%: 1 per 10,000 tonnes
 - where all Wet/Dry Strength Variation results are < 30%: 1 per 4,000 tonnes
 - in all other cases: 1 per 2,000 tonnes
- (iv) for Test Method TfNSW T219:
 - where test results are < 0.1%: 1 per 10,000 tonnes
 - where test results are < 0.3%: 1 per 4,000 tonnes

- (v) for Test Methods TfNSW T219 and T239, the Principal may grant an exemption to carry out test upon request in accordance with the footnotes for Table 3051.3.

ANNEXURE 3051/M – REFERENCED DOCUMENTS

Refer to Clause 2.4.

TfNSW Specifications

TfNSW D&C Q6	Quality Management System (Type 6)
TfNSW D&C R71	Construction of Unbound and Modified Pavement Course
TfNSW D&C R73	Construction of Plant Mixed Heavily Bound Pavement Course
TfNSW D&C R75	Insitu Pavement Stabilisation Using Slow Setting Binders
TfNSW D&C R76	Insitu Pavement Stabilisation Using Foamed Bitumen
TfNSW D&C 3153	Reclaimed Asphalt Pavement Material
TfNSW D&C 3154	Granulated Glass Aggregate

TfNSW Test Methods

TfNSW T100	Sampling Road Construction Materials (Soil, Gravel, Sand, Aggregate, Rock and Recycled Products)
TfNSW T102	Pretreatment of Road Construction Materials by Compaction
TfNSW T103	Pretreatment of Road Construction Materials by Artificial Weathering
TfNSW T105	Preparation of Samples for Testing (Soils)
TfNSW T106	Coarse Particle Size Distribution of Road Construction Materials (By Dry Sieving)
TfNSW T107	Fine Particle Size Distribution of Road Construction Materials
TfNSW T108	Liquid Limit of Road Materials
TfNSW T109	Plastic Limit and Plasticity Index of Road Construction Materials
TfNSW T111	Dry Density/Moisture Relationship of Road Construction Materials
TfNSW T112	Dry Density/Moisture Relationship of Road Construction Materials (Modified Compaction)
TfNSW T114	Maximum Dry Compressive Strength of Road Construction Materials
TfNSW T116	Unconfined Compression Strength of Remoulded Road Construction Materials
TfNSW T117	California Bearing Ratio of Remoulded Specimens of Road Construction Material
TfNSW T131	Unconfined Compressive Strength of Road Construction Materials (Blended in the Laboratory with Cementitious Binders)
TfNSW T134	Lime or Cement Content of Uncured Stabilised Soil (EDTA Method)
TfNSW T171	Modified Texas Triaxial Compression Test for Pavement Materials
TfNSW T213	Particle Shape by Proportional Calliper
TfNSW T215	Wet/Dry Strength Variation
TfNSW T219	Acid Soluble Sulfate Content in Road Construction Materials
TfNSW T239	Fractured Faces of Coarse Aggregate

TfNSW T276 Foreign Materials Content of Recycled Crushed Concrete

Australian Standards

AS 1289 Methods of testing soils for engineering purposes

AS 1289.3.6.1 Soil classification tests – Determination of the particle size distribution of a soil – Standard method of analysis by sieving

AS 1289.6.7.2 Soil strength and consolidation tests – Determination of permeability of a soil – Falling head method for a remoulded specimen

AS/NZS ISO 9001 Quality Management Systems – Requirements

ASTM Standards

ASTM E178-16 Standard Practice for Dealing with Outlying Observations