AUSTRALIAN RAIL TRACK CORPORATION LTD

HEAVY HAUL INFRASTRUCTURE GUIDELINES

TRACK, CIVIL AND STRUCTURES

20 June 2013

Version 7.0

Document Overview

Client:	Australian Rail Track Corporation – Hunter Valley
Project:	HEAVY HAUL
Document Title:	HEAVY HAUL INFRASTRUCTURE GUIDELINES TRACK, CIVIL AND STRUCTURES
Date Issued:	12 June 2013
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Prepared by:	C Crump / T Neville / G Jayakumar
Document Owner:	Heavy Haul Development Manager
Applicability	Hunter Heavy Haul Network (Newcastle to Ulan and Muswellbrook to Turrawan)
Purpose:	These guidelines are not intended to replace any ARTC standards, but are to be used as a supplement to deliver consistency in: design, systems provided, components installed, installation arrangements and deliverables applicable to the Heavy Haul requirements of the Hunter Valley.
Related Documents:	Heavy Haul Infrastructure Guidelines Signalling, Communications & Electrical. Hunter Corridor Asset Management Plan ARTC Geotechnical Guidelines
Endorsed :	EGM Hunter Valley

Revision History

Revision	Date Issued	To	Description
Zero	12 Aug 2010	Budget Investment Committee	Discussion
1	01 Oct 2010	HV Users	Access traffic barrier and access road gradient update, appendix C amendments, Overbridge footings,
2	30 Nov 2010	HV Users	OSC clause added (see this page)
3	24 Jan 2011	HV Users	Subgrade design & performance, passing areas, culvert extensions & sleeving, trench compaction, Gap-Turrawan.
4	13 April 2011	HV users, standards, OSC, maintenance, performance,	Turnouts, clearances, drainage blankets, overbridges, typical sections, bridges, formatting, stockpiles.
5	22 Sept 2011	Intranet	Minor updates throughout, upper hunter loop calc.
6	19 April 2013	Peer Review Panel	Change to document title Changes to reflect ACCC decision on Initial Indicative Service – length of train Various formatting changes
7	20 June 2013	HV Users	Final Draft after Peer Review

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1 GENERAL

The objective of this document is to provide clear insight into the considerations required in designs, equipment types and configurations of infrastructure installed in the Hunter Valley Heavy Haul Network. These considerations are the core of the Hunter Valley Business Units' key performance criteria with the planned expansion of the coal throughput to the port of Newcastle, namely:

- Improvement of operational reliability (reduction of asset failures),
- Improvement of asset availability (reduction of maintenance possession time) and
- The need to achieve prudent capital expenditure taking into account maintainability and asset life cycle maintenance costs

1.1 Application to Works in the Corridor

1.1.1 These guidelines are applicable only to the Hunter Valley Heavy Haul network as defined by Figure 1 and/or Pricing Zones 1, 2, 3 and 4 of the Hunter Valley Coal Network Access Undertaking as amended from time to time.

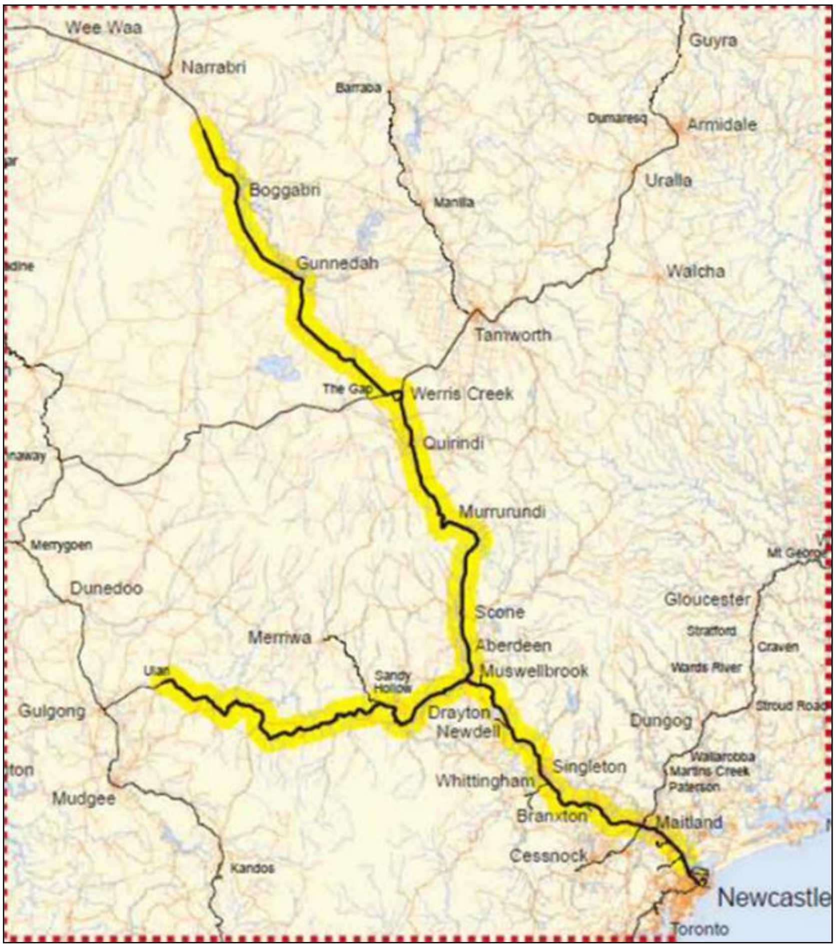

Figure 1.1 – Hunter Valley Heavy Haul Network

1.1.2 Projects with a budget less than $100,000 will not be required to comply with this guideline as these projects are typically small repairs to existing infrastructure. In these circumstances the further scope required to comply with these guidelines may generate an unnecessary cost burden upon the project.

Therefore the applicability of this guideline to most RCRM, MPM works will be determined by the Manager Infrastructure and Planning (MIP) on a case-by-case basis during project scope development. The MIP will consider the scope of the project in context with the business unit objectives of the Hunter Valley.

1.1.3 Minor Capital, Major Capital and other projects with a budget of $100,000 or greater will generally be expected to adhere to these guidelines as published

1.1.4 Any departures in the application of these guidelines must be declared and presented for endorsement by the Operational Steering Committee (OSC), prior to implementation.

Endorsement of these departures should be obtained from the Authorised Infrastructure Representative (AIR) - refer to Appendix A - prior to presentation at the OSC, however if this is not possible due to an impasse then a joint presentation to the OSC is required by the project owner and the AIR.

1.2 Interpretation of Guideline Clauses

1.2.1 Where clarification is required to these guidelines – including conflict with current ARTC standards (perceived or otherwise) – a technical query is to be forwarded to the Authorised Infrastructure Representative, or their nominated representative.

1.3 Innovative Solutions

1.3.1 To meet the business objectives of the Hunter Valley Business Unit, the investigation and use of new technological solutions in the field is encouraged. This document does not intend to restrict innovation in design or the introduction of new technology.

With respect to innovation, some sections of this document refer the reader to a preferred proprietary product or design solution – this is made in an attempt to avoid a situation where a variety of different spares, training requirement and equipment performance is experienced throughout the Heavy Haul.

However, the mention of a preferred proprietary product or design solution shall not preclude other equipment or solutions to be considered, investigated and recommended by the project team.

The recommendation of non-preferred products and solutions shall be considered a departure from the guidelines and are to be considered as per clause 1.1.4 above.

1.4 Design Concept, Review and Presentation

1.4.1 Final designs for recently commissioned Hunter Valley projects are to be used as a baseline model for projects with similar infrastructure configurations – this is to prevent starting from scratch and also capturing lessons learnt during design phases of previous projects.

1.4.2 Hunter Valley main line signalling headways are to be designed to meet forecast capacity requirements. For guidance on headways and other capacity requirements please refer to the current version of the Hunter Valley Corridor Capacity Strategy which is publically available on ARTC's website <www.artc.com.au>

1.4.3 All concept plans, proposal specifications, designs, installation and commissioning documentation are to be reviewed and accepted by the Authorised Infrastructure Representative (see Appendix A) before any work is progressed.

1.4.4 Signalling Infrastructure to be shown on any related Track and Civil IFC drawings including GPS coordinates.

2 CURRENT OPERATING CONDITIONS

2.1 General

2.1.1 The current operating environment in the Heavy Haul Hunter Valley is summarised below in Table 2.1.

For more detailed information please refer to the ARTC Route Access Standard (RAS) Manual <http://www.artc.com.au/Content.aspx?p=257>.

Table 2.1 - Current Operating Criteria in Heavy Haul Areas

Area	Ports to Ulan	Muswellbrook to Turrawan#
Pricing Zones	1 and 2	3 and 4
Max Axle Load	30 T	25 T
Max Speed for Coal Traffic	60km/h (loaded) 80km/h (unloaded)	80km/h (loaded) 80km/h (unloaded)

The Muswellbrook to Dartbrook Section is able to operate under Pricing Zones 1 and 2 criteria

2.2 Future Operating Conditions

2.2.1 At the time of publication there is no firm commitment to change any of the operating criteria of the Heavy Haul areas of the Hunter Valley, albeit there are reviews underway to determine the benefits of various upgrades to the infrastructure. Some current reviews and special conditions for new works are summarised in Table 2.2

Table 2.2 - Planned Changes to Operating Criteria for Heavy Haul Areas

Area	Ports to Ulan	Muswellbrook to Turrawan
Pricing Zones	1 and 2	3 and 4
Planned Changes	Nil	Nil
Current Reviews	32.5 TAL Infrastructure Review	30.0 TAL Infrastructure review
Special Conditions for New Construction Works	Nil	All new infrastructure shall be designed to meet the current operating criteria of Pricing Zones 1 and 2 (refer Table 2.1)

2.2.2 Headways on new infrastructure projects are to be designed to meet forecast capacity requirements.

Headway requirements are to be confirmed on a project-by-project basis with reference to the current version of the Hunter Valley Corridor Capacity Strategy.

2.3 Current Infrastructure Rating

2.3.1 Rail capacity is summarised below in Table 2.3.

Table 2.3 –Rail Capacity

Rail Section	Axle Load (T)	Max Speed (km/h)	Max Head Loss (%)
53kg SC	25.0	80	N/A
	30.0	40	N/A
60kg SC *	30.0	80	40%
	32.5	80	37%
	37.0	80	32%
60kg HH *	30.0	80	55%
	32.5	80	50%
	37.0	80	44%

* Refer: Steve Marich Consulting 2009

2.3.2 Sleeper capacity is summarised below

SRA Type 1

- 28 TAL at 80 km/h (ref Weltrack report 1999) this is pending an investigation on rating and remaining life.

SRA Type 5, Austrak HD30 and Rocla SG-30

- 30 TAL as per AS 1085

2.3.3 Formation capacity is summarised as below

- 30 TAL at 80 km/h (ref Steelcon consultants 2006), based on a track superstructure of 60 kg HH on concrete sleepers.
- Pending Load rating as per 2.2.1.

2.3.4 Steel Bridges (Ref ARTC 30TAL load ratings 2007 & 2009 and 32-37TAL ratings RIC pre-feasibility spreadsheet Nov 2001.)

Ports to Muswellbrook

- Average Rating = 252LA, ≈ 32.5 TAL at 80 km/h, 35 TAL at 70 km/h, 37.5 TAL at 60 km/h.
- Glennies Creek ≈ 30 TAL >80 km/h, 32.5 TAL at 54 km/h, 37 TAL at 36 km/h
- Black Creek ≈ 30 TAL at 60 km/h

Ulan Line

- Average Rating is 274LA ≈ 32.5 TAL at 80 km/h, 35 TAL at 63 km/h, 37.5 TAL at 48 km/h
- Hunter River and Wybong Creek ≈ 30 TAL at >80 km/h, 32.5 TAL at 44 km/h, 37 TAL at 50 km/h

Muswellbrook to The Gap

- Average rating is 250LA ≈ 30 TAL >80 km/h.

The Gap to Turrawan Junction

- Average rating is 220LA ≈ 30 TAL > 80 km/h.
- 416.270 km, 476.5 km, 532.150 km ≈ 30TAL at 60 km/h.

2.4 Crossing Loop Minimum Configuration

2.4.1 Train Length and Loop Design Lengths are as per below Table 2.4

Table 2.4 – Loop Length Design Criteria

	Area	
	Ports to Muswellbrook Ulan Line	**Muswellbrook to Turrawan**
Pricing Zone	1 and 2	3 and 4
Max Length of Train	1,543m	1,329m
Max Amount of Wagons	96	82
Max Speed	60 km/h (loaded) 80 km/h (unloaded)	80 km/h (loaded) 80 km/h (unloaded)

Note that the overall crossing loop length is dependent on the design of the turnout used. The turnout tangent point (TOTP) to clearance point measurement must be added on either end of the crossing loop to determine the overall crossing loop length TOTP to TOTP (please refer to Appendix B for detailed calculation and example).

2.4.2 A 300 m minimum of non-shared overlap between home and starter must also be considered within loop design. Please refer to current ARTC signalling standards.

3 RAIL

All infrastructure under this category is to be designed/installed/maintained as per Section 01 of the ARTC Track and Civil Code of Practice unless noted otherwise

3.1 General

3.1.1 All rail installed during new construction projects or maintenance re-railing shall conform to the below Table 3.1 as a minimum requirement.

Table 3.1 – Rail Installation Guidelines

AREA	MINIMUM RAIL TO BE INSTALLED
All Mainlines including Terminal Arrivals	New 60kg HH (ref AS 1085.1 – 2002)
Crossing Loops, Terminal Departures, Yards and Sidings that carry ≥25 TAL traffic	Used 60kg (HH or SC) within wear and damage limits
Freight Yards and Perway Sidings that carry <25 TAL traffic	Used 53kg within wear and damage limits

3.1.2 All new rails installed as a part of new construction or corridor re-railing works should be welded together using flash butt welds. This requirement supports the strategy to reduce the use of alumino-thermic welds in the heavy haul areas of the Hunter Valley, which have shown to be a source of rail breaks.

Note: At the start and finish of new rail installations, the welding of mismatched heads or different rail sizes is usually required.

At these locations specially manufactured tapered rail sections are required for flash butt welders to weld rails together. Where tapered rails are not available alumino-thermic welds are still approved for use in accordance with the ARTC welding standards.

3.1.3 Rail lubricators are to have electronic delivery systems, remote monitoring capability for lubricant levels and equipment faults.

Lubricant delivery systems are also to be suitable for frequent removal for tamping and grinding.

4 SLEEPERS AND FASTENINGS

All infrastructure under this category is to be designed/installed/maintained as per Section 02 of the ARTC Track and Civil Code of Practice unless noted otherwise

4.1.1 Rail Pads to be 7-10 mm HDPE with completely flat contact surface to the foot of the rail to prevent coal and water build up e.g. Pandrol 14536 (or type approved equivalent).

4.1.2 Reinforced insulators are to be installed on the field side for all curves ≤ 600m radius.

4.1.3 Either 'fastclip' or 'E clip' elastic fastenings to be used.

4.1.4 30 TAL Concrete Sleepers (designed as per Australian Standard) at 600 mm spacing are to be installed on all new infrastructure projects.

5 POINTS AND CROSSINGS

All infrastructure under this category is to be designed/installed/maintained as per Section 03 of the ARTC Track and Civil Code of Practice unless noted otherwise

5.1 Mainline: General

5.1.1 Turnout geometry is to be selected to facilitate the operational requirements of the project.

5.1.2 The turnout through road is to be designed to accommodate the existing posted track speed (i.e. turnout installation should not lower the existing track speed on the through road).

5.1.3 All new turnouts are to be installed on tangent track with formation as per Section 2.

5.1.4 Rail used in turnout manufacture to be a minimum 60 kg HH and have a TGT1 rail profile milled during manufacture to reduce rail flow if turnout is not ground prior to traffic..

5.1.5 Concrete bearers are to be used.

5.1.6 Tangential switches are to be used.

5.1.7 Switch is to have a self-contained switch locking mechanism (e.g. Spherolocks)

5.1.8 For detailed signalling aspects, refer to the Heavy Haul Infrastructure Guidelines: Signalling, Communications & Electrical.

5.1.9 Switch rollers to be installed and are to be resistant to coal and general debris fouling.

When selecting roller supply, preference is to be given to “in-plate” rollers as opposed to “in-bay” rollers as the “in-plate” roller systems do not need to be removed for effective tamping.

5.1.10 For ease of maintainability and the reduction of spares inventory, the project must consider using the same turnout designs as other turnouts in the local area.

5.1.11 Turnouts subjected to high levels of coal fouling (Ports-Maitland-via the down coal) are to have iodised clips installed.

5.2 Mainline: KCT to Muswellbrook (via Coal Roads) and Ulan Line

5.2.1 Notwithstanding Section 5.1.1 current practice is for a minimum 75 km/hr crossing speed.

5.2.2 Swing Nose Crossing (SNX) with a design life of at least 1,000 MGT

5.2.3 ‘In Bearer’ Switch and SNX point drives.

5.2.4 Turnout roads with a yearly turnout road line tonnage >20 MGT are to have ‘cast in’ shoulders along the turnout including the switch section instead of screw spikes and nylon ferrules.

5.2.5 Turnout roads with a yearly turnout road line tonnage >40 MGT are to have a Kinematic Gauge Optimised (KGO) Switch or an approved equivalent.

5.2.6 Reinforced insulators to be installed

5.3 Mainline: Muswellbrook to Turrawan Junction, Islington to Telarah via Mains and Sandgate to CCT via Coals

5.3.1 Notwithstanding clause 5.1.1, the current practice is for a minimum 50 km/h crossing speed.

5.3.2 Fixed Nose Crossing (FNX): RBM or Monoblock.

5.4 Yard: Coal Departures

5.4.1 50 km/h crossing speed.

5.4.2 FNX: RBM or Monoblock.

5.4.3 Standard Flexi-Switch

5.5 Yard: Freight Yards and Sidings

5.5.1 Minimum acceptable turnout size is 1:8.25

5.5.2 Minimum 53 kg rail section

5.5.3 Standard Flexi-Switch

5.5.4 FNX: Fabricated, RBM or Monoblock

5.5.5 If throw levers are planned they must conform to WH&S requirements.

6 BALLAST

All infrastructure under this category is to be designed/installed/maintained as per Section 04 of the ARTC Track and Civil Code of Practice unless noted otherwise

6.1.1 Minimum of 300 mm of ballast under sleeper, with a maximum of 500 mm.

7 TRACK GEOMETRY

All infrastructure under this category is to be designed/installed/maintained as per Section 05 of the ARTC Track and Civil Code of Practice unless noted otherwise

7.1.1 Design superelevation is to be biased for coal traffic as much as possible by using the maximum allowable cant deficiency as per TDS09.

8 TRACK LATERAL STABILITY

All infrastructure under this category is to be designed/installed/maintained as per Section 06 of the ARTC Track and Civil Code of Practice unless noted otherwise

8.1.1 Trackside monuments for all new track construction should be installed as per ARTC specification ETD-11-01
<http://intranet.artc.com.au/docs/eng/track-civil/procedures/railsigns/ETD-11-01.pdf>

8.1.2 Track Control Markers (TCMs) to be 2.5 m from the near rail running face.

8.1.3 TCMs are to be provided at all “frame points”. Spacing of TCMs to be every 20 m on curves and every 100 m on straights

9 CLEARANCES

All infrastructure under this category is to be designed/installed/maintained as per Section 07 of the ARTC Track and Civil Code of Practice unless noted otherwise

9.1 Design

Up to date clearance information for the Hunter Valley is published in the ARTC TOC Manual until superseded by the [ARTC RAS Manual](http://www.artc.com.au/Content.aspx?p=257) <http://www.artc.com.au/Content.aspx?p=257>.

9.1.1 Current Hunter Valley rolling stock design outline is the Narrow Non Electric - [4265 mm high x 2970 mm wide]

A proposal to introduce the Association of American Railroads (AAR) Plate B – [4,598 mm high x 3,252 mm wide] – rolling stock outline is being considered as an option by industry for future increased tonnages.

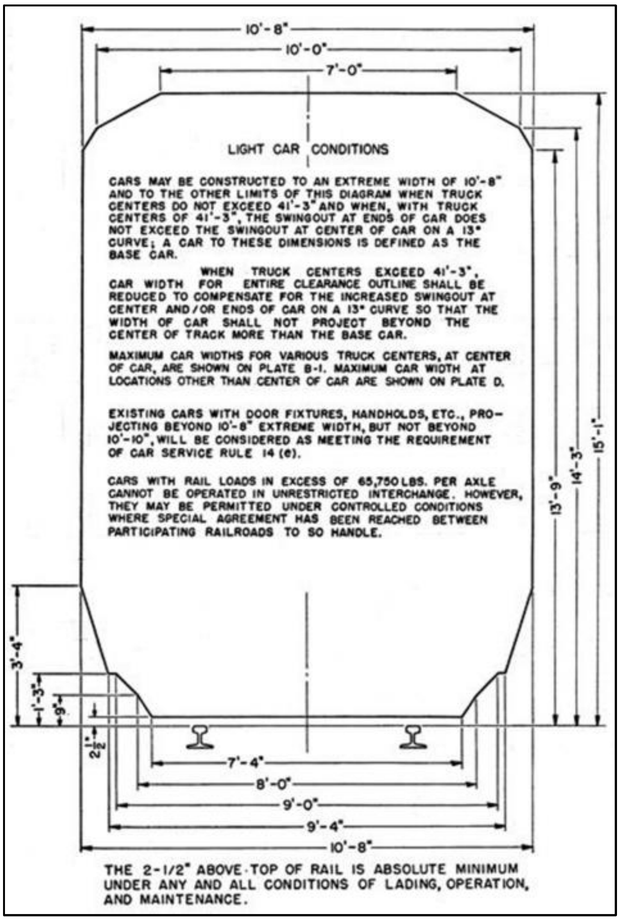

Figure 9.1 - AAR Plate B (AREMA Manual for Railway Engineering Section 28-2-3)

9.1.2 New permanent structures and platforms are to be built to the existing clearance standards, but designed with a view to easily modify the structure to suit the AAR Plate B if this becomes a future operating requirement of the future Hunter Valley network.

9.2 Clearances

9.2.1 Minimum vertical clearance must be 5.150 m; with a design provision to lift the structure to 7.100 m should future requirements change.

9.2.2 With reference to BDS12 Section 3, a minimum horizontal clearance of 4.3m from track centreline is to apply. e.g. bridge abutments, buildings, cuttings with no access roads, columns, any structures adjacent to a track which has no access road.

9.2.3 Minimum Track Centres for all new construction projects to be a minimum 4.5 m – this may be even greater in areas where special maintenance consideration is required.

10 EARTHWORKS

All infrastructure under this category is to be designed/installed/maintained as per Section 08 of the ARTC Track and Civil Code of Practice unless noted otherwise

10.1 Earthworks and Drainage

10.1.1 Cut and fill batters to be designed with a long-term Factor of Safety ≥1.5.

10.1.2 Cess to be upgraded on existing tracks to account for any new adjacent formation and thus negate or reduce any subsurface formation drainage - refer to drawings in Appendix C.

10.1.3 Top drains to be installed and lined where necessary.

10.1.4 Surface drainage systems not to discharge into sub surface drainage systems.

10.1.5 No flexible subsurface drainage pipes within or below the track formation

10.1.6 Subsurface drainage pipes to have diameters ≥150 mm.

10.1.7 Aggregate and Geotextile for subsurface drains to be specified by the designer.

10.1.8 No finger/French/trench drains to be installed in new capping or new structural fill.

10.1.9 The location of any permanent stockpiles are to be endorsed by the applicable Team Manager.

10.2 Drainage Blankets

10.2.1 Preference is for no drainage blankets in embankments less that 3 m in height when measured from top of rail.

10.2.2 For drainage blankets exiting into a cess, a 20 year ARI freeboard is required.

10.2.3 Drainage blankets in cuttings are generally not required if the cutting does not “make water” i.e. there is no upwards ingress of water into the formation.

10.2.4 For cuttings that do “make water” i.e. water ingresses upwards into the formation. As well as a drainage blanket, a longitudinal subsoil drain is also required to lower the ground water table to a suitable level beneath the drainage blanket. Drainage blankets and the subsoil drainage are ideally not to have a single common mode of failure (i.e. if the pipe blocks there should be a redundancy system to drain the blanket).

10.3 Trenching

10.3.1 The backfill of trenches shall comply with and be compacted to, the same specifications as the materials in which the trench was excavated. Compaction and moisture content testing to be as per 10.3.3.

10.3.2 In the absence of any such specification, trenches shall be backfilled with material which matches the adjacent/excavated materials and be compacted to 95% standard compaction in accordance with AS 1289. Compaction and moisture content testing to be as per 10.3.3.

10.3.3 Quality Control.

- The Maximum loose layer thickness to be 300 mm.
- Compaction testing to be 1x test per layer per 200 linear metres or one test per layer for trenches ≤200 linear metres.
- All results are to be greater than the specified compaction and within the specified moisture content range.

10.4 Formation – Mainline and Loops (refer also to Appendix C)

10.4.1 Track formation design shall be based on limiting rail deflections (controlling track modulus and track stiffness) so as to give Heavy Haul track a combination of flexibility and stiffness.

10.4.2 The Heavy Haul 'default' design shown below is illustrated in Appendix C.

- 200 mm capping CBR ≥50 - compacted to 95% Modified at 60-90% of MOMC
- 500 mm structural CBR ≥30 - compacted to 95% Modified at 60-90% of MOMC
- For subgrade CBR <3 add 500 mm structural layer minimum CBR ≥8.
- For subgrade CBR >20 install a 400 mm capping only (e.g. hard rock cuts).

10.4.3 Formation design differing from the Heavy Haul default design is to be based on:

- 3.3 mm to 5.1 mm deflection for main lines and 3.3 mm to 6.35 mm for loops
- Using 4 x design axles (2 coupled bogies) travelling at the design speed
- Using the characteristic subgrade resilient modulus/moduli

10.4.4 Minimum formation width to be 4.25m from centre line where no access road is built or 6.50m where an access road is provided (refer to Appendix C).

10.4.5 The new formation structural fill zone is to extend a minimum of 3.0 m either side of track centreline. This does not negate the shoulder distance requirements in clause 10.4.4.

Note: For duplications this will reduce to 2.65 m on the six foot side if track centres are 4.5 m.

10.4.6 Track to be of uniform stiffness in cross-section.

10.4.7 For new construction at track centres between 7.25 m and 8.5 m from existing tracks, the new formation capping shall extend to within 3 m of the existing track centreline. The depth to the top of the new capping at this location (3 m from the existing track centreline) shall be determined based on site specific investigation, but should generally be between 0.8 m and 1.2 m below the existing track rail level.

10.4.8 Smooth longitudinal transitions are to be provided where variations in track stiffness/modulus occur e.g. turnouts, cut-fill interfaces and bridge ends.

At turnouts, recons are to extend 10m past the last long bearer, then transition into the existing formation at a 1:4 rate.

10.5 Formation - Yards and Sidings

10.5.1 Formation/Subgrade to be graded and proof rolled

10.5.2 Formation to be subject to a site specific investigation and design. The minimum design to be 300 mm of capping. Refer to point 10.4.5

10.6 Formation – Slews

10.6.1 Slews < 100 mm

- No special requirements

10.6.2 Slews ≥100 mm and ≤300 mm

- Remove existing ballast shoulder.
- Grade and proof roll formation/subgrade out from original sleeper ends

10.6.3 Slews > 300 mm and ≤1000 mm

- The formation is to be investigated and assessed prior to the works for the most appropriate treatment, this treatment may range from 'do nothing' to a full formation upgrade.
- Treatment option to take into account site specific track configuration etc. Requirements for a single mainline likely to be less onerous than in and around turnouts etc..
- In general situations remove the ballast shoulder, grade and proof roll the formation/subgrade out from original alignment sleeper ends
- In cases where the slew is onto new track formation built to current standards, then the track formation is to be upgraded as per 10.4.

10.6.4 Slews > 1000 mm

- Full Track formation upgrade as per 10.4

10.7 Formation - Infrastructure Removals

10.7.1 A specific design is required to maintain the general uniform stiffness of the existing plain track. This could range from a proof roll to a full formation upgrade.

10.8 Track work

10.8.1 Surface and Sub-Surface Track drainage to be incorporated in designs.

10.8.2 A SS30 or equivalent Geogrid layer is to be installed at the bottom of ballast (i.e. on top of capping).

10.8.3 Refer to Typical section on Drawing ARTCN3110140001.

11 STRUCTURES

All infrastructure under this category is to be designed/installed/maintained as per Section 09 of the ARTC Track and Civil Code of Practice unless noted otherwise

11.1 General

11.1.1 All designs to be undertaken as per the ARTC Code of Practice Section 9 with underbridges and large box culverts to be designed for 350LA rail loading.

11.1.2 Underbridges and Culverts to be of concrete construction.

11.1.3 Walkways to be provided on all bridges and large box culverts. One side only for single tracks and amplifications. A walkway will need to be installed 'as required' between existing structures and the amplified structure.

11.2 Underbridges

11.2.1 To have a ballasted track decking system.

11.2.2 No 'Track Transition' approach slabs.

11.2.3 Abutment Relief slabs are to be avoided but will be considered on individual business cases.

11.2.4 A ballast matt is not required unless there is <250 mm of ballast depth.

11.2.5 The ballast retention walls at bridge ends must be integral with the main structure.

11.2.6 For girders 6.0 m to 15.9 m in length, utilise ARTC standard drawings ARTCN1060013001 through to ARTCN1060013024.

11.2.7 In some cases where an underbridge is amplified, the existing kerb-log will need to be demolished.

11.3 Culverts

11.3.1 Pipe Culverts to be at minimum Class 4 under rail tracks.

11.3.2 Water courses must align to suit new structure and free drain off the corridor.

11.3.3 Safety handrails are to be installed were appropriate on headwalls ≥1.6 m above culvert invert:

11.3.4 For culverts in low 'headroom' situations the use of an open drain type structure is to be considered refer to drawings CS2108-C01 though to CS2108-C07

11.3.5 For box culverts 3.5 m to 4 m in span and for 1.2 m to 3.0 m in height, the following ARTC accepted standard design drawings are to be utilised:CV0041438,39,40, & 41, CV0078337, 338, CV0191708, 09 and CV0170059.

11.3.6 General culvert sleeving as per ARTCN309009601.

11.4 Culvert Extensions

11.4.1 Existing original culverts or culvert extensions are to be individually assessed regarding suitability to be extended/re-extended with respect to: hydraulic capacity, structural capacity, defect status and the condition and standard of any existing extension.

11.4.2 Main line 'Arch' culverts are to be extended as per the concept design drawing ARTCN3110128001.

11.5 Overbridges

11.5.1 To be single span over the rail tracks including any access roads.

11.5.2 To have an appropriate level of traffic barrier protection as per AS5100, the minimum requirement being "Medium Performance level".

11.5.3 All redundant bridge structures resulting from new works are to be removed, including the piers and footings to a minimum depth of 1.5m below rail.

11.6 Overbridge Clearance Provision

11.6.1 The horizontal clearances with consideration of Section 9, and Section 19 are to suit:

- Werris Creek to Muswellbrook 2 x Tracks
- Muswellbrook to Whittingham 3 x Tracks
- Whittingham to Maitland 4 x Tracks
- Maitland to Sandgate 4 x Tracks
- Ulan Line 2 x Tracks

12 FLOODING

All infrastructure under this category is to be designed/installed/maintained as per Section 10 of the ARTC Track and Civil Code of Practice unless noted otherwise

12.1 General

12.1.1 Refer also to Section 10.

12.1.2 Surface and Sub-Surface Track drainage to be incorporated in designs.

12.1.3 Refer to Typical section on Drawing ARTCN3110141001.

13 RAILWAY SIGNS

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All infrastructure under this category is to be designed/installed/maintained as per Section 11 of the ARTC Track and Civil Code of Practice

14 ACCESS CONTROL AND PROTECTION

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All infrastructure under this category is to be designed/installed/maintained as per Section 12 of the ARTC Track and Civil Code of Practice

15 FIRE PREVENTION AND CONTROL

All infrastructure under this category is to be designed/installed/maintained as per Section 13 of the ARTC Track and Civil Code of Practice unless noted otherwise

15.1 General

15.1.1 To reduce the risk of fire outbreak due to normal maintenance activities (e.g. grinding, welding), no revegetation works must occur within Zone ONE of Figure 15.1.

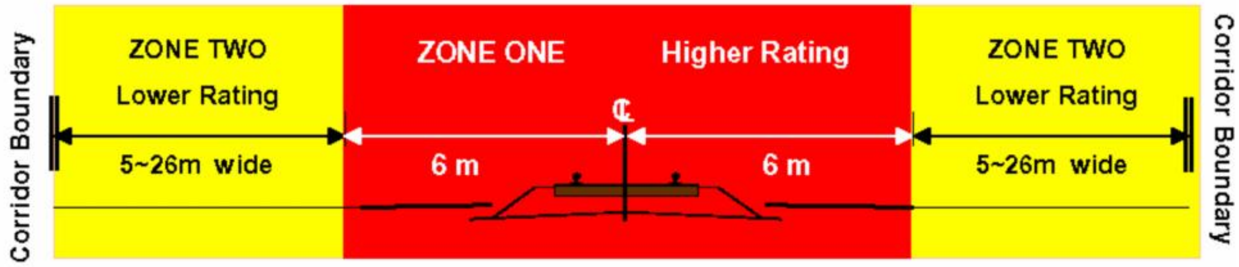

Figure 15.1 – Fuel Loading Zones (PP167)s

16 ELECTRICAL INFRASTRUCTURE

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All infrastructure under this category is to be designed/installed/maintained as per Section 14 of the ARTC Track and Civil Code of Practice

http://intranet.artc.com.au/eng_track-civil_procedure.html#electrical

17 LINE OF SIGHT

Section Left Intentionally Blank

All infrastructure under this category is to be designed/installed/maintained as per Section 15 of the ARTC Track and Civil Code of Practice

http://intranet.artc.com.au/eng_track-civil_procedure.html#los

18 GRADE CROSSINGS

All infrastructure under this category is to be designed/installed/maintained as per Section 16 of the ARTC Track and Civil Code of Practice unless noted otherwise

18.1 General

18.1.1 Alternate access/closure to be investigated in the first instance.

18.1.2 Any impact on sighting distance to be re-evaluated at passive level crossings prior to construction.

18.1.3 Any 'project impacted' public level crossing is to be upgraded to AS 1742.7, private levels crossings upgraded as per XDS02 minimum standard.

18.1.4 No public level crossing is to be blocked by trains stopped at signals

18.1.5 Low use private level crossings may be blocked provided there is a formal agreement with the effected landowner, with any access protocols fully described and included in the agreement.

18.1.6 For actively protected crossings refer also to H200+ Infrastructure Guidelines Signalling, Communications & Electrical.

18.2 Road Panels

18.2.1 Removable steel panels as per drawings ARTCN1060028001 through to 28004 are to be installed on all private road crossings and minor public roads. Liaison to be had with the landowner regarding stock use, as some crossings will require a rubber layer installed to ease cattle/sheep movements.

18.2.2 Removable Rubber road panels with concrete or steel edge beams are to be installed on major arterial roads (eg Highways) and also in 'built up' area's.

19 RIGHT OF WAY

All infrastructure under this category is to be designed/installed/maintained as per Section 17 of the ARTC Track and Civil Code of Practice unless noted otherwise

19.1 General

19.1.1 Any new infrastructure is to have an access plan developed with the applicable Team Manager and approved by the Operational Steering Committee.

19.1.2 Continuous access is required on both up and down sides if three or more tracks are proposed.

19.1.3 Continuous access is required on one side only if single or double track.

19.1.4 Suitable 'at grade' access is to be provided to key items of infrastructure (i.e. turnouts, signal equipment) and a 75 m long access section at a minimum of 500 m intervals along mainlines.

19.1.5 Access road to be 'at grade' where cuts or fills are <1.5 m in height when measured from the top of capping.

19.1.6 Passing areas of a minimum length of 30 m are to be installed at a nominal minimum of every 500 m, these should be placed to take advantage of the natural lay of the land and account for any infrastructure.

19.2 Access Road Geometric Design

19.2.1 The configuration of a new access road shall provide for:

- Vehicle entries and exits.
- Turning circles and standing areas provided where necessary;

- The minimum clear width of access road is 3.5 m (e.g. between signals/survey markers/toe of ballast and edges of access roads/drains/crash barriers/buildings);
- The minimum clear width of a passing area is 5.5 m.
- The default minimum vertical clearance shall be 4.6 m from road pavement to any overhead structures. Where this cannot be achieved any locations with lesser clearances shall be signposted accordingly;
- Suitable grades and cross-falls are to be used, the maximum grade is typically 10%

19.2.2 Excluding heavy construction equipment, vehicles used by ARTC may be up to 2.5 m wide, 4.3 m high and be trafficked by 3-axle rigid vehicles of up to 12.5 m in length.

19.2.3 Minimum shoulder width to the edge of the roadway is to be 6.5 m from track centreline which allows for 3.5 m carriageway.

- On the outside of curves <1000 m radius, add 0.5 m to access road widths to allow for increased ballast depth beneath sleepers.
- For embankments >3 m height when measured to the top of capping, add 0.5 m to the shoulder distance to allow for soft edges and increased safety.

19.2.4 Minimum shoulder width at turnouts to be 7.5 m from track centreline over the length of the turnout.

19.2.5 Passing areas located 'at grade' are to be a minimum width of 8.5 m from the track centreline.

19.3 Traffic Barriers

19.3.1 Install a vehicle safety barrier on embankments which meet all the following;

- Higher than 5 m
- Edge hinge point less than 7.5 m from track centre
- Batter is steeper than 1:2

19.3.2 For roads supported by a retaining wall or are near a vertical edge drop off ≥2 m in height, additional to any WHS requirements a vehicle safety barrier is to be installed on the edge of the access road. This does not necessarily need to be on the wall or structure.

19.3.3 For roads with a vertical edge drop off < 2 m, reflective guideposts are to be installed

19.4 Pavement (refer also to Appendix C)

19.4.1 The design of flexible access road pavements should generally be in accordance with 'Austroads' design guides e.g. Figure 4.3 of part 6.

19.4.2 The average ARTC Work Truck (single rear axle with dual tyres);

- Front axle 3 tonne empty, 5.6 tonne loaded
- Rear axle 3.4 tonne empty, 9.3 tonne loaded
- For design purposes this is ≈ R20 or ≈ 2 x Equivalent Standard Axles (ESA).

Note: rear tandem axle truck ≈2.65 ESA's, 30 tonne Dumper ≈ 4 ESA's

19.4.3 The total ESA's for a 20 year pavement design life are:

- x 10^3 Muswellbrook to Turrawan & Muswellbrook –Gulgong (≈ 1 truck per week).
- x 10^4 Newcastle to Muswellbrook (≈ 1 truck per day).

19.4.4 Where a road is 'at track grade' the pavement RL is to match the capping layer.

19.4.5 To be "All Weather" i.e. safely accessed by light vehicles in wet weather without damage.

19.4.6 There are three alternate ARTC 'default' designs contained in Appendix C

20 APPENDICIES

Appendix A – Hunter Valley Authorised Infrastructure Representatives

For consistency in interpretation of these guidelines the following staff are authorised to provide guidance and advice to Project Managers within their respective area of responsibility.

Area of Responsibility	Authorised Infrastructure Representative	Incumbent
Civil Concept Design	Manager Infrastructure and Projects	Jay Jayakumar
Civil Earthworks Design	Manager Infrastructure and Projects	Jay Jayakumar
Civil Drainage Design	Manager Infrastructure and Projects	Jay Jayakumar
Rail Infrastructure	Manager Infrastructure and Projects	Jay Jayakumar
Signal Concept Design	Manager Signalling and Compliance	John Gifford
Signal Infrastructure	Senior Signal and Systems Engineer	Mark Blaik
Signalling Control Systems	Senior Signal and Systems Engineer	Mark Blaik
Communication/Telemetry Network	Senior Signal and Systems Engineer	Mark Blaik

Appendix B – Minimum Crossing Loop Lengths

Loop Design

The “crossing loop length” is defined as the distance between the turnout tangent points (TOTP) at each end of the crossing loop. This distance should not be confused with “standing room” - which has a variety of definitions - but is more commonly known as the distance between clearance points at each end of the crossing loop.

Crossing loop length requirements vary in the Hunter Valley rail corridor due to TOC restrictions, the maximum length of train to be accommodated and operational requirements. For these reasons it is not possible to adopt a standard crossing loop length across the entire Hunter network. As such two worked example crossing loops are provided below for each area. Please note that these examples do not include an allowance for “simultaneous entry” signalling – the inclusion of simultaneous entry adds approximately 300-400m more to the overall crossing loop length (to be calculated on a case by case basis).

Minimum Crossing Loop Lengths (Ports to Muswellbrook and Ulan Line)

Reference	Crossing Loop Element	Length Required
Refer to design	Turnout TOTP to Clearance Point	x m
Section 1.4.2	Clearance Point to GIJ	3 m
Section 1.4.3	GIJ to Starter Signal	2 m (max)
Section 1.4.4	Starter Signal to Front of Train Consist (Lead Locomotive)	15 m
Section 1.4.1	Length of Train Consist	1,543 m
N/A	Allowance for recovery (3 x Locomotives @ 22m each)	66 m
Section 1.4.3	GIJ to Starter Signal	2 m (max)
Section 1.4.2	Clearance Point to GIJ	3 m
Refer to design	Turnout TOTP to Clearance Point	x m
	Minimum Lower Hunter + Ulan Crossing Loop Standing Room (CP to CP)	**1,634 m**
	Minimum Lower Hunter + Ulan Crossing Loop Length (TOTP to TOTP):	**1,634 + 2x m**

An example configuration for a crossing loop layout in the Lower Hunter is shown below in Figure B1. This example uses Vossloh Cogifer 1:18.5 R1200 turnouts (where; TOTP to CP or x = 100m) at each end of the crossing loop, giving the crossing loop an overall loop length of 1,834m.

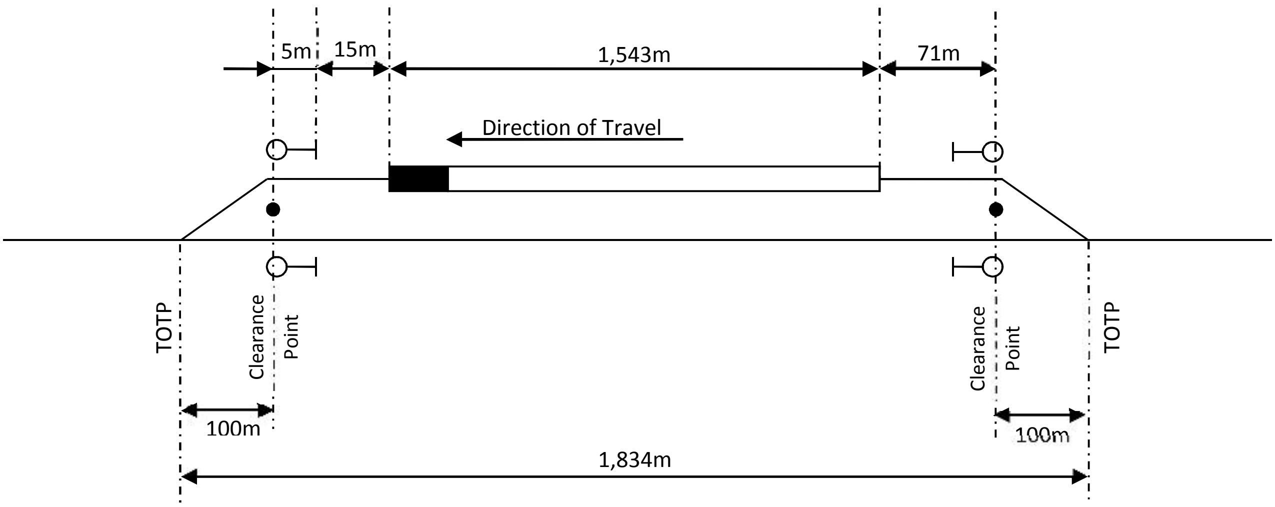


Figure B1 - Example Lower Hunter Crossing Loop with VC 1:18.5 R1200 Turnouts

Minimum Crossing Loop Lengths (Upper Hunter: Muswellbrook – Turrawan)

Reference	Crossing Loop Element	Length Required
Refer to design	Turnout TOTP to Clearance Point	x m
Section 1.4.2	Clearance Point to GIJ	3 m
Section 1.4.3	GIJ to Starter Signal	2 m (max)
Section 1.4.4	Starter Signal to Front of Train Consist (Lead Locomotive)	15 m
Section 1.4.1	Length of Train Consist	1,329 m
N/A	Allowance for recovery (3 x Locomotives @ 22m each)	66 m
Section 1.4.3	GIJ to Starter Signal	2 m (max)
Section 1.4.2	Clearance Point to GIJ	3 m
Refer to design	Turnout TOTP to Clearance Point	x m
	Minimum Upper Hunter Loop Standing Room (CP to CP)	**1,420 m**
	Minimum Upper Hunter Loop Length (TOTP to TOTP):	**1,420 + 2x m**

An example configuration for a crossing loop layout in the Upper Hunter is shown below in Figure B2. This example uses Vossloh Cogifer 1:12 R500 turnouts (where; TOTP to CP or x = 65m) at each end of the crossing loop, giving the crossing loop an overall minimum loop requirement of 1,571m.

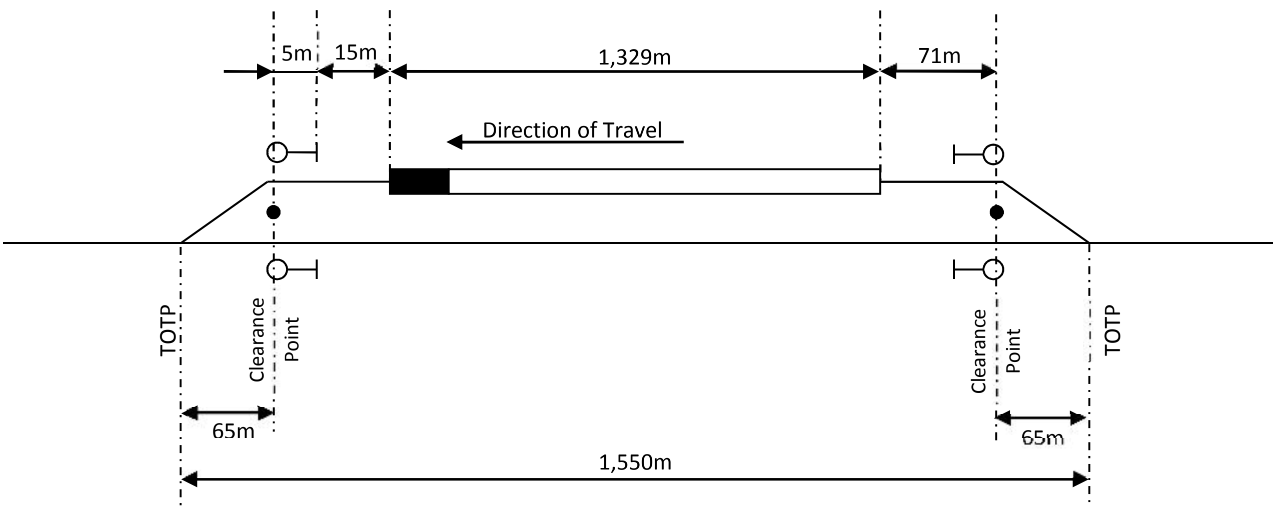
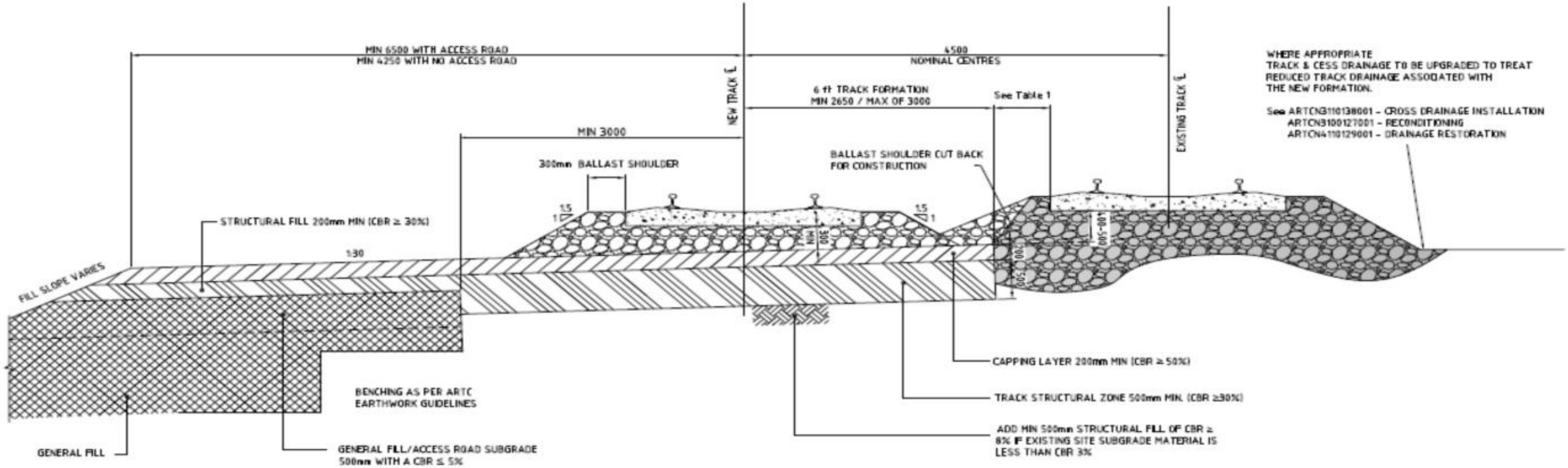


Figure B2 - Example Upper Hunter Crossing Loop with VC 1:12 R500 Turnouts

Appendix C – Typical Track Duplication Cross Sections



NOTE:
Removal of the shoulder may require precautions such as limiting the extent of longitudinal excavation of the shoulder in hot weather, the assessment of existing subgrade once excavated, and TSRs.

DIMENSIONS OPTION 1

TABLE 1

TRACK CENTRES (mm)	MAX OFFSET
≤4850	600
>4850	(Track Centres)−4250

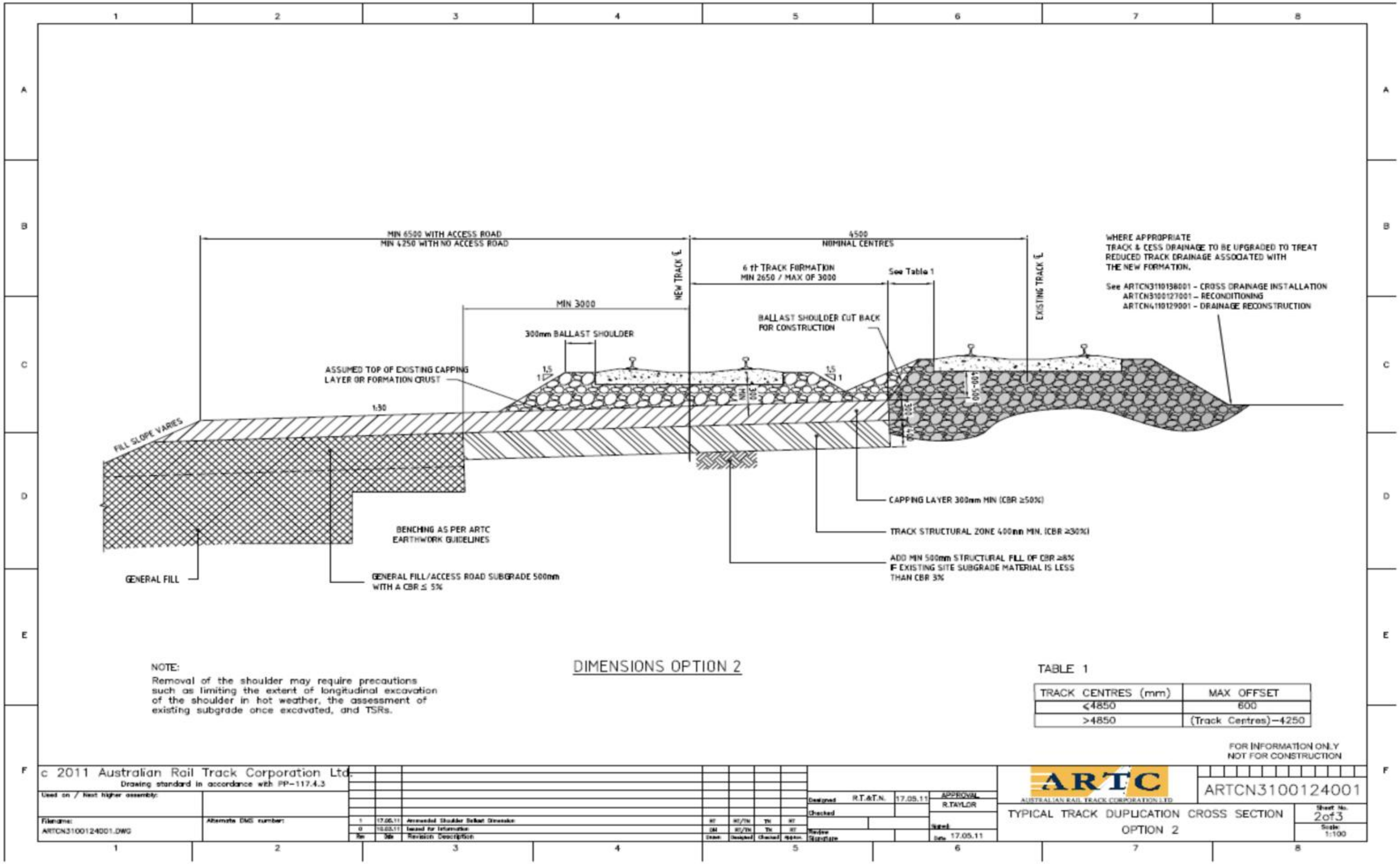
FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

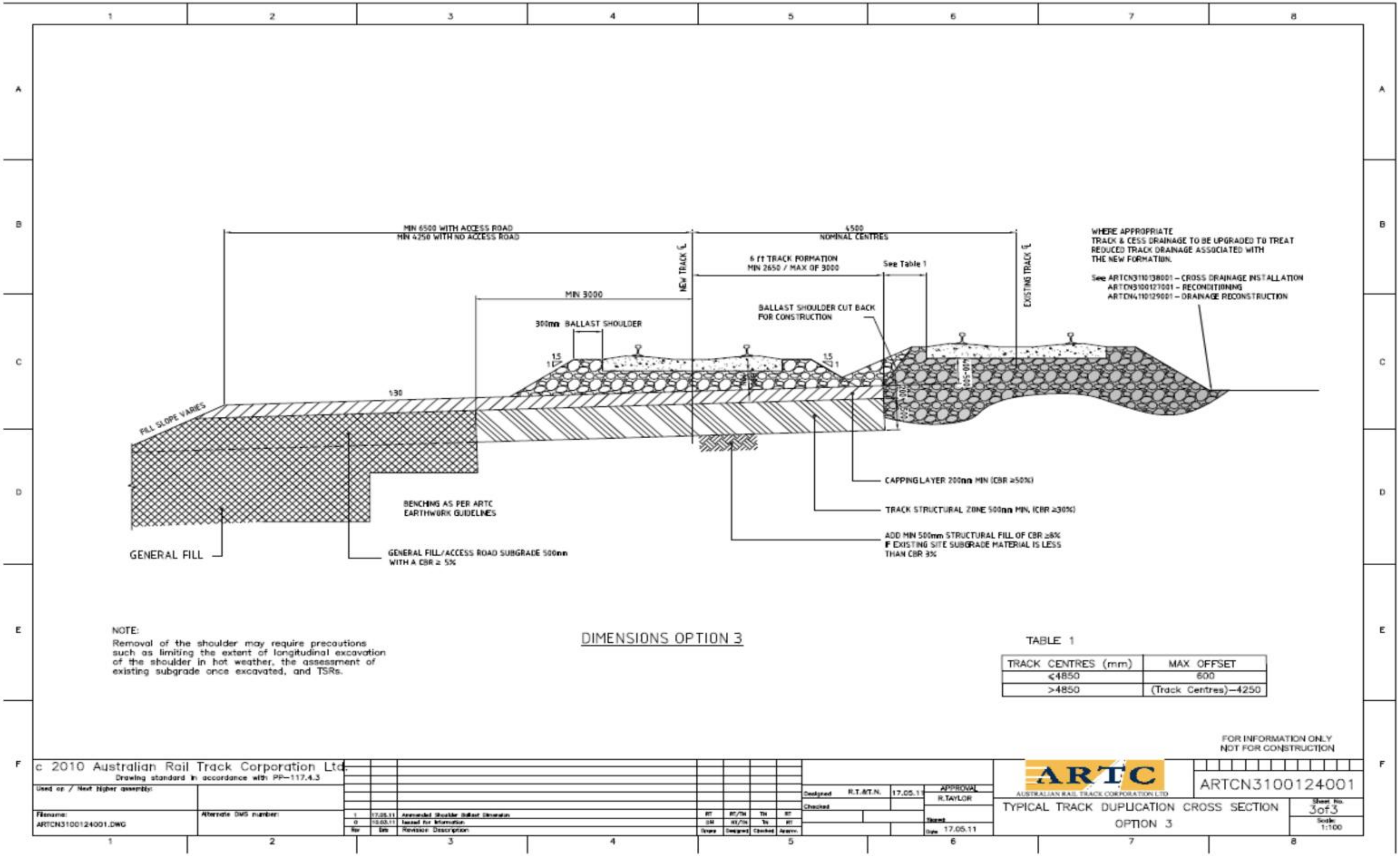
Drawing standard in accordance with PP–117.4.3
Used on / Next Higher assembly:
Filename: ARTCN3100124001.DWG
Alternate DMS number:

Rev	Date	Revision Description	Drawn	Designed	Checked	Approved
1	17.05.11	Amended Shoulder Ballast Dimension	RT	RT/TN	TN	RT
0	10.03.11	Issued for Information	DH	RT/TN	TN	RT

Designed R.T.&T.N. 17.05.11
Checked
APPROVAL R.TAYLOR
Signed:
Date 17.05.11

ARTC AUSTRALIAN RAIL TRACK CORPORATION LTD
ARTCN3100124001
TYPICAL TRACK DUPLICATION CROSS SECTION
OPTION 1
Sheet No. 1of3
Scale: 1:100


MIN 6500 WITH ACCESS ROAD
MIN 4250 WITH NO ACCESS ROAD
4500
NOMINAL CENTRES
NEW TRACK ℄
EXISTING TRACK ℄
6 ft TRACK FORMATION
MIN 2650 / MAX OF 3000
See Table 1
MIN 3000
300mm BALLAST SHOULDER
BALLAST SHOULDER CUT BACK
FOR CONSTRUCTION
ASSUMED TOP OF EXISTING CAPPING
LAYER OR FORMATION CRUST
1:30
FILL SLOPE VARIES
WHERE APPROPRIATE
TRACK & CESS DRAINAGE TO BE UPGRADED TO TREAT
REDUCED TRACK DRAINAGE ASSOCIATED WITH
THE NEW FORMATION.
See ARTCN3110138001 - CROSS DRAINAGE INSTALLATION
ARTCN3100127001 - RECONDITIONING
ARTCN4110129001 - DRAINAGE RECONSTRUCTION
CAPPING LAYER 300mm MIN (CBR ≥50%)
TRACK STRUCTURAL ZONE 400mm MIN. (CBR ≥30%)
ADD MIN 500mm STRUCTURAL FILL OF CBR ≥8%
IF EXISTING SITE SUBGRADE MATERIAL IS LESS
THAN CBR 3%
BENCHING AS PER ARTC
EARTHWORK GUIDELINES
GENERAL FILL
GENERAL FILL/ACCESS ROAD SUBGRADE 500mm
WITH A CBR ≤ 5%
NOTE:
Removal of the shoulder may require precautions
such as limiting the extent of longitudinal excavation
of the shoulder in hot weather, the assessment of
existing subgrade once excavated, and TSRs.
DIMENSIONS OPTION 2
TABLE 1
TRACK CENTRES (mm) | MAX OFFSET
<4850 | 600
>4850 | (Track Centres)-4250
FOR INFORMATION ONLY
NOT FOR CONSTRUCTION
c 2011 Australian Rail Track Corporation Ltd
Drawing standard in accordance with PP-117.4.3
Used on / Next higher assembly:
Filename:
ARTCN3100124001.DWG
Alternate DMS number:
1 17.05.11 Amended Shoulder Ballast Dimension
0 10.03.11 Issued for Information
Rev Date Revision Description
Designed R.T.&T.N. 17.05.11
Checked
APPROVAL
R.TAYLOR
Date 17.05.11
ARTC
AUSTRALIAN RAIL TRACK CORPORATION LTD
ARTCN3100124001
TYPICAL TRACK DUPLICATION CROSS SECTION
OPTION 2
Sheet No. 2of3
Scale: 1:100


MIN 6500 WITH ACCESS ROAD
MIN 4250 WITH NO ACCESS ROAD
4500
NOMINAL CENTRES
NEW TRACK ℄
EXISTING TRACK ℄
6 ft TRACK FORMATION
MIN 2650 / MAX OF 3000
See Table 1
MIN 3000
300mm BALLAST SHOULDER
BALLAST SHOULDER CUT BACK
FOR CONSTRUCTION
WHERE APPROPRIATE
TRACK & CESS DRAINAGE TO BE UPGRADED TO TREAT
REDUCED TRACK DRAINAGE ASSOCIATED WITH
THE NEW FORMATION.
See ARTCN3110138001 – CROSS DRAINAGE INSTALLATION
ARTCN3100127001 – RECONDITIONING
ARTCN4110129001 – DRAINAGE RECONSTRUCTION
1:30
FILL SLOPE VARIES
CAPPING LAYER 200mm MIN (CBR ≥50%)
TRACK STRUCTURAL ZONE 500mm MIN. (CBR ≥30%)
ADD MIN 500mm STRUCTURAL FILL OF CBR ≥8%
IF EXISTING SITE SUBGRADE MATERIAL IS LESS
THAN CBR 3%
BENCHING AS PER ARTC
EARTHWORK GUIDELINES
GENERAL FILL
GENERAL FILL/ACCESS ROAD SUBGRADE 500mm
WITH A CBR ≥ 5%
NOTE:
Removal of the shoulder may require precautions such as limiting the extent of longitudinal excavation of the shoulder in hot weather, the assessment of existing subgrade once excavated, and TSRs.
DIMENSIONS OPTION 3
TABLE 1
TRACK CENTRES (mm) | MAX OFFSET
≤4850 | 600
>4850 | (Track Centres)–4250
FOR INFORMATION ONLY
NOT FOR CONSTRUCTION
c 2010 Australian Rail Track Corporation Ltd
Drawing standard in accordance with PP–117.4.3
Used on / Next higher assembly:
Filename:
ARTCN3100124001.DWG
Alternate DMS number:
1 17.05.11 Amended Shoulder Ballast Dimension RT RT/TN TN RT
0 10.03.11 Issued for Information SM RT/TN TN RT
Rev Date Revision Description Drawn Designed Checked Approved
Designed R.T.&T.N. 17.05.11
Checked
APPROVAL
R.TAYLOR
Signed
Date 17.05.11
AUSTRALIAN RAIL TRACK CORPORATION LTD
ARTCN3100124001
TYPICAL TRACK DUPLICATION CROSS SECTION
OPTION 3
Sheet No. 3of3
Scale 1:100