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DEVELOPMENT CONSTRUCTION SPECIFICATION

C213

EARTHWORKS

Amendment Record for this Specification Part

This Specification is Council's edition of the AUS-SPEC generic specification part and includes Council's primary amendments.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1	Measurement and Payment Clause "Pay Items" removed	C213.46	O	JM	19/2/99

SPECIFICATION C213 : EARTHWORKS

GENERAL

C213.01 SCOPE

1. The work to be executed under this Specification consists of:- ***Scope***

   (a) removal of topsoil

   (b) all activities and quality requirements associated with site regrading, the excavation of cuttings, the haulage of material and the construction of embankments to the extent defined in the Drawings and Specification.

   (c) removal and replacement of any unsuitable material,

   (d) any spoil or borrow activities associated with earthworks, and

   (e) any additional processing of selected material for the selected material zone.

C213.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. ***Documents Standards Test Methods***

(a) Council Specifications

C201	-	Control of Traffic
C211	-	Control of Erosion and Sedimentation
C212	-	Clearing and Grubbing
C220	-	Stormwater Drainage - General
C273	-	Landscaping

(b) Australian Standards

AS 1289.F1.1	-	Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen.
AS 1289.3.3.1	-	Calculation of the plasticity index of a soil.
AS 1289.5.1.1	-	Determination of the dry density/moisture content relation of a soil using standard compactive effort.
AS 1289.5.4.1	-	Compaction control test - Dry density ratio, moisture variation and moisture ratio.
AS 1289.5.7.1	-	Compaction Control Test (Rapid Method).
AS 2187		Explosives - Storage, transport and use (SAA Explosive Code)
		Part 1 Storage and land transport
		Part 2 Use of explosives

(c) Other

AUSTROADS	-	Explosives in Roadworks, Users Guide 1982.
EPA	-	Environmental Noise Control Manual.

C213.03 NATURAL SURFACE AND EARTHWORKS MATERIALS

(a) Natural Surface

1. The Contractor shall submit details of the Contractor's proposed survey system to the Principal for approval, prior to commencement of clearing and grubbing or earthworks.

Contractor's Survey System

2. Computer generated road design data files containing the ground model surface may be supplied to the Contractor in the format of the approved software as outlined in Information for Tenderers. If desired, the Contractor, may verify the accuracy of the model by field surveys. If the Contractor considers any areas of the model not to be representative or submitted plans to be inaccurate the Contractor shall give not less than seven (7) days notice to the Superintendent to allow checking. However, if the subsequent check survey reveals the ground model to be correct, then the Contractor shall bear the cost of the check survey.

Verify Accuracy of Ground Model

(b) Earthworks Materials

1. The Contractor shall be responsible for any assumptions made by the Contractor in relation to the nature and types of the materials encountered in excavations and the bulking and compaction characteristics of materials incorporated in embankments.

Material Characteristics

2. The estimated quantity for general earthworks at any cutting includes all types of materials which may be encountered in the cutting.

3. Where material from excavations is acceptable for use in embankments, but the Contractor elects to:-

Embankment Material Deficiency

(a) Spoil it, or

(b) Use it for the Contractor's own purposes, or

(c) Use it as a source of pavement materials, or

(d) Construct embankments with dimensions in excess of those specified.

and a deficiency of material for embankment construction is thereby created, the Contractor shall make good that deficiency from sources of material meeting the quality requirements specified in Clause C213.23. The cost of making good such deficiency of material shall be borne by the Contractor.

Contractor's Cost

C213.04 PROTECTION OF EARTHWORKS

1. The Contractor's responsibility for care of the Works shall include the protection of earthworks.

Contractor's Responsibility

2. The Contractor shall install effective erosion and sedimentation control measures in accordance with the Specification for CONTROL OF EROSION AND SEDIMENTATION, prior to commencing earthworks, and shall maintain these control measures for the duration of the contract.

Erosion and Sedimentation Control

3. Adequate drainage of all working areas shall be maintained throughout the period of construction to ensure run-off of water without ponding, except where ponding forms part of a planned erosion and sedimentation control system.

Drainage of Working Areas

4. When rain is likely or when work is not proposed to continue in a working area on the following day, precautions shall be taken to minimise ingress of any excess water into earthworks material. Ripped material remaining in cuttings and material placed on embankments shall be sealed off by adequate compaction to provide a smooth tight surface. ***Wet Weather Precautions***

5. Should insitu or stockpiled material become over wet as a result of the Contractor not providing adequate protection of earthworks, the Contractor shall be responsible for replacing and/or drying out the material and for any consequent delays to the operations. ***Wet Material***

C213.05 SETTING OUT OF EARTHWORKS

1. Before earthworks operations commence and after survey controls are in place, batter profiles shall be established by the Contractor and the necessary pegs driven at 25 m intervals or at each cross section shown on the Drawings, whichever is the lesser. The chainage/station, offset from control line and slope distance to finished surface level, shall be clearly marked on each peg. ***Batter Profiles***

2. The batter profiles shall be repositioned by the Contractor at each change in the slope of the batter and at intervals of not more than 5 m of vertical height. ***Profile Location***

3. All pegs and batter profiles shall be maintained in their correct positions. They shall be removed by the Contractor on completion of the contract or separable part. ***Retention and Removal of Pegs***

4. The foregoing shall be the minimum requirement. Additional pegs and profiles may be required to suit the Contractor. These shall not be painted with the same colours used for the specified setting out pegs and stakes. ***Additional Pegs***

5. The position and extent of all transitions from cuttings to embankments and foundations for shallow embankments shall be marked with clearly labelled stakes in accordance with Clauses C213.15 and C213.24. ***Transitions Cuttings/ Embankments***

C213.06 STOCKPILE SITES

1. The Contractor shall obtain the written consent of the Superintendent to the use of any stockpile site which is not shown on the Drawings. Proposals in this regard shall be submitted at least three working days before stockpiling is due to commence and shall specify the maximum dimensions of the proposed stockpile. ***Additional Stockpile Sites***

2. Any clearing and grubbing required for these sites shall be carried out in accordance with the Specification for CLEARING AND GRUBBING. Temporary erosion and sedimentation control measures shall be taken in accordance with the Specification for CONTROL OF EROSION AND SEDIMENTATION. ***Clearing and Grubbing***

3. Restoration of stockpile sites following completion of the work shall be carried out in accordance with the Specification for LANDSCAPING. ***Restoration***

REMOVAL OF TOPSOIL

C213.07 SCOPE

1. Topsoil is surface soil which is reasonably free from subsoil, refuse, clay lumps and stones. ***Definition***

2. Removal of topsoil from any section of the Works shall only commence after erosion and sedimentation controls have been implemented and when clearing, grubbing and disposal of materials have been completed on that section of the Works. Topsoil throughout the length of the work shall be removed and stockpiled separately clear of the work with care taken to avoid contamination by other materials. ***Prerequisites***

3. The work shall include the following:- ***Extent of Work***

(a) Cuttings

Removal of the topsoil to a depth quoted in Annexure C213A or as directed by the Superintendent.

(b) Embankments

Removal of topsoil over the base of embankments up to the depth below the natural surface quoted in Annexure C213A, or as directed by the Superintendent. For those embankments or sections of embankment where the height of embankment from natural surface to underside of pavement is less than two metres, topsoil which is deeper than the depth quoted in Annexure C213A shall be removed to its full depth as directed by the Superintendent.

(**c) Other Locations**

Removal of topsoil as directed by the Superintendent.

C213.08 SURVEY AFTER REMOVAL OF TOPSOIL

1. Where payment is on a 'Schedule of Rates' basis, and unless alternative arrangements have been made by the Superintendent, after removing the topsoil the Contractor shall determine the surface levels in each cutting and embankment at sufficient locations to determine the volume of excavation for general earthworks and the volume of compacted fill. A schedule of these surface levels shall be submitted to the Superintendent for concurrence at least three working days before commencement of any work which will alter the ground surface as surveyed. Such work shall only commence with the approval of the Superintendent. ***Establish Surface Level***

C213.09 TOPSOIL STOCKPILES

1. Where payment is on a 'Schedule of Rates' basis, at least three working days before stockpiling of topsoil at any site, the Contractor shall submit, for the approval of the Superintendent, a site survey which will be sufficient to subsequently measure the volume placed in stockpile. ***Site Survey***

2. The maximum height of stockpiles shall not exceed 2.5 m and the maximum batter slope shall not exceed 2:1. ***Height and Batter***

3. Topsoil stockpiles shall not contain any timber or other rubbish and shall be trimmed to a regular shape. ***Stockpiles Trimmed***

4. To minimise erosion, stockpile batters shall be track rolled or stabilised by other means acceptable to the Superintendent. ***Erosion Control***

5. Where seeding of stockpiles to encourage vegetation cover is specified, such work shall be carried out in accordance with the Specification for LANDSCAPING. ***Seeding Stockpile***

CUTTINGS

C213.10 SCOPE

1. Construction of cuttings shall include all operations associated with the excavation of material within the limits of the batters including benching, treatment of cutting floors and transition from cut to fill. ***Extent of Work***

C213.11 EXCAVATION

1. Materials encountered in cuttings shall be loosened and broken down as required so that they are acceptable for incorporation in the Works. In this regard, the Contractor's attention is drawn to Clauses C213.21, C213.22 and C213.23.

2. Cuttings shall have batter slopes as shown on the Drawings or as redetermined by the Superintendent on the basis of site inspection and investigation during the excavation. ***Batter Slopes***

3. The tops of all cuttings shall be neatly "rounded".

4. In all cuttings, undulations in the general plane of the batter shall not be permitted except that batters may require progressive flattening at the ends of cuttings due to the presence of less stable material. ***Batters to be Even***

5. Cut faces shall be cleaned of loose or unstable material progressively as the excavation proceeds. ***Unstable Material***

6. Where, after the removal of topsoil as specified in Clause C213.07, material of variable quality or moisture content is encountered, the Contractor shall adjust his excavation methods to ensure blending of the materials, to obtain material meeting the requirements of Clause C213.23. ***Blending Material***

7. Where the Superintendent redetermines the batter slope of any section of a cutting after it has been completed in accordance with this Clause, the Superintendent shall order a Variation to the Contract for the resetting out, removal of additional material and retrimming of the batter. This Variation shall include all additional costs incurred by the Contractor who shall not have any further claim upon the Principal as a result of the redetermination of the batter slope. ***Variation for Batter Slopes***

C213.12 BATTER TOLERANCES

1. The tolerances for the excavation of batters, measured at right angles to the design grade line, shall be ± 300mm. ***Batter Tolerances***

2. If the Contractor excavates the batter beyond the batter slope line and the tolerance applicable thereto, the Superintendent may authorise a minor change in the general slope of the batter to suit the convenience of the Contractor, but such a change shall not be regarded as a redetermination of the batter slope under Clause C213.11. The cost of any increase in excavation quantities resulting from such change in batter slope shall be borne by the Contractor. Alternatively the Contractor shall submit details of the material and/or methods proposed to restore the specified slope and stability of the batter for the Superintendent's approval. ***Excavation beyond Batter Line*** ***Contractor's Cost***

3. For batters steeper than 1:1, if any section of the batter up to a height of 3m above the table drain level has been over excavated beyond the tolerance limit specified, ***Restoration of Batter Slope***

the Superintendent may direct that the batter be restored to the average batter slope using randomly mortared stone. The stone shall be similar to the sound rock in the cutting and the mortar shall be coloured to match the colour of the rock.

4. The cost of restoring batters shall be borne by the Contractor. ***Contractor's Cost***

C213.13 BENCHING IN CUTTINGS

1. Cut batters shall be benched as shown on the Drawings to provide drainage and erosion control. Notwithstanding the tolerances permitted under Clause C213.12, bench widths shall not be less than those shown on the Drawings. ***Bench Construction***

2. Benches shall be maintained and cleaned of loose stones and boulders regularly throughout the Contract period. The cost of such maintenance and cleaning of benches shall be borne by the Contractor. ***Bench Maintenance Contractor's Cost***

C213.14 TREATMENT OF FLOORS OF CUTTINGS

1. The floors of cuttings shall be excavated, parallel to the designed grade line, to a designed floor level which shall be at the underside of the selected material zone or where there is no selected material zone, to the underside of the pavement subbase. The floors shall then be trimmed to a level of not more than 50 mm above or below the designed floor level. ***Excavation Level***

2. The Contractor shall rip or loosen all material in the floor to a minimum depth of 200mm below the designed floor level for the width of the selected material zone (or subbase layer, where no selected material zone). The maximum dimension of any particles in the ripped or loosened zone shall not exceed 150mm. ***Floor Material Ripped***

3. Prior to ripping or loosening the cutting floor the Contractor shall determine the CBR of the material in the floor by AS 1289.F1.1. Sufficient tests shall be taken to represent all the various materials which may exist in the cutting floor. If material in the floors of cuttings has a CBR value less than the value quoted in Annexure C213A, the Superintendent will direct the action to be taken. ***CBR Testing***

4. Ripped or loosened material shall be made available for inspection by the Superintendent before recompaction commences. It shall be recompacted in accordance with Clause C213.36. No account shall be taken of the volume involved in loosening when measuring the volume of excavations. ***Inspection by Super-intendent***

5. After recompaction, the floors of cuttings shall be re-trimmed parallel with the finished wearing surface so that their levels do not vary more than 10 mm above or 40 mm below the designed floor levels. ***Level Tolerances***

C213.15 TRANSITION FROM CUT TO FILL

1. After the removal of topsoil and before the excavation of any cutting commences the Contractor shall survey and mark the position of the intersection line between cutting and embankment occurring at the underside of the selected material zone or pavement subbase. ***Intersection Line***

2. Following excavation to the cutting floor, a terrace shall be excavated for the width of the selected material zone (or subbase layer, where no selected material zone) to a depth of 600mm below and parallel to the cutting floor, as shown in Figure C213.1. ***Terrace Construction***

3. The terrace shall extend into the cut to the point where the cutting floor is 600mm below the original stripped surface, or a distance of 20 metres, whichever is the lesser. ***Extent of Terrace***

4. The material excavated shall be either incorporated in the embankments or spoiled as directed by the Superintendent. Material incorporated in embankments shall be included in the excavated volume for General Earthworks and material spoiled shall be included in the excavated volume of Unsuitable Material to Spoil.

Excavated Quantity

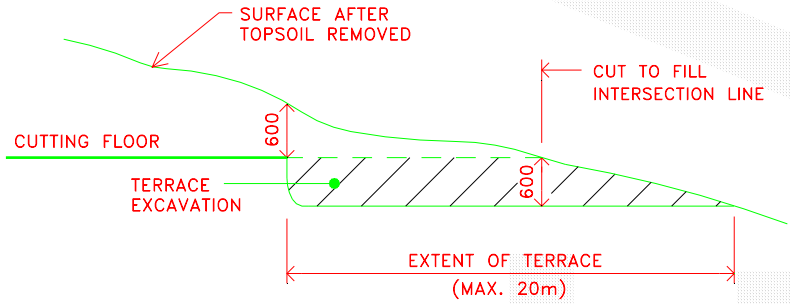

Figure C213.1 - Transition from Cut to Fill

5. The material placed above the terrace shall satisfy the requirements of Clause C213.23 and shall be compacted in accordance with Clause C213.36.

Quality and Compaction

BLASTING

C213.16 GENERAL

1. When explosives are permitted to be used, the Contractor shall obtain all necessary licences from the appropriate authorities, and shall comply with all Government and Council regulations relating to transport, storage, handling and the use of explosives and also to the rules set out in AS2187, Parts 1 and 2. The requirements of the Environment Protection Authority (EPA) shall be complied with.

Contractor to Obtain Licences

2. The Contractor shall be liable for any accident, damage or injury to any person, property or thing, resulting from the use of explosives.

Contractor's Responsibility

3. Before the start of blasting operations, the Contractor, in the presence of the Superintendent, shall conduct a survey to determine and record the existing condition of all structures likely to be affected by any blast.

Pre-blast Survey

4. Structures shall include public utilities. The survey shall include all structures within 500m of any blast but shall be extended where the maximum instantaneous charge proposed is likely to produce peak particle velocities greater than allowable at structures more remote from a blast site. A written report of the survey, supported by photographs where necessary, together with a list of any existing defects in the structures, shall be submitted to the owner of each structure and to the Superintendent before blasting commences.

Amendment Extent of Survey

5. The Contractor shall advise the Superintendent of the proposed maximum instantaneous charge and the Contractor's validation of the adequacy of the proposed structural survey at least three working days before the survey is due to commence. The Superintendent may direct amendments to the scope of the survey as a result of blast

Amendment to Extent of Survey

monitoring during the work. All costs associated with the surveys and reports shall be borne by the Contractor.

6. Before each blasting operation, the Contractor shall submit to the Superintendent written details of the proposed blasting procedure including the quantity and type of explosive to be detonated, the blasting pattern to be used and measures proposed to limit noise and to ensure that vibration from blasting does not adversely affect nearby structures. ***Proposed Blasting Procedure***

7. Ground vibration caused by blasting shall not exceed the values of peak particle velocity listed in Table C213.1: ***Ground Vibration***

Point of Potential Damage (within 1km of blasting site)	**Peak Particle Velocity**
Completed and cured bridge structures or sub-structures (eg completed abutment),	25 mm/sec
Bridgeworks and structural retaining walls under construction,	20 mm/sec
Residential premises, schools, hospitals and other buildings	5 mm/sec (with 10% not to exceed 10 mm/sec)
Buildings or monuments of historical significance	2 mm/sec

Table C213.1 - Limiting Peak Particle Velocity

8. The Contractor shall advise all residents within a radius of 1km, by letter drop before blasting operations commence, of the likely times, frequency and duration of blasting and precautions being taken to ensure that damage to property will not result. ***Advice to Residents***

9. Unless otherwise approved, blasting operations shall be confined to the periods Mondays to Fridays (excluding public holidays), 9am to 3pm. ***Time Limits***

10. When blasting operations are being carried out, precautions shall be taken relating to the safety of persons and animals and the road shall be closed to traffic and the appropriate signs erected in accordance with the Specification for CONTROL OF TRAFFIC. A standard warning procedure such as that given in the AUSTROADS Explosives in Roadworks, Users Guide 1982, shall be established and observed at all times. ***Safety Precautions***

C213.17 PRESPLITTING

1. Where presplitting is carried out the spacing of presplit drill holes shall not exceed 750mm centre to centre. ***Presplitting***

C213.18 BLASTING RECORDS

1. The Contractor shall maintain accurate records of each blast showing the details listed below:- ***Records to be kept***

Date and time of blast

Location, number and diameter of holes loaded

Depth of each hole loaded

Inclination of holes

Maximum and minimum burden

Types of explosives used

Charge distribution in each hole

Maximum instantaneous charge

Delay periods and sequence

Total amount of charges in the blast

Length and type of stemming in each hole

2. The records shall be prepared as holes are loaded and signed by the Powderman. A copy shall be provided to the Superintendent on the day of the blast. ***Record Preparation***

C213.19 CONTROL OF AIR BLAST OVER-PRESSURE

1. This Clause shall apply only where a noise sensitive location exists within 1km of the blasting site. ***Incidence***

2. The Contractor's attention is drawn to the recommendations given in the EPA Noise Control Manual for the reduction of air blast over-pressure. ***Noise Control Manual***

3. The noise emanating from blasting operations shall not exceed an over-pressure level of 115 decibels (linear peak) at any noise sensitive location (such as residential premises, schools or hospitals). Up to 10 per cent of the total number of blasts may exceed this value provided a level of 120 decibels is not exceeded at any time. ***Noise Limitations***

4. The Contractor shall arrange for the monitoring of air blast over-pressure to ensure compliance with the specified limits. All monitoring shall be carried out by personnel possessing current NATA registration for such monitoring. All test results shall be reported on NATA endorsed test certificates which shall include a clear statement as to compliance or non-compliance with the requirements of this Specification. In general, a monitoring location will be near the perimeter of the noise sensitive location at the point closest to the maximum charge. The Contractor shall submit a copy of the monitoring record to the Superintendent. ***Monitoring of Air Blast Over-Pressure***

5. In the event that the measured air blast over-pressure exceeds the specified limits, the Contractor shall suspend further blasting work and shall submit to the Superintendent proposals detailing any additional steps and precautions the Contractor shall take to ensure that for any future blast, the limiting over-pressure shall not be exceeded. The Contractor shall not resume any blasting until such proposals have been submitted. ***Excessive Air Blast Over-Pressure***

C213.20 CONTROL OF GROUND VIBRATION

1. The Contractor shall arrange for the monitoring of ground vibrations to ensure compliance with the peak particle velocity limits shown in Table C213.1. All monitoring shall be carried out by personnel possessing current NATA registration for such monitoring. All test results shall be reported on NATA endorsed test certificates which shall include a clear statement as to compliance or non-compliance with the requirements of this Part of the Specification. In general a monitoring location shall be ***Monitoring Vibrations***

near the perimeter of the structure or building at the point closest to the maximum charge. The Contractor shall submit a copy of the monitoring record to the Superintendent.

2. To minimise the risk of peak particle velocity limits being exceeded, the Contractor shall develop a blasting site relationship between peak particle velocity, distance and blasting charge. ***Blasting Site Relationship***

3. For the first blast, monitors shall be set up at not less than five points at varying distances away from the blasting site. The Maximum Instantaneous Charge for the first blast shall not exceed that calculated from the following formula: ***Maximum Instantaneous Charge***

$$MIC = 0.5\left[\frac{D}{\left[\frac{PPV}{1140}\right]^{-0.625}}\right]^2$$

where MIC = Maximum Instantaneous Charge in kilograms

D = Distance in metres from charge to the point of potential damage

PPV = limiting peak particle velocity from Table C213.1

4. A log-log (base 10) graph of measured peak particle velocity (vertical axis) versus Scaled Distance (horizontal axis) shall be plotted, where

$$\text{Scaled Distance} = \frac{D}{\sqrt{MIC}}$$

The mean regression line shall be obtained by the least squares method.

5. For subsequent blasts, the MIC and other aspects of blast design may be adjusted provided that further ground vibration monitoring is undertaken and the mean regression line redetermined to demonstrate that peak particle velocity limits are not exceeded. The Contractor shall make the regression line plots available to the Superintendent, if so requested. ***Adjustment of Blast Design***

UNSUITABLE MATERIAL

C213.21 GENERAL

1. Unsuitable material is that occurring below the designed floor level of cuttings and below the nominated depth for stripping topsoil beneath embankments, which the Superintendent deems to be unsuitable for embankment or pavement support in its present position. Unsuitable material also includes material in cuttings which the Superintendent deems to be unsuitable for embankment construction. ***Definition***

2. Such material shall be excavated to the extent directed by the Superintendent. Material removed as unsuitable, as directed by the Superintendent, shall be incorporated in embankments in accordance with Clause C213.23 or spoiled in accordance with Clause C213.34. ***Extent of Excavation***

3. After removal of the unsuitable material, the floor of the excavation shall be re-presented to the Superintendent for inspection, prior to backfilling with replacement material, to determine whether a sufficient depth of unsuitable material has been removed. Prior to placing replacement material the excavated surface shall be ***Floor Inspection***

compacted in accordance with Clause C213.36.

4. The unsuitable material which has been removed shall be replaced with material from cuttings, or with material borrowed in accordance with Clause C213.35, of the quality specified in Clause C213.23. Replacement material is deemed to form part of embankment construction. It shall be placed in accordance with Clause C213.26 and compacted in accordance with Clause C213.36. ***Replacement Material***

5. All costs associated with reworking or replacing any material which the Superintendent deems to have become unsuitable because of inappropriate construction activities shall be borne by the Contractor. ***Contractor's Costs***

EMBANKMENT CONSTRUCTION

C213.22 SCOPE

1. Embankment construction includes all operations associated with the preparation of the foundation areas on which fill material is to be placed, the placing and compacting of approved material within areas from which unsuitable material has been removed in accordance with Clause C213.21, the placing and compacting of fill material and of materials of specified quality in nominated zones throughout the Works and all other activities required to produce embankments as specified to the alignment, grading and dimensions shown on the Drawings. It also includes any pretreatment such as breaking down or blending material or drying out material containing excess moisture. ***Extent of Work***

C213.23 EMBANKMENT MATERIAL

1. Material for embankment construction shall be obtained from the cuttings within the Works, supplemented by borrow in accordance with Clause C213.35 if necessary. The material shall be free of tree stumps and roots and shall be capable of being compacted in accordance with Clause C213.36. ***Location and Quality***

2. The work shall be programmed so that material of the quality specified in Clause C213.26 and C213.30 for the upper zones of the formation is available when required. ***Selection of Material***

C213.24 FOUNDATIONS FOR EMBANKMENTS

1. Following removal of topsoil in accordance with Clause C213.07, the embankment foundation area shall be made available for inspection by the Superintendent. ***Inspection***

2. Where the Superintendent considers that any underlying material is unsuitable, he may direct that it be removed and replaced in accordance with Clause C213.21. ***Unsuitable Material***

a) Foundations for Shallow Embankments ***Shallow Embankments***

1. Shallow embankments are those embankments of a depth less than 1.0 metre from the top of pavement to natural surface. After removal of topsoil the Contractor shall survey and work out the extent of the area of shallow embankments.

2. Material in the foundations for shallow embankments which does not meet the requirements specified in Annexure C213A, shall be deemed unsuitable in accordance with Clause C213.21 and shall be replaced by material of the specified quality. ***Unsuitable Material***

3. Foundations for shallow embankments shall be prepared for embankment construction after removing topsoil and unsuitable material, by loosening the material exposed to a depth of 200mm, adjusting the moisture content of the loosened material ***Preparation of Foundations***

and compacting as specified in Clause C213.36. The Contractor shall use equipment and techniques to minimise surface heaving or other foundation damage.

b) Other Embankments

1. For all other embankments the foundation shall be prepared by grading and levelling the general area, adjusting the moisture content where necessary and compacting the top 200mm as specified in Clause C213.36. ***Preparation***

2. Where a bridging layer has been specified as a foundation treatment in the Contract documents, it shall be supplied and placed as part of General Earthworks. The bridging layer shall consist of free-draining granular material with or without geofabric interlayer as specified on the Drawings. The granular material shall be end-dumped and spread in a single layer and in sufficient depth to allow the passage of earthmoving equipment with minimal surface heaving. The compaction requirements of Clause C213.36 shall not apply to the bridging layer. Where it is necessary to import suitable material from off site and no suitable borrow source is available as provided in Clause C213.35, the supply and placing of the bridging layer shall be treated as a Variation to the Contract. ***Bridging Layer***

3. A bridging layer may also be employed, subject to the approval of the Superintendent, where ground water or seepage is encountered in the foundation area or where the Contractor demonstrates that it is impracticable to achieve the degree of compaction specified for the foundation in Clause C213.36. A bridging layer shall not be acceptable if its proximity to the pavement is likely to affect the pavement design. ***Seepage from Foundations***

C213.25 HILLSIDE EMBANKMENTS

1. Where embankments are to be constructed on or against any natural slopes or the batters of existing embankments, the existing slope or batter, if it is steeper than 4 horizontal to 1 vertical in any direction shall be cut in the form of horizontal terraces over the whole area to be covered by new filling. The existing slope or batter shall be stepped in successive terraces, each at least 1 metre in width, the terraces to be cut progressively as the embankment is placed. Wherever possible terraces shall coincide with natural discontinuities. Subsoil drainage may be required in some instances. Material thus excavated shall be compacted as part of the new embankment material. ***Horizontal Terraces***

2. No account shall be taken of the material removed in terracing when determining the General Earthworks excavated volume. ***Excavated Volume***

C213.26 PLACING FILL FOR EMBANKMENT CONSTRUCTION

1. The fill material for embankment construction shall be obtained from the cuttings within the work in accordance with Clause C213.11, supplemented by borrow when authorised by the Superintendent in accordance with Clause C213.35. ***Source of Material***

2. The methods of excavation, transport, depositing and spreading of the fill material shall be selected so as to ensure that the placed material is uniformly mixed. ***Uniformity of Material***

3. The embankment shall be constructed so as to derive its stability from the adequate compaction of the fine material embedding the large rock pieces rather than mechanical interlock of the rock pieces. The fine material shall be compacted to meet the requirements of Clause C213.36. ***Embankment Stability***

4. Fill material for embankment construction shall be placed in layers parallel to the grade line and compacted in accordance with Clause C213.36. The layers shall be of uniform compacted thickness not exceeding 200mm, except that where more than 25 per cent by volume of the filling consists of rock with any dimension larger than 150mm, the Superintendent may approve an increase in the compacted layer thickness to 300mm, provided that the relative compaction specified in Clause C213.36 is attained. ***Layer Thickness***

5. The maximum dimension, measured in any direction, of rock pieces in the fill material for embankment construction shall not exceed two-thirds of the approved compacted layer thickness. Any larger rock pieces shall be reduced in size for incorporation in the embankment layers. ***Maximum Size Rock Pieces***

6. Rock material shall be broken down and evenly distributed through the fill material, and sufficient fine material shall be placed around the larger material as it is deposited to fill the voids and produce a dense, compact embankment. Where the Superintendent considers insufficient fine material is present to fill the voids, additional fine material shall be obtained from other places in the work or by a change in the method of winning fill material. ***Grading of Fill Material***

7. Stony patches with insufficient fine material to fill the voids shall be reworked with additional fine material being blended in to achieve a dense, compact layer. The cost of any reworking shall be borne by the Contractor. ***Reworking Stony Patches Contractor's Cost***

8. In placing embankment layers, the Contractor shall use equipment and techniques to avoid surface heaving or other damage to the foundations and underlying embankment layers. ***Equipment Selection for Placement***

9. After compaction, embankment material in the zone(s) below the selected material zone (or subbase layer, where no selected material zone) shall have a CBR value not less than that quoted in Annexure C213A for the depth(s) specified in Annexure C213A. ***CBR Value***

10. For the purpose of this Clause, the CBR value of the material shall be determined by Test Method AS 1289.F1.1. ***Test Methods***

11. The Contractor shall be responsible for determining suitable sources of material and for any processing to satisfy these quality requirements. ***Contractor's Responsibility***

C213.27 EMBANKMENT BATTERS

1. The batter slopes shown on the Drawings represent the estimated requirements for the expected types of materials, and may be subject to redetermination by the Superintendent according to the Superintendent's assessment of the materials encountered. ***Batter Slopes***

2. When completed, the average planes of the batters of embankments shall conform to those shown on the Drawings or as determined by the Superintendent. No point on the completed batter shall vary from the specified slope line by more than ± 300mm when measured at right angles to the grade line. However, in no case shall the edge of the formation at the underside of the pavement be nearer to the roadway than shown on the Drawings. ***Slope Tolerances***

3. Undulations in the general plane of the batter shall not be permitted. ***Slope Undulations***

4. Where the Superintendent redetermines the slope of any section of an embankment batter which has been completed in accordance with this Clause the Superintendent shall order a Variation to the contract for the resetting out and removal or addition of fill material and retrimming of the batter. ***Slope Redeter-mination***

C213.28 ROCK FACING OF EMBANKMENTS

1. Where shown on the Drawings, embankment batters (including embankments at bridge abutments) shall be provided with a facing of clean, hard, durable rock. ***Extent***

2. The rock facing shall be built up in layers ahead of each layer of filling. Rock may be placed by hand or plant but shall be placed in such a manner that its least dimension is vertical and that mechanical interlock between the larger stones occurs. Any rock deposited in the rock facing which has an excess of fine material surrounding it shall be removed together with the excess fine material and replaced. ***Mechanical Interlock***

3. The Contractor shall adjust his working methods and programme the work so as to obtain hard and durable rock of the specified dimensions as it is required. The space between larger batter rocks shall be filled with progressively smaller rocks to form a 'graded filter' which prevents the leaching out of fines from the fill material but which does not overfill the voids between larger rocks, or cause the larger rocks to lose contact with one another. Fine material shall not cover the outside of the rocks on the face of the batter. ***Graded Filter***

4. The Contractor shall exercise extreme caution whilst placing the rock facing. Where embankment material is placed above other roads in use the outer rock layer shall be placed in such a manner as to prevent spillage down the batter. The Contractor shall ensure that, under no circumstances, could any rock be dislodged and roll onto any adjacent roadway or track in use. ***Caution in Placement***

C213.29 TRIMMING TOPS OF EMBANKMENTS

1. The tops of embankments shall be trimmed parallel to the designed grade line at levels equal to the finished surface level less the thicknesses of pavement courses and the selected material zone. ***Levels***

2. The tops of embankments at these levels shall be compacted to meet the requirements of Clause C213.36 and trimmed so that they do not vary more than 10 mm above or 40 mm below the levels as calculated above. ***Tolerances***

C213.30 SELECTED MATERIAL ZONE

1. A selected material zone may be indicated on the Drawings as a zone below the subbase layer and in accordance with the following quality requirements: ***Dimension and Quality***

   (a) it shall be free from stone larger than 100mm maximum dimension

   (b) the fraction passing 19.0mm AS sieve shall have a CBR value of not less than that quoted in Annexure C213A.

2. The selected material shall be obtained from cuttings excavated under the Contract or from borrow areas as specified in Clause C213.35. If necessary, the Contractor shall use working methods to yield material for the selected material zone by breaking down oversize rock or by other means, including processing through a crusher, to ensure that the resulting material conforms to the requirements of this Clause. ***Winning Material***

3. The Contractor shall ensure that any material encountered of the quality specified for the selected material zone shall be either placed directly in the selected material zone or stockpiled at locations approved by the Superintendent for future use by the Contractor in the selected material zone until at least sufficient material is reserved to complete the selected material zone over the whole work. Should the Contractor fail to conserve material of the specified quality, the Superintendent may direct that material of equivalent quality be provided. The cost of providing such extra material shall be borne by the Contractor. ***Selection of Material*** ***Contractor's Cost***

4. The Contractor shall have no right to monetary compensation or a claim for damages in respect of any loss the Contractor may claim to have suffered by reason of the Contractor's failure to reserve sufficient selected material or by reason of stockpiling material for the selected material zone. ***Cost of Handling***

5. The selected material zone shall be placed and compacted in layers with the compacted thickness of each layer not exceeding 150mm. Compaction shall be as specified in Clause C213.36. ***Layer Thickness***

6. After placement the selected material shall be homogeneous and free from patches containing segregated stone or excess fines. There shall be no areas containing material which does not comply with the specified requirements of this Clause. ***Homogeneous Layers***

7. The top of the selected material zone shall be compacted and trimmed parallel with the designed grade line at a level equal to the finished surface level minus the thickness of pavement layers adopted. The tolerances for the trimmed levels are given in Annexure C213A. ***Tolerances***

C213.31 FILL ADJACENT TO STRUCTURES

1. Supply and placement of fill adjacent to structures shall be deemed to be part of General Earthworks. ***Payment***

2. For the purpose of this Clause, structures shall include bridges, precast and cast-in-place box culverts and retaining walls. Fill adjacent to other culverts and drainage structures shall be provided in accordance with the particular Specifications for STORMWATER DRAINAGE as appropriate. ***Structure Types***

3. No filling shall be placed against structures, retaining walls, headwalls or wingwalls within 21 days after placing of the concrete, unless the walls are effectively supported by struts to the satisfaction of the Superintendent, or when the Contractor can demonstrate that 85 per cent of the design strength of the concrete has been achieved. ***Time of Placement***

C213.32 TREATMENT AT WEEPHOLES

1. Drainage adjacent to weepholes shall be provided by either a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from 50mm to 10mm such that: ***Grading***

   (a) The maximum particle dimension shall not exceed 50mm

   (b) No more than 5 per cent by mass shall pass the 9.5mm A.S. sieve.

2. The broken stone or river gravel shall be continuous in the line of the weepholes, extend at least 300mm horizontally into the fill and extend at least 450mm vertically above the level of the weepholes. ***Extent***

3. Alternatively the Contractor may provide a synthetic membrane of equivalent drainage characteristics at no extra cost to the Principal. It shall be stored and installed in accordance with Manufacturer's instructions. The use of a synthetic membrane shall be subject to the Superintendent's approval. ***Synthetic Membrane***

C213.33 SELECTED BACKFILL

1. Selected backfill shall be placed adjacent to structures in accordance with Table C213.2. The selected backfill shall consist of a granular material having a maximum dimension not exceeding 50mm and a Plasticity Index, determined by ***Quality***

AS 1289.3.3.1, neither less than 2 nor more than 12.

Structure Type	Selected Backfill	
	Width	Height
Bridge abutments	2m	H
Cast-in-place Box Culverts	H/3	H + 300mm
Corrugated Steel Pipes and Arches	0.5m	H + 500mm
Retaining walls	H/3	H

(Where H = height of structure)

Table C213.2 - Selected Backfill, Width and Height

2. The selected backfill shall be placed in layers, with a maximum compacted thickness of 150mm. Layers shall be placed simultaneously on both sides of box culverts to avoid differential loading. Compaction shall start at the wall and proceed away from it, and shall meet the requirements of Clause C213.36. ***Placement in Layers***

3. The existing embankment slope behind the structure shall be cut in the form of successive horizontal terraces, each terrace being at least 1 metre in width, and the selected backfill shall be placed in accordance with Clause C213.26. ***Horizontal Terraces***

4. No selected backfilling shall be placed against structures, retaining walls, headwalls or wingwalls within 21 days after placing of the concrete, unless the walls are effectively supported by struts to the satisfaction of the Superintendent, or when the Contractor can demonstrate that 85 per cent of the design strength of the concrete has been achieved. ***Time of Placement***

5. Where a bridge deck is being concreted adjacent to an abutment, no filling shall be placed against the abutment within twenty-one days after placing concrete in the bridge deck, unless approved by the Superintendent. ***Adjacent to Concrete Deck***

6. In the case of spill-through abutments, rocks shall not be dumped against the columns or retaining walls but shall be built up evenly by individual placement around or against such structures. ***Spill through Abutments***

7. In the case of framed structures, embankments at both ends of the structure shall be brought up simultaneously, the difference between the levels of the embankments at the respective abutments, shall not exceed 500mm. ***Framed Structures***

C213.34 SPOIL

1. Spoil is surplus material from excavations under the Contract which is not required to complete the Works as specified or material from excavations under the Contract whose quality the Superintendent deems to be unacceptable for incorporation in the Works. ***Definition***

2. Where there is surplus material the Superintendent may direct that flatter batter slopes be provided on embankments which have not been commenced, and/or direct that the excess material be used in the uniform widening of embankments, the surface of which shall be shaped so as to provide a tidy appearance and effective drainage. The surplus material shall be spread and compacted as specified in Clauses C213.26 and C213.36 for material in embankments. ***Use in Embankments***

3. Alternatively, spoil shall be disposed of in the manner and at locations approved by the Superintendent within the specified working area for the Works or be removed and ***Disposal of Spoil***

disposed of off site by the Contractor. Surplus material so deposited shall be compacted as specified in Clause C213.36 for material in embankments or to such lesser extent as may be approved by the Superintendent.

C213.35 BORROW

Borrow to be Authorized

1. Unless provided by the Contract, borrow will only be authorised by the Superintendent if, in constructing cuttings and embankments to the batter slopes specified or directed by the Superintendent or in providing materials of the quality specified, and not by reason of excess widening of embankments or wastage by the Contractor of material of the quality specified in Clauses C213.23, C213.28, C213.29 or C213.31, there is an overall deficiency in either the quantity or the quality of material required to complete the Works.

Borrow Site Characteristics

2. Where borrow material is required to complete the Works as specified, the location of borrow sites shall be as approved by the Superintendent, and the quality of material shall be acceptable to the Superintendent in accordance with Clauses C213.23, C213.28 or C213.31 as appropriate. The edges of borrow sites shall be no closer than 3 metres from any fence line, or edge of excavation or embankment. Adequate clearance shall be provided for the construction of catch drains. Borrow sites shall have drainage outlets acceptable to the Superintendent, cut batter slopes not steeper than 4 to 1, and shall be left by the Contractor in a tidy and safe condition.

Site Preparation and Restoration

3. For borrow within the defined working area for the Works as specified, site preparation shall be in accordance with the Specification for CLEARING AND GRUBBING and Clause C213.07. Restoration of borrow sites shall be carried out in accordance with the Specification for LANDSCAPING.

Widening of Cutting

4. If borrow material is obtained by uniformly widening a cutting, the requirements of Clauses C213.11, C213.12 and C213.14 as to the redetermination of batter slopes, the trimming of batters and the compaction of floors of cuttings respectively shall apply to the borrow area.

Contractor Responsibility

5. If the Superintendent accepts that borrow has to be obtained from locations outside the specified working area for the Works, such work shall be treated as a Variation to the Contract. The Contractor shall be responsible for obtaining any permits required for entry on land and for the payment of any royalty for such borrow material. The Contractor shall also comply with any requirements of the Environmental Planning and Assessment Act, the Local Council, land owners, the Rural Lands Protection Board and the NSW Soil Conservation Service, as appropriate.

COMPACTION AND QUALITY CONTROL

C213.36 COMPACTION AND MOISTURE REQUIREMENTS

Trimming and Compaction

1. In areas listed below, all layers shall be uniformly compacted to not less than the relative compaction specified before the next layer is commenced. Each layer of material shall be trimmed prior to and during compaction to avoid bridging over low areas. A smooth surface shall be presented at the top of each layer.

92% Compaction Requirements

2. The following areas shall be compacted to provide a relative compaction, determined by AS 1289.5.7.1 for modified compactive effort, of not less than 92 per cent.

- Each layer of material replacing unsuitable material as detailed in Clause C213.21.
- Each layer of material placed in embankments, up to 0.5 metres from the

top of the pavement.

- The whole area on the floors of cuttings.
- Fill placed adjacent to structures up to 1.0 metre from the top of pavement.
- Material in unsealed verges and within medians up to the level at which topsoil is placed.
- Spoil (excluding unsuitable material)
- All other areas except those where 98 per cent relative compaction is specified.

Unsuitable Material

3. Unsuitable material shall be stockpiled as directed by the Superintendent and compacted by track rolling.

95% Compaction Requirements

4. The following areas shall be compacted to provide a relative compaction of not less than 95 per cent as determined by AS 1289.5.7.1 for modified compactive effort:

- Foundations for shallow embankments.
- Foundations other than shallow embankments.
- Each layer of the embankment within 0.5 metres from the top of pavement.
- Each layer of the selected material zone as specified in Clause C213.30.
- Any areas of material of specified quality which may be shown on the Drawings or specified elsewhere behind kerbs and/or gutters or adjacent to rigid pavements.
- The fill material placed adjacent to structures as specified in Clauses C213.31 and C213.33 in each layer within 1.0 metre from the top of the pavement.

Moisture Content

5. At the time of compaction the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is within the range set out in Annexure C213A of the optimum moisture content as determined by AS 1289.5.1.1 or AS 1289.5.7.1. Material which becomes wetted up after placement shall not be compacted until it has dried out so that the moisture content is within this range. The drying process may be assisted by aeration, or where approved by the Superintendent, by the use of hydrated or quick lime at the Contractor's cost. Alternatively the Contractor may transport the wet material to a stockpile site for drying out and later use as fill material. The cost of transport to stockpile for drying out and later use shall be borne by the Contractor. If there is insufficient moisture in the material for it to be compacted as specified, water shall be added. The added water shall be applied uniformly and thoroughly mixed with the material until a homogeneous mixture is obtained. The cost of such wetting or drying the material to be compacted shall be borne by the Contractor.

Contractor's Cost for Drying and Wetting

Prompt Compaction

6. Compaction shall be undertaken to obtain the specified relative compaction for the full depth of each layer in embankments and for the full width of the formation over the entire length of the work. Compaction shall be completed promptly to minimise the possibility of rain damage.

Moisture Content above Optimum

7. Any material placed by the Contractor that has attained the specified relative compaction but subsequently becomes wetted up so that the moisture content is greater than the apparent optimum, determined by AS 1289.5.7.1, shall be dried out and uniformly recompacted to the required relative compaction in accordance with this Clause before the next layer of material is placed. Alternatively, the Contractor may remove the layer of wetted material to a stockpile site for drying and later re-use. The cost of the removal to stockpile, drying out and reincorporation of the wet material shall

Contractor's Cost

be borne by the Contractor.

C213.37 TEST LOCATIONS

1. The specified compaction and moisture tests shall be taken at the random test locations established in each lot in accordance with the specified minimum testing frequency. Prior to testing the Contractor shall work the area to ensure uniform moisture content and compaction of all material within the area. ***Contractor to Prepare Area***

2. The tests then taken shall be considered to represent the total volume of material placed within the lot. ***Test Representation***

3. Where the Superintendent considers that the material which is present has not achieved uniformity required by this Clause or Clause C213.26, he may take or direct further testing. The Superintendent shall nominate the area represented by the additional testing. ***Further Testing***

4. If such testing confirms that material not conforming to the Specification is present the cost of such tests shall be borne by the Contractor. The Contractor shall carry out remedial work as necessary to achieve conformance to the requirements of Clause C213.36. ***Contractor's Cost***

C213.38 DEFLECTION MONITORING

1. Following completion of the formation to the underside of the selected material zone in accordance with Clause C213.24 and C213.26, and completion of the selected material zone in accordance with Clause C213.30, the Contractor shall make the work available in lots, for the Superintendent or Council to carry out deflection monitoring. ***Timing of Deflection Monitoring***

2. A lot for deflection testing shall consist of a continuous length of formation, in compliance with Council requirements, and a single carriageway width which is generally homogeneous with respect to material and appearance. The Contractor shall identify the boundaries of each lot with stakes clearly labelled to the satisfaction of the Superintendent. The cost of preparing the surface for deflection monitoring is deemed to be included in the rate for General Earthworks. ***Lot Size***

C213.39 WIDENING OF FORMATION

1. Road shoulders and formation shall be widened to accommodate footpaths, guardfence, streetlight plinths, emergency telephone bays and vehicle standing areas as shown on the Drawings. ***Provision for Services***

SPECIAL REQUIREMENTS

C213.40 RESERVED

C213.41 RESERVED

C213.42 RESERVED

C213.43 RESERVED

C213.44 RESERVED

LIMITS AND TOLERANCES

C213.45 SUMMARY OF TOLERANCES

1. The tolerances applicable to the various clauses in this Specification are summarized in the Table below:

Item	Activity	Limits/Tolerances	Spec Clause
1.	**Batter Slopes** a) Excavation	± 300mm	C213.12
	b) Embankment	± 300mm	C213.27
2.	**Floors** a) Floor of Cutting	Parallel to the designed grade line and ± 50mm of the designed floor level	C213.14
3.	**Tops of Embankments** Trimming tops of Embankments	Parallel to the designed grade line, +10mm or -40mm of the levels specified	C213.29
4.	**Selected Material**	Annexure C213A	C213.30

NOTE: Plus (+) is towards the roadway/surface and minus (-) is away from the roadway/surface. Tolerances are measured at right angles to design surfaces.

Table C213.3 - Limits and Tolerances

C213.46 RESERVED

ANNEXURE C213A
EARTHWORKS - SUPPLEMENTARY INFORMATION

CLAUSE	DESCRIPTION	VALUE
C213.07	The depth below natural surface up to which the removal and measurement of top soil shall apply: a) Cutting areas b) Embankment areas	 _____mm _____mm
C213.14	Minimum CBR value in cutting floors used for design of pavement	_____ %
C213.24	Requirements of material in foundations for shallow embankments: Moisture Content - within the range of __% to __% of optimum.	
C213.26 and C213.30	Upper Zones of Formation Selected Material Zone Material within each zone shall have a CBR value of not less than the following, under the nominated test conditions:	

Location	Minimum CBR Value	Depth	Nominated Soaking Period (Days)
a. Selected Material Zone			
b. Material below Selected Material Zone to 1.0 metre from top of pavement			

C213.30 Construction tolerances for Selected Material Zone are + mm or - mm of the designed grade and crossfall.

C213.36 Moisture Content of material placed in embankments:

(a) Material in upper zones of formation:- within the range of % to % of optimum.

(b) All other embankment material:- within the range of % to % of optimum.

SPECIFICATION C213 – EARTHWORKS