

# Roads

## Master Specification

### RD-EW-C1 Earthworks

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## Document Management

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## RD-EW-C1 Earthworks

### 1 General

- 1.1 This Part specifies the requirements for the construction of earthworks, including proof rolling, treatment of unsuitable material, excavation, the construction of fill, verges, levees, catch drains, earth side drains / swales, spreading of topsoil and spreading of mulch.
- 1.2 Any information known to the Principal regarding the condition or nature of the existing ground, including existing pavements, will be included in report(s) of investigation and / or the Contract Documents.
- 1.3 The Contractor must construct earthworks in accordance with the drawings and the Contract Documents.

### 2 Quality requirements

- 2.1 The Contractor must prepare and implement an Earthworks Management Plan that includes (where appropriate):
  - a) calculations of earthworks quantities (in cubic metres solid) and a mass – haul diagram;
  - b) assumed Bulking Factors;
  - c) table showing the estimated quantities of material excavated from the site, imported and spoiled;
  - d) nominated dump site;
  - e) overview of plant proposed to be used;
  - f) cross reference to Inspection and Test Plans;
  - g) methodology for managing any industrial by-products or recycled material used as fill;
  - h) methodology for placement and compaction of material (including management of moisture content), particularly for General Fill, Oversize Material and Type D Material; and
  - i) details of proposed haulage routes and copy of agreement with Council.
- 2.2 If not submitted previously, the Earthworks Management Plan must be submitted at least 28 days prior to the commencement of site work.
- 2.3 Provision of the Earthworks Management Plan shall constitute a **Hold Point**.

### 3 Materials for earthworks

#### Material Classification

- 3.1 Subject to Clause 3.5 "Unsuitable Material", material is classified in accordance with Table RD-EW-C1 3-1.

**Table RD-EW-C1 3-1 Material classification**

Classification	A	B	C	General Fill (GF)	Oversize	D
Material Type	Sand-clay, Sand, Rubble, Quarry or Pit overburden or by-product	Sand-clay, Sand, Rubble, Quarry or Pit overburden or by-product	Sand-clay Sand, Clay, Rubble, Quarry or Pit overburden or by-product	Refer to Contract Documents	Refer note <sup>(3)</sup>	Other material
Max. Particle Size (mm)	75	106	150	150	500	500

Classification	A	B	C	General Fill (GF)	Oversize	D
Particle Size Distribution (% passing)						
75 mm	100	-	-		-	-
37.5 mm	80-100	80-100	80-100		<20	-
0.075 mm	0-25	0-35	0-35		-	-
Max. Plasticity Index (%)	12	15	-	Refer to Contract Documents	-	-
Max. Linear Shrinkage (%)	6	7	-		-	-
Max. Weighted Plasticity Index <sup>(1)</sup>	1000	1200	1500		-	-
Shrink Swell Index Iss (%)	≤0.4	≤0.7	≤1.1		-	-
Emerson Class Number	-	-	>2			
Mica, shale and similar laminated materials <sup>(2)</sup>	Not permitted	Not permitted	Not permitted	Not permitted	Not permitted	Permitted

(1) The Weighted Plasticity Index (WPI) is defined as the value of the plasticity index (PI) multiplied by the % passing the 425 micron sieve. The Contractor must provide the calculations to verify the WPI.

(2) Mica, shale and similar laminated materials, adherent coatings or other foreign material must not be present in form or sufficient quantity to produce adverse effect upon the usage and performance of the material.

(3) Oversize Material does not meet Type A, B or C criteria, but is capable of being compacted in accordance with Table RD-EW-C1 9-2.

(4) Organic material must not be present in structural fill.

## Industrial By-products or Recycled Material

- 3.2 The use of industrial by-products or recycled material is conditional upon the Contractor providing evidence that the material will not cause any detrimental environmental effects and that it complies with RD-PV-S1 "Supply of Pavement Materials", Section "Recycled Materials and Blast Furnace Slag".
- 3.3 Provision of this evidence and any associated procedures shall constitute a **Hold Point**.
- 3.4 If existing asphalt or stabilised pavement is to be recycled insitu, the maximum particle size must not exceed 75 mm. The method of breaking the material down and the method of compaction must be addressed in the Earthworks Management Plan.

## Unsuitable Material

- 3.5 "Unsuitable Material" is defined as material which is unsuitable for the support of pavement or layers of fill. It includes material which:
- exhibits deformation, rutting, softness, yielding, distress or instability under proof rolling or the loading from any construction machinery;
  - contains topsoil, peat or any organic material;
  - contains soluble material such as gypsum or rock salt; or
  - is susceptible to scouring, is dispersive and has an Emerson Class number 1 or 2.

## 4 Site preparation

### General

- 4.1 This Clause specifies the requirements for preparation of the site prior to the commencement of construction, which may include demolition of existing structures, clearing and grubbing and stripping of topsoil.
- 4.2 Site preparation must be restricted to the minimum area practicable and must not take place outside the area defined by the plan area of the Works ("Footprint") and an additional 1.0 m beyond the Footprint. Generally, clearing and grubbing and stripping of topsoil must not take place more than 14 days prior to earthworks commencing and must consider existing soil moisture conditions.

### Clearing and Grubbing

- 4.3 All vegetation must be removed in accordance with PC-ENV2 "Environmental Protection Issues". Loose material, rubbish and existing structures (including fences, retaining walls, concrete slabs, service pits, tree stumps, kerbing, abandoned services and obsolete underground drainage lines) within the zone of earthworks construction defined in Clause 4.1 "General" must be removed to a depth of not less than 300 mm below the:
  - a) subgrade level and batters in areas of cut; and
  - b) stripped surface in areas of fill.
- 4.4 Unless specified otherwise, grubbed holes (and any area requiring filling due to the removal of a structure) must be backfilled with Type (A) Material compacted in accordance with Clause 14 "Verification Requirements". Inspections are required by the Minister's representative prior to backfilling and constitute a **Hold Point**. Refer to PC-ENV2 "Environmental Protection Issues" for requirements relating to the removal of cleared, grubbed and demolished materials.

### Topsoil Stripping

- 4.5 The Contractor must strip any topsoil present within the Footprint. Unless specified otherwise, the depth of stripping must be 100 mm and the topsoil must be windrowed or stockpiled prior to respreading on completed batter slopes.

## 5 Proof rolling

- 5.1 Proof rolling is the process of identifying any unsuitable material by moving heavy plant over the subgrade or existing surface and observing the resultant deformation in the underlying material. Material which is observed to move under the loading of the plant is deemed to be Unsuitable Material.
- 5.2 Proof rolling must:
  - a) in fill, cover all of the existing underlying material which will be covered by fill;
  - b) in cut, cover all of the formation;
  - c) be carried out as soon as practicable, and in any case not later than 2 days, after topsoil stripping / clearing and grubbing (in areas of fill) or completion of the formation (in areas of cut);
  - d) where soft ground conditions are present, be carried out after ground improvement processes (e.g. placement of geogrid, ballast and / or working platforms) have been completed; and
  - e) be undertaken prior to any hauling over the prepared area.
- 5.3 The plant must move at walking pace (between 3 and 10 km/h) when undertaking proof rolling.
- 5.4 Except for small areas, proof rolling must be undertaken by a minimum of 3 passes of heavy plant which complies with the following:
  - a) a pneumatic multi-wheel roller with a mass > 24t; or
  - b) a fully loaded tandem truck or water cart of minimum 10 kl capacity which:

- i) has ground contact pressure under either the front or rear wheels of not less than 450 kPa per tyre;
  - ii) has a ground contact area which is not less than 0.035 m<sup>2</sup> per tyre, and
  - iii) follows a rolling pattern that ensures the entire ground surface is subject to the specified number of passes.
- 5.5 In small areas where the above plant will not fit, at least 6 passes of the heaviest plant practicable must be used for proof rolling. A leg rammer may be used, but a plate compactor is not acceptable.
- 5.6 For the purposes of this clause, “pass” means the movement of the plant in a single direction. If the observation of deformation is inconclusive or the extent of unsuitable material is unclear, additional passes must be undertaken until a determination regarding the suitability of the material can be made.
- 5.7 The Contractor must ensure that plant complying with the above requirements is on site during all earthworks, fill, subgrade and pavement operations. If payment for proof rolling is to be made at Day work rates, separate payment will not be made for the transportation of the plant around the site. Proof rolling must not be carried out over any Utility Services without prior notification to the Utility Service Authority.

## 6 Excavation

### General

- 6.1 Excavation works must be carried out in compliance with:
  - a) DPTI: Master Specification Part RD-EW-C4 “Trench excavation and backfill”.
  - b) Excavation work code of Practice - Safe Work Australia.
  - c) Work Health and Safety (Excavation Work) Code of Practice.
- 6.2 Where excavation is carried out adjacent to existing sealed pavements, saw cutting or planing must be carried out to the depth of the existing pavement / asphalt. Excavation by cold planing must be carried out in accordance with RD-EW-C6 “Cold Planing”.

### Rock strength materials

- 6.3 This sub-clause only applies where the Contractor is entitled to additional payment for rock excavation under the terms of this Contract. Material is deemed to be rock if the production rate specified in Table RD-EW-C1 6-1 cannot be achieved.

**Table RD-EW-C1 6-1 Excavation rates for rock strength materials**

PLANT (Refer CCF Plant Specs)	EXCAVATION RATE cubic metres (loose) per hour
Class 20 Excavator	30
Class 20 Dozer - Crawler	150
Class 60 Excavator	120

- 6.4 The machine employed must be in good condition, with matching heavy duty, single tyne ripper or rock bucket fitted with rippers and operated by an experienced operator.
- 6.5 If the Contractor considers that rock has been encountered and seeks payment pursuant to this subclause, a **Hold Point** shall apply.

## 7 Preparation of the existing surface under fill and the subgrade in cut

### General

- 7.1 This Clause applies at the completion of clearing and grubbing and topsoil stripping in accordance with Clause 4 "Site Preparation" in areas of fill and at the completion of excavation in cuts.

### Assessment and Treatment of Existing Material

- 7.2 Prior to the placement of fill or pavement, the Contractor must provide a notice and arrange for a joint inspection and joint survey of the ground surface for the purpose of identifying unsuitable material, the foundation surface condition and the bed design elevation.
- 7.3 Provision of the notice shall constitute a **Hold Point** unless not addressed in the Earthworks Management Plan or the Contract Documents.
- 7.4 The assessment will be undertaken in the form of a visual assessment and by proof rolling of the areas of ground surface in accordance with Clause 5 "Proof Rolling". The Contractor must trim these areas prior to proof rolling. For the purpose of undertaking proof rolling in areas of cut, the Contractor may elect to excavate and trim the earthworks to within 50 mm of the final subgrade level before undertaking proof rolling.
- 7.5 Prior to placing fill or pavement, any unsuitable material identified must be:
- a) removed and replaced with suitable compacted material; or
  - b) treated (e.g. by installing geotextile or stabilising the material).
- 7.6 To make the subgrade fit for its intended purpose:
- a) Any filling required must be placed with a minimum thickness of 150 mm.
  - b) Where the material underlying a fill is either existing pavement or the existing formation of an unsealed road, the area must be scarified and Type (A) Material placed such that the thickness of loose material is not less than 150 mm, prior to compaction in accordance with Clause 9 "Fill Construction".
  - c) Following Proof Rolling and / or treatment in accordance with this Clause, the Contractor must ensure that water does not pond on the surface and the earthworks material properties do not deteriorate.

## 8 Geotextiles

### General

- 8.1 This Clause applies where the earthworks design incorporates geotextile for the purpose of filtration, drainage or separation. Geotextiles must be supplied in accordance with RD-EW-S1 "Supply of Geotextiles" and must be placed in accordance with the manufacturer's instructions, unless amended by this clause.

### Site Preparation over Soft Soils

- 8.2 The site must be prepared by clearing and grading the area required. All sharp objects and large stones must be removed. If the earthworks design specifies that site preparation in accordance with Clause 4 "Site Preparation" is not required, the topsoil and vegetation mat may remain with any trees and shrubs cut flush with the ground surface.
- 8.3 Geotextiles must be placed without puncture or tears ahead of associated construction works and be covered by relevant construction materials or suitable protective sheeting within 48 hours of placement. Geotextiles used in trench drains must be placed so as to conform loosely to the shape of the trenches. The geotextile must fully envelop the drainage material in the trench.



## Initial Layer Thickness Requirements for Separation Applications

- 8.4 The minimum required initial layer thickness for fill material placed directly over the geotextile must meet the requirements specified in Table RD-EW-C1 8-1.

**Table RD-EW-C1 8-1 Minimum initial layer thickness**

Nominal Maximum Fill Particle Size D85 (mm)	Minimum Initial Layer Thickness (mm)
< 150	The largest of 3 times Maximum Fill Particle Size or 200 mm minimum.
150 – 225	450 mm.
225 – 400	Two times Maximum Fill Particle Size.

## Joining

- 8.5 Joining of geotextiles must be by overlap or by sewing. Unless otherwise specified, the minimum overlap must be 500 mm. Where the geotextile is used for drainage blankets the encapsulated overlap must be one metre unless otherwise specified. As an alternative to overlapping, sewing of seams is permitted. Sewing of joins must comply with the following:
- a) Seam Type: J seam or double J seam.
  - b) Stitch Type: Double thread lock stitch. Two lines of stitching must be used.
  - c) Thread Type: Polyester thread 300 tex (minimum).
- 8.6 If it is necessary to measure geotextile for payment purposes, the measurement must be based on the final surface area covered, with no allowance for any overlaps.
- 8.7 Checking of the joints, the proposed initial layer thickness and the plant to be used for compaction will be made and will constitute a **Hold Point**.

## Filling over Installed Geotextile

- 8.8 Construction equipment must not stand or travel directly on the laid geotextile. A minimum cover of 200 mm (uncompacted) of cover material must be placed over the geotextile prior to construction equipment travelling over the area concerned. Rock armour placed directly on the geotextile must be placed with a drop height not exceeding 1.0 m.
- 8.9 The mechanical equipment must be selected and operated so as not to cause rupture of the geotextile. Vibratory and heavy compaction plant must not be used on the initial lifts of filling material.

# 9 Fill construction

## General

- 9.1 Type (A) Material must be used within 0.5 m of the underside of the pavement.
- 9.2 Fill material must be placed and compacted uniformly in layers in accordance with Table RD-EW-C1 9-1.

**Table RD-EW-C1 9-1 Fill construction**

Maximum Particle Size of Fill Material (mm)	Layer Thickness (mm loose)	Compaction	Moisture Content when Compacted
150 or less: Types A, B and C	150 to 200	In accordance with Clause 14 "Verification Requirements and Records".	OMC $\pm$ 2%
150 or less: General Fill	150 to 200	In accordance with the Contract Documents.	In accordance with the Contract Documents.

Maximum Particle Size of Fill Material (mm)	Layer Thickness (mm loose)	Compaction	Moisture Content when Compacted
> 150	Minimum layer thickness of one and a half times the maximum particle size, or 300 mm, whichever is greater.	In accordance Table RD-EW-C1 9-2.	In accordance with the Earthworks Management Plan.

## Placement of Oversize Material

9.3 Material with a maximum particle size of 150 mm or more must:

- not be placed within 500 mm of the underside of the pavement;
- have the top surface of the material blinded with Type A or B Material to fill surface voids before the placement of subsequent layers; and
- be compacted using of vibrating drum rollers in accordance with Table RD-EW-C1 9-2.

**Table RD-EW-C1 9-2 Compaction of oversize material**

Minimum Roller Classification* (Refer CCF Plant Specs)	Maximum Layer Thickness	Minimum Number of Passes
Class 5	300	6
Class 10	500	6
Class 12.5	750	6

\*The minimum static mass on the vibrating drum must be 4.5 tonnes.

9.4 Where alternative compaction specifications for oversized material are proposed verification test methods and frequencies are required to be submitted.

## Placement of General Fill

9.5 General Fill must be placed and compacted in accordance with the requirements specified in the Contract Documents. Compaction of General Fill must be determined by Standard Compaction in accordance with AS 1289.5.1.1.

## Placement of Type D Fill

9.6 Where the use of Type D materials is permitted, it must be placed and compacted in accordance with the Earthworks Management Plan to achieve a stable fill.

## Miscellaneous

- All filling must be supervised by a qualified civil / geotechnical engineer or earthworks site supervisor to address any issues related to fill construction.
- Where new embankment fill is to be placed against an existing surface which is steeper than 3 horizontal to 1 vertical, benching within the existing surface must be carried out to allow placement of fill in layers. The width of benches must be 1 m minimum and must be constructed at 0.5 m vertical intervals to create a stepped surface.
- The Contractor must maximise the usage of suitable material excavated from the site, which may involve double handling, to minimise the requirement for imported fill.
- Any noise mounds must not contain material with a particle size greater than 150 mm and must contain more than 20% finer than 0.075 mm particle size. Notwithstanding Sub-Clause 9.2, fill in noise mounds may be compacted in layers up to 300 mm loose depth.
- During construction surface grades shall be cut to allow for drainage of surface water to low points where removal of water is possible in a timely manner to prevent softening of subgrade soils or destabilisation of nearby cuttings and retaining structures.

## 10 Completed surface of the subgrade and batters

- 10.1 The levels of points not detailed on the drawings must be determined by linear interpolation. The surface must be constructed to within the tolerances specified in Clause 14 "Verification Requirements and Records" at all interpolated and discrete points.
- 10.2 Lines, grades, cross-sections, levels, dimensions and tolerances specified in the Contract Documents do not include an allowance for a layer of topsoil.
- 10.3 Batters must be constructed to the slopes shown on the drawings. The slope of all batters must be even and consistent from top to bottom and free from abrupt changes in level. Tops of batters must be rounded over the width shown on the drawings to reduce erosion.
- 10.4 The Contractor must ensure that subgrade has a tight dense surface and does not deteriorate after proof rolling or verification testing. Completed sections of subgrade must be maintained in a well-drained condition.
- 10.5 Where the subgrade occurs in rock, the excavated surface must be blinded with subbase material and graded, shaped and compacted to produce a tight dense surface.

## 11 Treatment of the constructed surface

### General

- 11.1 For the purpose of this clause only "Constructed Surface" means any location within the Site where the ground surface is disturbed or altered, excluding a hard surface such as pavement, footpath, compacted rubble or exposed bedrock.
- 11.2 The Contractor must:
  - a) apply the treatment specified in the Contract Documents to the Constructed Surface; and
  - b) comply with this clause until Completion.
- 11.3 Material placed near the surface of batters (including imported topsoil) must exhibit sufficient properties such that:
  - a) the surface is highly resistant to surface scour and erosion;
  - b) in cuts, any material which becomes detached is prevented from reaching the road shoulder; and
  - c) there is no undermining or destabilisation of any existing batter slopes or structures.
- 11.4 The Contractor must repair any surface scour and erosion that occurs prior to the establishment of permanent or temporary stabilisation or revegetation.

### Cut-off Drains

- 11.5 Cut off drains are not to be constructed unless specified on the drawings. If specified, open trench "V" drains must be constructed and maintained on the top of batters for the full length of the cutting prior to commencement of excavation in cuttings.

### Spreading of Topsoil

- 11.6 Topsoil must be spread on all of the Constructed Surface where shown on the drawings. The layer thickness must be as uniform as practicable and the surface of the topsoil after spreading must be free of lumps greater than 50 mm maximum dimension.
- 11.7 Any remaining topsoil stockpiles must be rounded off with batters of maximum slope of 6 horizontal to 1 vertical. All topsoil won from the works must be used before any topsoil is imported.

## Weed Control

- 11.8 The Contractor is responsible for the control of all declared and environmental weeds on the Constructed Surface. Weed control must be undertaken in accordance with PR-MA-M1 "Control of Weeds and Herbicide Control of Roadside Vegetation". Unless specified otherwise in the Contract Documents, the Contractor is responsible for determining the details of the slashing frequency and / or herbicide application (including chemical used and application rate).

## Surface Treatment

- 11.9 If details of the treatment of the Constructed Surface is not provided in the Contract Documents, the Contractor is responsible for determining all details necessary for ensuring that the treatment is successful for the design life of the treatment, such as the method of seedbed preparation / sowing and fertiliser application.
- 11.10 Provision of these details shall constitute a **Hold Point**.
- 11.11 Treatments applied to the Constructed Surface must comply with the following:
- Erosion Control Matting: PR-LS-C1 "Erosion Control Matting".
  - Hydroseeding: PR-LS-C6 "Hydroseeding".
  - Direct Seeding: PR-LS-C7 "Direct Seeding".
  - Maintenance: PR-LS-M2 "Maintenance of Hydroseeded and Direct Seeded Areas".
  - Mulch: Where vegetation from the works has been mulched and is suitable for use on the earthworks in accordance with the Environmental Management Plan, the mulch must be spread at an even thickness over the specified area.

## 12 Test procedures

- 12.1 The Contractor must use the following test procedures (refer [https://www.dpti.sa.gov.au/contractor\\_documents](https://www.dpti.sa.gov.au/contractor_documents)) to verify conformance with the Specification:

**Table RD-EW-C1 12-1 Test procedures**

Test		Test Procedure
Sampling of Soil, Aggregates and Rocks		TP 226
Preparation of Samples		AS 1289.1
Site Selection by Stratified Random Technique		AS 1289.1.4.2
Field Density:	Nuclear Method	AS 1289.5.8.1
Moisture Content:	Oven Drying Method	AS 1289.2.1.1
	Microwave Method	AS 1289.2.1.4
Maximum Dry Density:	Standard Compaction*	AS 1289.5.1.1
	Modified Compaction	AS 1289.5.2.1
	Three Point Method	TP 164
Dry Density Ratio		TP 320
Emerson Class		AS 1289.3.8.1
Particle Size Distribution		TP 134
Plasticity Index		TP 141
Linear Shrinkage		AS 1289.3.4.1
Shrink Swell		AS 1289.7.1

\* Used for General Fill only.

## 13 Hold points

The following is a summary of Hold Points referenced in this Part:

Document Ref.	Hold point	Response time
2.3	Earthworks Management Plan	5 working days
3.3	Proposed use of industrial by-products or recycled material as fill	2 working days

Document Ref.	Hold point	Response time
4.4	Clearing and grubbing	1 working day
6.5	Notification that rock has been encountered	1 working day
7.3	Notice prior to a joint Inspection and joint survey of existing surface	1 working day
8.7	Checking joining of geotextile and initial layer thickness	1 working day
11.10	Provision of earthworks surface treatment details	2 working days

## 14 Verification requirements and records

The Contractor must supply written verification that the following requirements have been complied with and supply the verification with the lot package.

**Table RD-EW-C1 14-1 Verification requirements**

Document Ref.	Subject	Property	Test procedure	Test frequency	Acceptance limits
3.1.	Fill Material Properties	Grading	TP 134 AS 1152	One test per lot	Refer Table RD-EW-C1 3-1
		Plasticity Index	TP 141	One test per lot	Refer Table RD-EW-C1 3-1
		Linear Shrinkage	AS 1289.3.4.1	One test per lot	Refer Table RD-EW-C1 3-1
		Emerson class number	AS 1289.3.8.1	One test per day's production	Classified as Emerson Class number 3 or higher
		Shrink Swell Index	AS 1289.7.1	One test per lot	Refer Table RD-EW-C1 3-1
		Weighted Plasticity Index	Refer Clause 3	One test per lot	Refer Table RD-EW-C1 3-1
8, 9, 10, 11	Earthworks levels and position	Variation in subgrade level:	As specified in Part PC-QA3	As specified in Part PC-QA3	Within + 0, - 40 mm of design level
		Variation in lateral position:	As specified in Part PC-QA3	As specified in Part PC-QA3	Within ± 50 mm of design level
		Variation of reduced levels of fill batters:	As specified in Part PC-QA3	As specified in Part PC-QA3	Within ± 75 mm of design level
		Variation of reduced levels of open drains:	As specified in Part PC-QA3	As specified in Part PC-QA3	Within ± 50 mm of design level with the proviso that, notwithstanding tolerances, open drains must be self-draining.
9	Earthworks Compaction	Type A Material in top 150 mm of fill	TP 320	1 test per 500 square metres with a minimum of 4 tests per lot*.	Compaction: Not less than 95% Modified Moisture Content: OMC ± 2%
		Type A Material other than in top 150 mm of fill	TP 320	1 test per 400 cubic metres or part thereof with a minimum of 4 tests per lot*.	Compaction: Not less than 92% Modified Moisture Content: OMC ± 2%
		Type B & C Material	TP 320	1 test per 400 cubic metres of compacted material or part thereof with a minimum of 4 tests per lot*.	Compaction: Not less than 90% Modified Moisture Content: OMC ± 2%

Document Ref.	Subject	Property	Test procedure	Test frequency	Acceptance limits
		General Fill	TP 320	1 test per 400 cubic metres of compacted material or part thereof with a minimum of 4 tests per lot*	Refer Contract Documents

\* Every layer must be tested