NSW GOVERNMENT

TS 03510:1.0

Standard

Track System

Issue date: 08 July 2025

Effective date: 08 July 2025

Disclaimer

This document has been prepared by Transport for NSW (TfNSW) specifically for its own use and is also available for use by NSW public transport agencies for transport assets.

Any third parties considering use of this document should obtain their own independent professional advice about the appropriateness of using this document and the accuracy of its contents. TfNSW disclaims all responsibility and liability arising whether directly or indirectly out of or in connection with the contents or use of this document.

TfNSW makes no warranty or representation in relation to the accuracy, currency or adequacy of this document or that the document is fit for purpose.

The inclusion of any third-party material in this document, does not represent an endorsement by TfNSW of any third-party product or service.

For queries regarding this document, please email Transport for NSW Asset Management Branch at standards@transport.nsw.gov.au or visit www.transport.nsw.gov.au

Document information

Owner:	Director Corridor Infrastructure and Engineering Asset Management Planning, Integration and Passenger
Mode:	Heavy rail
Discipline:	Track

Document history

Revision	Effective date	Summary of changes
1.0	08/07/2025	This standard is a first issue as TS 03510 and supersedes ESC 200 *Track System*, version 4.3. This document also supersedes UGL Regional Linx standard TS 01044:1.0 *Track System* (CRN CS 200 *Track System*, version 2.1).

Preface

This standard is a first issue as TS 03510 and supersedes ESC 200 *Track System,* version 4.3. This document also supersedes UGL Regional Linx standard TS 01044:1.0 *Track System* (CRN CS 200 *Track System*, version 2.1).

This document establishes the operational requirements of the heavy rail network as well as functional and design requirements, approved configurations, and acceptance standards for track configurations for use on the MRA and CRN heavy rail networks.

This document was developed in response to the requirements for harmonisation of heavy rail standards.

The changes to the previous version include:

- Harmonisation of TS 03510:0.0 (ESC 200 Version 4.3) and TS 01044:1.0 into a unified track system standard.
- Harmonisation of operational concept and traffic classification with new naming convention for Metropolitan Rail Area and Country Regional Network.
- Introduction of a dedicated section as “Track Structure as a System” outlining different structural systems and associated components and requirements according to the Metropolitan Rail Area and the Country Regional Network within the unified standard.
- Modifications to the System map of the Metropolitan Rail Area and the Country Regional Network to reflect the harmonised traffic classification as well as recent updates to the rail network.

Table of contents

1 Scope

This standard establishes functional and performance requirements for track. It establishes specific characteristics and, where necessary, limitations to be incorporated in any final design solution.

It applies to the following elements and attributes of track infrastructure for main lines, sidings and yards:

- track system – including geometry, stability and transit space
- rail – including rail joints and rail-to-rail fastenings,
- ties and track support, including sleepers, rail-to-sleeper fastenings, direct fixation systems, sleeper plates and pads
- ballast
- special trackwork – including turnouts, diamonds, catchpoints, slips and expansion switches
- formation width and earthworks profile.

2 Application

This document is intended for use by TAOs and is applicable to all the MRA and CRN main lines and siding tracks within the heavy rail network.

This document applies for all new works, or where a significant alteration to the existing infrastructure occurs and incorporation of the requirements is strategically necessary to progress its general adoption. Small alterations or additions to existing infrastructure may employ the same track configuration as existing at that location.

3 Referenced documents

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

Australian standards

AS/RISSB 4292 *Railway Safety Management*

Transport for NSW documents

MN A 00100 *Civil and Track Technical Maintenance*

TfNSW *Service Level Charter*

TS 00003.1 *Concessions to Transport Standards – Part 1 – Concession Process*

TS 00021 *Track Type Approved Product Register*

TS 00172 *Track Glossary of Terms*

TS 01608 (T HR CI 12110 ST) *Earthworks and Formation*

TS 01638 (T HR CI 12130 ST) *Track Drainage*

TS 01713 (T HR CI 12020 ST) *Underbridges*

TS 02402 (T HR CI 12072 ST) *Track Slabs*

TS 03499 (ESC 210) *Track Geometry and Stability* (standard)

TS 03500 (ESC 215) *Transit Space*

TS 03501 (ESC 250) *Turnouts and Special Trackwork*

TS 03504 (SPC 206) *Track Construction*

TS 03508 (TMC 211) *Track Geometry & Stability* (manual)

TS 03509 (TMC 251) *Turnouts*

TS 03511 (TMC 202) *Track Fundamentals*

TS 03512 (TMC 213) *Derailment Investigation – Track and Rolling Stock*

TS 03554 (TMC 101) *Track Service Schedules*

TS 03609 (T HR TR 00192 ST) *Ballast* (standard)

TS 03611 *Rail and Rail Joints*

TS 03612 (ESC 230) *Sleepers and Track Support*

TS 03621 (TMC 203) *Track Inspection*

TS 03622 (TMC 221) *Rail Installation and Repair*

TS 03623 (TMC 222) *Rail Welding*

TS 03624 (TMC 223) *Rail Adjustment*

TS 03625 (TMC 224) *Rail Defects and Testing*

TS 03626 (TMC 225) *Rail Grinding*

TS 03627 (TMC 226) *Rail Defects Handbook*

TS 03628 (TMC 227) *Surface Defects in Rails*

TS 03629 (TMC 231) *Sleepers & Fastenings*

TS 03630 (TMC 241) *Ballast* (manual)

TS 04443 (TS TOC 1) *Train Operating Conditions (TOC) Manual – General Instructions*

TS 04444 (TS TOC 2) *Train Operating Conditions (TOC) Manual – Division Pages*

TS 04445 (TS TOC 3) *Train Operating Conditions (TOC) Manual – Track Diagrams*

TS 06178 (T MU MD 00005 GU) *Type Approval of Products*

TS TOC 4 *Train Operating Conditions (TOC) Manual – Road rail vehicle database*

CRN documents

CRN CM 002 *Engineering Waivers*

CRN CM 005 *Track Structure Design Assessment*

Standard working timetable

TOC 00 *Section 0 – TOC Manual Format and Glossary*

TOC 01 *Section 1 – Route Information*

TOC 02 *Section 2 – Locomotive Operations*

TOC 03 *Section 3 – Train Operations*

TOC 04 *Section 4 – Train Marshalling*

TOC 05 *Section 5 – Loading Restrictions*

TOC 06 *Section 6 – Train Inspection*

TOC 07 *Section 7 – Train Numbering*

TOC 08 *Section 8 – Disabled Trains and Defective Vehicles*

TOC 09 *Section 9 – Infrastructure Maintenance Vehicle Operations*

TOC 10 *Section 10 – Locomotive & Rolling Stock Data*

TOC 11 *TOC Section 11 – Infrastructure Maintenance Vehicle Data*

TOC 12 *Section 12 – RRV, Trolley, Quadricycle & Trailer Data*

TOC 13 *Section 13 – Northen Section Pages*

TOC 14 *Section 14 – Northen Track Diagrams*

TOC 15 *Section 15 – Southern Section Pages*

TOC 16 *Section 16 – Southern Track Diagrams*

TOC 17 *Section 17 – Western Section Pages*

TOC 18 *Section 18 – Western Track Diagrams*

TS 01002 (CRN CS 310) *Underbridges*

TS 01004 (CRN CS 330) *Engineering Standards – Miscellaneous Structures*

TS 01043 (CRN CS 100) *Civil Technical Maintenance Plan*

TS 01045 (CRN CS 210) *Track Geometry and Stability* (standard)

TS 01046 (CRN CS 215) *Transit Space*

TS 01047 (CRN CS 220) *Rail and Rail Joints*

TS 01048 (CRN CS 230) *Sleepers And Track Support*

TS 01049 (CRN CS 240) *Ballast* (standard)

TS 01050 (CRN CS 250) *Turnouts and Special Trackwork*

TS 01051 (CRN CS 410) *Engineering Standard – Geotechnical Formation and Earthworks*

TS 01052 (CRN CS 420) *Track Drainage*

TS 01089 (CRN CP 204) *Product Approval*

TS 01091 (CRN CP 206) *Track Construction*

Legislation

Rail Safety Act 2002 (NSW)

Rail Safety National Law National Regulations 2012 (NSW)

Rail Safety National Law (NSW) 2012 (NSW)

4 Terms, definitions and abbreviations

The following terms, definitions and abbreviations apply in this document.

For additional track-related definitions and terminologies, refer to TS 00172.

CRN Country Regional Network, owned by Transport for NSW and links broad areas of regional NSW to interstate and metropolitan rail systems. In addition it supports customers transporting coal, grain, cotton, minerals and containerised freight to domestic and export markets.

CWR continuous welded rail

HH head hardened

LWR long welded rail

MGT mega gross tonne

MRA metropolitan rail area, the area bounded by Newcastle Interchange (in the north), Richmond (in the northwest), Bowenfels (in the west), Macarthur (in the southwest) and Bomaderry (in the south), and all connection lines and sidings within these areas, but excluding private sidings

RIM rail infrastructure manager

TAO Technically Assured Organisation

TfNSW Transport for NSW

5 Functional requirements

5.1 General

MRA and CRN track systems shall be designed, constructed and maintained to meet the following general criteria:

- provide a safe and reliable corridor for the passage of all rail traffic
- be capable of supporting the operation of rail traffic at the designated loads and speeds for each section of track
- provide a path for signalling circuits (where required)
- provide a safe return path for electric traction currents in electrified sections
- conform with transit space requirements
- meet specified availability, reliability and maintainability requirements.

5.2 Operating environment

This document has been developed in consideration of the following operational and environmental variables:

- traffic types
- line function (e.g. passenger, freight, siding and maintenance facility)
- vehicle speeds, axle loads, wheel diameter and gross annual tonnages
- longitudinal and lateral loads generated by rolling stock
- requirements for track signalling circuits
- requirements for electric traction
- rail temperature range – thermal expansion and contraction forces act on rail within a temperature range from –10°C to 75°C, with a neutral temperature of about 35°C, or as specified by the RIM's rail stressing strategy and defined neutral temperature
- air temperature range of –10°C to 45°C.

The operating environment may also include potentially corrosive situations, such as wet tunnels, salty atmospheres, and locations subject to chemical contamination or electrolysis.

5.3 Operating concept

Track systems shall be designed for train operations arising from one or more of the basic traffic classifications specified in Table 1. The maximum speeds and axle loads in Table 1are for the purposes of design and track configuration. The definitive speed and axle load conditions for all

rolling stock (which may be higher than that specified in Table 1) are detailed in TS 04443, TS 04444, TS 04445 and TS TOC 4 for the MRA and TOC 00 – TOC 18 for the CRN, as well as Standard Working Timetable for both the MRA and CRN.

Table 1 – Traffic classification

Traffic classification	Traffic description	Maximum axle load (tonne)	Maximum potential vehicle speed (km/h)
MP1	Old-style metropolitan passenger	18	115
MP2	New-style metropolitan passenger	19	145
RP1	Regional passenger 1 loco-hauled e.g. Indian Pacific	15	115
RP2	Regional passenger 2	19	160
LM1	Locomotive light	17.25	30
LM2	Locomotive	19	100
LM3	Locomotive	23	115
LM4	Locomotive heavy haul	28	60
F1	Freight (RS Class A)	19	115
F2	Freight (RS Class B)	21	100
F3	Freight (RS Class C)	23	80
F4	Freight heavy (RS Class F)	25	65
F5	Freight enhanced (RS Class C) (see note)	25	80
F6	Freight heavy haul (RS Class G)	30	60

Note: Class C vehicles enhanced with primary suspension or meeting steering requirements allowing 100 t operation.

TfNSW has adopted a set of standard operating classes to describe the current and potential mix of traffic classes in its operating environment. Each operating class detailed in Table 2 and Table 3 includes a mix of permitted traffic classes. that can make an unlimited contribution to the traffic volume on a line section, or can be restricted to a limited tonnage. Limited contribution describes traffic classifications that occasionally use the line but their effect on track structure fatigue and wear is negligible when compared to unlimited operations.

The expected operational speed of the traffic classes is specified in brackets following the traffic class. Table 2 describes the standard operating classes for the main lines. Table 3 describes the standard siding classes for the sidings.

For example, the passenger main line class may have an unlimited mix of old-style metropolitan passenger (MP1) operating at 115 km/h and new-style metropolitan passenger (MP2) operating at 140 km/h. However, it has a limited contribution for the regional passenger 2 (RP2) operating

at 160 km/h, the regional passenger 1 loco hauled (RP1) operating at 115 km/h, the freight (RS Class B) (F2) operating at 100 km/h, and the locomotive (LM3) operating at 115 km/h.

Unless otherwise specified, the track shall be designed to meet the requirements of one of the operating classes in Table 2 and Table 3. The operating class for each line section of TfNSW's current track network is detailed in Appendix A for the MRA and Appendix B for the CRN. Where major track construction is being planned, the operating class shall be reviewed to establish if it meets TfNSW's future operating requirements.

Table 2 – Operating classes – Main line

Operating class	Description	Unlimited operation traffic classes (operational speed km/h)	Limited contribution traffic classes (operational speed km/h)	Typical traffic volume (MGT/year)
OC-1	Passenger main line	MP1 (115), MP2 (145)	RP2 (160), RP1 (115), F1 (115), F2 (100), LM3 (115)	40
OC-2	Heavy haul main line	MP1 (115), MP2 (145), F3 (80), F4 (65), F5 (80), LM3 (115), F6 (80), LM4 (80)	RP2 (160), RP1 (115), F1 (115), F2 (100)	60
OC-3	Main line high density	MP1 (115), MP2 (145), F3 (80), F4 (65), F5 (80), LM3 (115)	RP2 (160), RP1 (115), F1 (115), F2 (100)	40
OC-4	Main line medium density	MP1 (115), MP2 (145), LM3 (115)	RP2 (160), RP1 (115), F1 (115), F2 (100)	20
OC-5	Main line low density	RP1 (115), RP2 (160), F1 (115), F2 (100), F3 (80), F4 (80)	LM1 (100), LM2 (115), LM3 (115)	10
OC-6	Light main line	RP1 (100), RP2 (140), F1 (100), F2 (65), F3 (50)	LM1 (100), LM2 (100), LM3 (80)	6
OC-7	Branch line	RP1 (100), RP2 (120), F1 (100), F2 (50)	LM1 (100), LM2 (100), LM3 (60)	5
OC-8	Light branch line	RP1 (50), RP2 (50), F1 (50), F2 (30)	LM1 (30), LM2 (50)	1

Note: A limited contribution describes a traffic classification that occasionally uses the line but its effect on track structure fatigue and wear is negligible when compared to unlimited operations.

Table 3 – Operating classes – Yard/siding (speed limited to 25 km/h)

Siding class	Description	Unlimited operation traffic classes	Limited contribution traffic classes	Typical traffic volume (MGT/year)
SC-1	High density general siding	MP1, MP2, F3, F4, F5	RP2, RP1, F2	50
SC-2	Medium density passenger operations or maintenance	MP1, MP2	RP2, RP1, F2, LM3	20
SC-3	Low density metropolitan freight siding	F3, F4, F5, LM3	RP2	5
SC-4	Low density passenger siding	MP1, MP2	RP2, RP1, F2, LM3	3
SC-5	Engineering maintenance siding	F3, F4, F5, LM3		1
SC-6	High density regional freight siding	F1, F2, F3, F4, RP2, RP1	LM1, LM2, LM3	6
SC-7	Low density regional freight siding	F1, F2, F3, RP2, RP1	LM1, LM2, LM3	6
SC-8	High density grain siding	F1, F2, RP2, RP1	LM1, LM2, LM3	5
SC-9	Low density grain siding	F1, F2, RP2, RP1	LM1, LM2	1

Note: A limited contribution describes a traffic classification that occasionally uses the line but its effect on track structure fatigue and wear is negligible when compared to unlimited operations.

5.4 Operating interfaces

Track infrastructure shall be compatible with and capable of operation with the infrastructure in adjoining sections. New works shall be designed to preserve physical and functional interfaces with adjoining sections and equipment.

5.5 Design life

Track shall be designed to achieve a minimum operating life of not less than 20 years, or as defined by the project custodian requirements, operating at the capacity nominated in the relevant operating class in Table 2 and Table 3 before requiring upgrading or rework in excess of routine or major cyclic maintenance.

The design should be such as to permit life extension up to 100 years at the loading and utilisation levels specified in Table 2 and Table 3 following completion of the appropriate major cyclic maintenance and minor upgrading to maintain compatibility with general system standards applicable at that time.

Track configuration shall be selected to minimise the whole-of-life cost of the asset.

5.6 Transit space requirements

The design of the track shall comply with transit space requirements specified in TS 03500 for the MRA and TS 01046 for the CRN.

5.7 Maximum speed

Track shall be designed to comply with maximum safe speed requirements defined in TS 03499 for the MRA and TS 01045 for the CRN.

The design shall provide for operation of trains at speeds nominated for the designated operating class in Table 2 and Table 3.

5.8 Maximum length of train

Maximum train lengths shall be specified where they may be limited by:

- lengths of refuges, loops or sidings, etc.
- train handling requirements
- signalling requirements.

5.8.1 Loop and siding lengths

The maximum loop or siding length shall be determined by the RIM as the longest effective section of track free from:

- controlling signals or related insulated joints
- clearance posts
- toes of catchpoints or derailers
- buffer stops.

For operational purposes, the length of occupying trains shall account for factors such as train handling allowance and drawgear stretch. This is known as the train comparison length.

5.9 Safety

All works shall be designed to comply with the requirements of relevant Commonwealth and NSW legislation for construction, operation and maintenance, in particular *Rail Safety National Law (NSW) 2012*, *Rail Safety National Law National Regulations 2012* and AS/RISSB 4292.

A risk analysis shall be completed in accordance with the requirements of the RIM's safety management system to cover design, construction, operation and maintenance activities to verify that there is no significant increase in risk to operators, construction and maintenance staff, or to the public.

5.10 Maintenance and maintainability

TfNSW's existing track assets shall be maintained in accordance with MN A 00100 for the MRA and TS 01043 for the CRN and the suite of service schedules for track in TS 03554, or the approved equivalent network specific versions managed by the RIM. In addition, track assets shall be installed, inspected and maintained using procedures documented in TS 03508, TS 03509, TS 03511, TS 03512, TS 03621 to TS 03630 or the approved equivalent network specific versions managed by the RIM. Installation, inspection and maintenance tasks shall be undertaken by people with the competencies documented in the RIM's competency requirement documents.

When undertaking new track designs, deterioration limits (to be referred to as damage limits or base operating limits) shall be set for relevant track components that have failure modes with significant impact. A mandatory response shall also be set for each damage limit found, ranging from recording for future information and action to immediate closure of the track. Limits and responses developed in the design shall be formulated to match the response regime documented in TS 03621 or the approved equivalent network specific version managed by the RIM.

Technical maintenance plans and service schedules shall be prepared and implemented for all track assets:

- specifying which items are to be maintained
- what maintenance is to be carried out
- when maintenance is required.

Preventive maintenance tasks already documented in MN A 00100 and TS 03554, or the approved equivalent network specific versions managed by the RIM shall be utilised where possible. The temporary maintenance plans and service schedules shall be documented in a format that can be readily incorporated into MN A 00100 and TS 03554 or the approved equivalent network specific versions managed by the RIM.

Installation, inspection and maintenance procedures shall be documented in a format that can be readily incorporated in TS 03508, TS 03509, TS 03511, TS 03512, TS 03621 to TS 03630 or the approved equivalent network specific versions managed by the RIM.

Those responsible for new designs shall take into account and incorporate appropriate solutions for maintainability. This includes, but is not limited to:

- taking into account access to the site
- distance (time) to attend
- staff training
- and knowledge of the equipment.

It is good practice to group similar items, and to minimise their variety to help ensure staff are familiar with the equipment. This approach optimises maintenance and repair times, and best ensures unsafe situations do not occur due to staff error.

When considering access to the site for maintenance, designers shall consider the location and orientation of equipment with respect to the defined danger zone within the rail corridor. To maximise the safety of personnel maintaining fixed equipment within the rail corridor, it is important that the manufacture and installation design of such equipment, wherever practicable, be such that personnel are able to work outside the danger zone and are not required to work with their backs to the danger zone.

5.11 Construction

For heavy rail network specifications for construction of track, refer to TS 03504 for the MRA and TS 01091 for the CRN.

These specifications provide a suite of requirements for track construction that may be included wholly, or in part, in a project specification.

Appropriate sections of the specifications shall be incorporated in the design and construction documentation of track works for the MRA and the CRN.

5.12 Type approval

New or reused track components, specialised repair processes and tools are subject to type approval, which is a process that assesses the fitness for purpose of any item from a specified manufacturer for use on the network. Products, manufacturers, and processes currently approved for use on heavy rail network track infrastructure are detailed in appendices to TS 03501, TS 03609, TS 03611 and TS 03612 for the MRA and TS 01047 to TS 01050 for the CRN.

If the design incorporates products (whether new or from a non-approved manufacturer) or processes that are not currently approved for use on track infrastructure, type approval shall be

sought in accordance with the requirements of TS 06178 for the MRA and TS 01089 for the CRN.

The type approval of an item from a specified manufacturer does not necessarily indicate that it is the preferred item for a specific site or operational requirement.

5.13 Standard plans

Standard plans are available in the RIM's Plan Room. The construction of assets shall be in accordance with the most recent version of the relevant standard plans. Maintenance activities shall use the standard plan relevant at the time of the design and construction.

6 Minimum design standards

6.1 Track geometry

The design of new track and the realignment of existing track shall meet the track geometry requirements established in TS 03499 for the MRA and TS 01045 for the CRN. The requirements include:

- spatial control of track location
- adoption of geometry based on defined geometry components (curves and straights) in both horizontal and vertical alignment
- limits for radius, superelevation, superelevation deficiency, length of horizontal alignment components, transition geometry, and grades based on operation of trains at speeds nominated for the designated operating class in Table 2 and Table 3
- Design of track vertical alignment to withstand flooding in accordance with TS 01638 for the MRA and TS 01052 for the CRN. This requirement shall be achieved in conjunction with the appropriate hydrology and earthworks design documented in TS 01713 and TS 01608 for the MRA and TS 01002 and TS 01051 for the CRN.

6.2 Track stability

The design of new track geometry and structure, and the reconstruction and maintenance of existing track, shall meet the track stability requirements established in TS 03499 and TS 03611 for the MRA and TS 01045 and TS 01047 for the CRN. The requirements include:

- rail neutral temperature of 35°C or otherwise determined by the RIM, with approval by AMB
- track structure design capable of providing resistance to lateral movement in the rail temperature range established in Section 5.2.

6.3 Track stiffness

Track stiffness is a result of the combination of the stiffness of the different constituents of the track.

For track on rigid foundations, such as ballast top bridges, a means of moderating the track stiffness shall be taken into account. Guidelines for use of ballast mat on rigid structures are provided in TS 03609 for the MRA and TS 01049 for the CRN. The design of the ballast mat should also take into account bridge design requirements, such as waterproofing, as per TS 01713 for the MRA and TS 01002 for the CRN.

6.4 Track structure – ballasted track

Open ballasted track comprises a combination of the components shown in Figure 1.

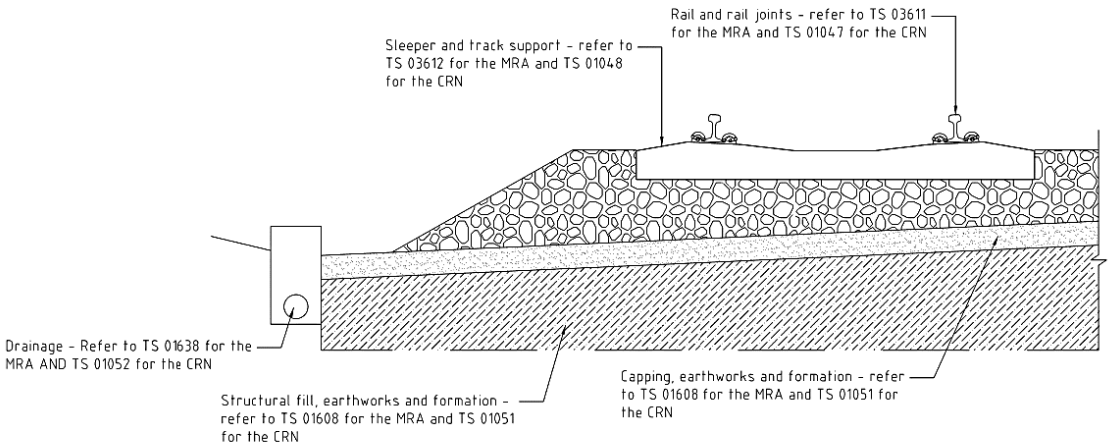

Figure 1 – Typical ballasted track structure

Open ballasted track structure features:

- Rail and rail joints: the requirements for new rail, rail section selection, the use of HH rail, rail installation, serviceable rail, transposed rails and rails in existing track shall be in accordance with TS 03611 for the MRA and TS 01047 for the CRN. With regards to the switches and crossing, rail size and type (standard carbon or HH) shall be selected for turnouts in accordance with the requirements of TS 03501 for the MRA and TS 01050 for the CRN.
- Sleepers and track support: the requirements for design, approved configurations, material, acceptance and repair standards for sleepers, turnout bearers, and sleeper fastenings shall be in accordance with TS 03612 for the MRA and TS 01048 for the CRN.

- Ballast: ballast material requirements based on the service loads, material, interfaces with other track components, support and performance needs shall be in accordance with TS 03609 for the MRA and TS 01049 for the CRN.
- Ballast mat: for track on rigid foundations, such as ballast top bridges, moderating the track stiffness in accordance with the requirements of use of ballast mat in TS 03609 for the MRA and TS 01049 for the CRN shall be taken into account.
- Formation: earthworks and formation design including cuttings, embankments and capping layers shall be in accordance with TS 01608 for the MRA and TS 01051 for the CRN.
- Drainage: track drainage requirements, including the surface and subsurface stormwater drainage of the track formation, shall be in accordance with TS 01638 for the MRA and TS 01052 for the CRN.

6.4.1 Ballasted track configuration

Colour-coded ballasted track configuration elements for new and existing main lines and sidings are defined in Table 5 to Table 8 with the key shown in Table 4.

Table 4 – Key for colour-coded track configuration elements

Rail	Standard carbon	Head hardened	Continuous welded rail	Jointed rail	Loose rail
Sleeper	Heavy concrete	Medium concrete	Steel	Timber non-elastic fastenings	Timber elastic fastenings
Ballast	Standard	Fine			

6.4.1.1 New track structure – main line

Main lines include crossing loops, refuge loops and other tracks where an operating speed in excess of 25 km/h is permitted.

New and reconstructed ballasted track shall conform to the minimum requirements shown in Table 5. The track structure configuration in Table 5 is a function of the operating class nominated in Table 2 and track curvature. The configuration of ballasted track elements for each operating class for new track is detailed in Table 5.

The MRA has adopted a general policy of using heavy duty concrete sleepers. Where the general policy is not applied, the minimum sleeper type is given in Table 5.

The default track structure detailed in Table 5 is a ballasted track structure. Track designs, in which the sleepers and/or ballast are replaced by direct fixation, shall be in accordance with the requirements of TS 03612 for the MRA and TS 01048 for the CRN.

Where there is a proposal to not apply minimum requirements, alternate configurations may be approved, as detailed in Section 5.5.

Table 5 – Configurations required for new main lines

Operational class	Description	Rail size (kg/m)	Rail tangent track to 800m radius	Rail 780 to 450m radius	Rail <450m radius	Weld type	Sleeper tangent track to 450m radius	Sleeper <450m radius	Ballast grade	Ballast depth (mm)
OC-1	Passenger main line	60	Standard carbon	Standard carbon	Head hardened	Continuous welded rail	Medium concrete	Heavy concrete	Standard	250
OC-2	Heavy haul main line	60	Head hardened	Head hardened	Head hardened	Continuous welded rail	Heavy concrete	Heavy concrete	Standard	350
OC-3	Main line high density	60	Standard carbon	Head hardened	Head hardened	Continuous welded rail	Heavy concrete	Heavy concrete	Standard	300
OC-4	Main line med density	60	Standard carbon	Standard carbon	Head hardened	Continuous welded rail	Medium concrete	Heavy concrete	Standard	300
OC-5	Main line low density	60	Standard carbon	Standard carbon	Standard carbon	Continuous welded rail	Medium concrete	Heavy concrete	Standard	270
OC-5	Main line low density (Note 1)	53	Standard carbon	Standard carbon	Standard carbon	Continuous welded rail	Medium concrete	Medium concrete	Standard	270
OC-6	Light main line	50	Standard carbon	Standard carbon	Standard carbon	Continuous welded rail	Medium concrete	Medium concrete	Standard	270
OC-7	Branch line	53 cascaded	Standard carbon	Standard carbon	Standard carbon	Continuous welded rail	Steel	Steel	Standard	150
OC-7	Branch line (Note 1)	41	Standard carbon	Standard carbon	Standard carbon	Continuous welded rail	Steel	Steel	Standard	200
OC-8	Light branch line	30	Standard carbon	Standard carbon	Standard carbon	Jointed rail	Steel	Steel	Fine	150

Note 1: Alternative track structure for the same operating class.

6.4.1.2 Existing track structure – main line

Existing track configuration in each operating class may not meet the relevant track structure classification for new track (see Table 2). The minimum acceptable track structure configurations for existing track are detailed in Table 5. Speeds in Table 1 may not be achieved for these configurations.

The track class for each line section of CRN's current track network is detailed in Appendix A. Where major track construction is being planned, the track class shall be reviewed to establish if it meets CRN's future operating requirements.

Table 6 – Minimum configuration of existing main lines

Operational class	Description	Rail size (kg/m)	Rail tangent track to 800m radius	Rail 780 to 400m radius	Rail <400m radius	Weld type	Sleeper tangent track to 800m radius	Sleeper 780 to 400m radius	Sleeper <400m radius	Ballast grade	Ballast depth (mm)
OC-1	Passenger main line	53	Standard carbon	Standard carbon	Standard carbon	Jointed rail	Timber non-elastic fastenings	Timber non-elastic fastenings	Timber non-elastic fastenings	Standard	250
OC-2	Heavy haul main line	60	(Note 3)	(Note 3)	(Note 3)	Continuous welded rail	Heavy concrete	Heavy concrete	Heavy concrete	Standard	350
OC-3	Main line high density	53	Standard carbon	Standard carbon	Standard carbon	Jointed rail	Timber non-elastic fastenings	Timber non-elastic fastenings	Timber non-elastic fastenings	Standard	300
OC-4	Main line med density	47	Standard carbon	Standard carbon	Standard carbon	Jointed rail	Timber non-elastic fastenings	Timber non-elastic fastenings	Timber non-elastic fastenings	Standard	250
OC-5	Main line low density	53	Standard carbon	Standard carbon	Standard carbon	Continuous welded rail	Steel (Note 1)	Steel (Note 1)	Steel (Note 1)	Standard	270
OC-6	Light main line	47	Standard carbon	Standard carbon	Standard carbon	Continuous welded rail	Steel	Steel	Steel	Standard	270
OC-7	Branch line	53 cascaded	Standard carbon	Standard carbon	Standard carbon	Continuous welded rail	Steel	Steel	Steel	Standard	150
OC-7	Branch line (Note 2)	41	Standard carbon	Standard carbon	Standard carbon	Continuous welded rail	Steel	Steel	Steel	Standard	200
OC-8	Light branch line	30	Standard carbon	Standard carbon	Standard carbon	Loose rail	Timber non-elastic fastenings	Timber non-elastic fastenings	Timber non-elastic fastenings	Fine	150

Notes:

1. Short sections of timber sleepers may exist where infrastructure prevented the installation of steel sleepers.
2. Alternative track structure for the same operating class.
3. Selection of hardness type is governed by additional factors detailed in TS 03611 for the MRA and TS 01047 for the CRN.

6.4.1.3 New track structure – sidings

In the MRA network, sidings include all tracks not specified in Section 6.4.1.1.

New or reconstructed sidings shall conform to the minimum requirements shown in Table 7. The track structure classification in Table 7 is a function of the operating class nominated in Table 3 and track curvature. The configuration of track elements for each track class for new track is detailed in Table 7. Reclaimed components (rail, joint components, sleepers, sleeper fastenings and ballast) may be used in new sidings in accordance with the requirements of the ballasted track structure in Section 6.4.

Where there is a proposal to not apply minimum requirements, alternate configurations may be approved as detailed in Section 6.4.2.

Table 7 – Configurations for new sidings

Siding class	Description	Rail size (kg/m)	Rail tangent track to 800m radius	Rail 780m to 400m radius	Rail <400m radius	Weld type	Sleeper tangent track to 800m radius	Sleeper 780m to 400m radius	Sleeper <400m radius	Ballast grade	Ballast depth (mm)
SC-1	High density general siding	53	Standard carbon	Standard carbon	Standard carbon	Continuous welded rail	Medium concrete	Medium concrete	Medium concrete	Standard	250
SC-2	Medium density passenger operations or maintenance	53	Standard carbon	Standard carbon	Standard carbon	Continuous welded rail	Medium concrete	Medium concrete	Medium concrete	Standard	250
SC-3	Low density metropolitan freight siding	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)
SC-4	Low density passenger siding	47	Standard carbon	Standard carbon	Standard carbon	Jointed rail	Timber non-elastic fastenings	Timber elastic fastenings	Timber elastic fastenings	Standard	100
SC-5	Engineering maintenance siding	47	Standard carbon	Standard carbon	Standard carbon	Jointed rail	Timber non-elastic fastenings	Timber non-elastic fastenings	Timber non-elastic fastenings	Standard	Nominal
SC-6	High density regional freight siding	53 cascaded	Standard carbon	Standard carbon	Standard carbon	Continuous welded rail	Steel	Steel	Steel	Standard	250
SC-7	Low density regional freight siding	47 cascaded	Standard carbon	Standard carbon	Standard carbon	Continuous welded rail	Steel	Steel	Steel	Standard	200

Siding class	Description	Rail size (kg/m)	Rail tangent track to 800m radius	Rail 780m to 400m radius	Rail <400m radius	Weld type	Sleeper tangent track to 800m radius	Sleeper 780m to 400m radius	Sleeper <400m radius	Ballast grade	Ballast depth (mm)
SC-8	High density grain siding	41 cascaded	Standard carbon	Standard carbon	Standard carbon	Jointed rail	Steel	Steel	Steel	Standard	150
SC-9	Low density grain siding	41 cascaded	Standard carbon	Standard carbon	Standard carbon	Loose rail	Timber non-elastic fastenings	Timber non-elastic fastenings	Timber non-elastic fastenings	Standard	150

Note 1: Low density metropolitan freight siding, track configuration to be determined on a case-by-case basis by the RIM.

6.4.1.4 Existing track structure – sidings

Existing track configuration in each operating class may not meet the relevant track structure classification for new sidings (see Table 7). The minimum acceptable track structure configuration for existing sidings is detailed in Table 8.

Table 8 – Configurations of existing sidings

Siding class	Description	Rail size (kg/m)	Rail tangent track to 800m radius	Rail 780m to 400m radius	Rail <400m radius	Weld type	Sleeper tangent track to 800m radius	Sleeper 780m to 400m radius	Sleeper <400m radius	Ballast grade tangent track to 800m radius	Ballast grade <800m radius	Ballast depth (mm)
SC-1	High density general siding	47	Standard carbon	Standard carbon	Standard carbon	Jointed rail	Timber non-elastic fastenings	Timber non-elastic fastenings	Timber non-elastic fastenings	Fine	Standard	150

Siding class	Description	Rail size (kg/m)	Rail tangent track to 800m radius	Rail 780m to 400m radius	Rail <400m radius	Weld type	Sleeper tangent track to 800m radius	Sleeper 780m to 400m radius	Sleeper <400m radius	Ballast grade tangent track to 800m radius	Ballast grade <800m radius	Ballast depth (mm)
SC-2	Medium density passenger operations or maintenance	47	Standard carbon	Standard carbon	Standard carbon	Jointed rail	Timber non-elastic fastenings	Timber non-elastic fastenings	Timber non-elastic fastenings	Fine	Standard	150
SC-3	Low density metropolitan freight siding	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)	(Note 1)
SC-4	Low density passenger siding	41	Standard carbon	Standard carbon	Standard carbon	Jointed rail	Timber non-elastic fastenings	Timber non-elastic fastenings	Timber non-elastic fastenings	Fine	Fine	100
SC-5	Engineering maintenance siding	41	Standard carbon	Standard carbon	Standard carbon	Jointed rail	Timber non-elastic fastenings	Timber non-elastic fastenings	Timber non-elastic fastenings	Fine	Fine	Nominal
SC-6	High density regional freight siding	47	Standard carbon	Standard carbon	Standard carbon	Jointed rail	Timber non-elastic fastenings	Timber non-elastic fastenings	Timber non-elastic fastenings	Fine	Fine	150
SC-7	Low density regional freight siding	41	Standard carbon	Standard carbon	Standard carbon	Loose rail	Timber non-elastic fastenings	Timber non-elastic fastenings	Timber non-elastic fastenings	Fine	Fine	150
SC-8	High density grain siding	41 cascaded	Standard carbon	Standard carbon	Standard carbon	Loose rail	Timber non-elastic fastenings	Timber non-elastic fastenings	Timber non-elastic fastenings	Fine	Fine	100

Siding class	Description	Rail size (kg/m)	Rail tangent track to 800m radius	Rail 780m to 400m radius	Rail <400m radius	Weld type	Sleeper tangent track to 800m radius	Sleeper 780m to 400m radius	Sleeper <400m radius	Ballast grade tangent track to 800m radius	Ballast grade <800m radius	Ballast depth (mm)
SC-9	Low density grain siding	30	Standard carbon	Standard carbon	Standard carbon	Loose rail	Timber non-elastic fastenings	Timber non-elastic fastenings	Timber non-elastic fastenings	Fine	Fine	100

Note 1: Low density metropolitan freight siding, track configuration to be determined on a case-by-case basis by the RIM.

6.4.2 Alternate track structure configurations for the Country Regional Network

This section is applicable to the use of alternate ballast track configuration within the CRN.

The concession process shall be followed in accordance with CRN CM 002 if the requirement of track structure cannot be met for the CRN. Detailed design of alternative track structure configurations should utilise a combination of empirical and theoretical methods. Suggested methods and applicable limits are provided in CRN CM 005. CRN CM 005 shall be used as the basis of the technical justification for the concession.

6.5 Track structure – ballastless track

The design of ballastless track shall incorporate the interaction with the track, the vertical and horizontal stiffness, and the effects of the following components shown in Figure 2.

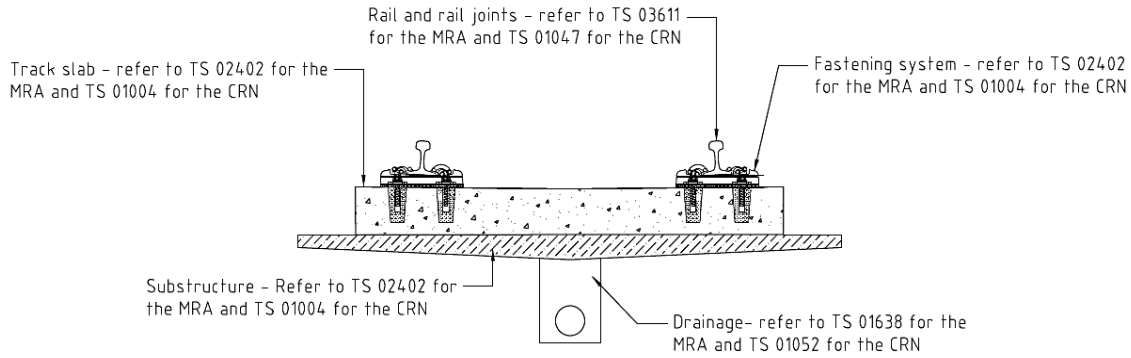

Figure 2 – Typical ballastless track structure

These include, but are not limited to:

- Rail and rail joints: the requirements for new rail, rail section selection, use of HH rail, rail installation, serviceable rail, transposed rails, and rails in existing track shall be in accordance with TS 03611 for the MRA and TS 01047 for the CRN. For switches and crossings, rail size and type (standard carbon or HH) shall be selected for turnouts in accordance with the requirements of TS 03501 for the MRA and TS 01050 for the CRN.
- Fastening system: resilient fastening systems and rail attachments shall be used for ballastless track in accordance with TS 02402 for the MRA and TS 01004 for the CRN.
- Track slab: structural design and material of prefabricated or in-situ concrete elements such as slab, frames, sleepers and blocks shall be used for ballastless track support, in accordance with TS 02402 for the MRA and TS 01004 for the CRN.
- Substructure: the design of the substrate earthworks (subbase and subgrade) shall be based on the results of geotechnical investigations to ensure that a continuous uniform

support of the track slab structure is provided. Substructure of ballastless track shall be designed in accordance with TS 02402 for the MRA and TS 01004 for the CRN.

- Drainage: the designer shall ensure that the drainage system used in the vicinity of a track slab takes into account the management of water at and below track slab foundation level in order to avoid upward water pressure forces on the track slab. Ballastless track drainage shall be designed in accordance with TS 02402 and TS 01638 for the MRA, and TS 01004 and TS 01052 for the CRN.

6.5.1 Ballastless track configurations

Ballastless tracks, shall be selected from the following configurations:

- Direct fixation track – a system of fixation of track directly to civil structures, such as bridges, tunnels, or continuous slabs. Direct fixing to slabs shall be designed in accordance with TS 02402 for the MRA and TS 01004 for the CRN. For requirements of directly fixed bridge decks and bridge approach slabs, refer to TS 01713 for the MRA and TS 01002 for the CRN.
- Single slab – a track slab directly fixed to the ground or supporting structure. Track slab design is a system that incorporates the stiffness of slab, subbase, subgrade, rail fastening assemblies and rail. The track slab shall be designed in accordance with TS 02402 for the MRA and TS 01004 for the CRN.
- Base slab with top (infill) slab – a top (infill) slab shall be adequately restrained laterally and anchored down to the base slab to ensure that debonding does not occur, as per requirements specified in TS 02402 for the MRA and TS 01004 for the CRN.
- Embedded polymer or reinforced concrete monoblock sleepers and embedded full reinforced concrete sleepers – ballastless track system that comprises of sleepers/blocks cast into a concrete trough or directly on top of a concrete roadbed, in accordance with requirements of TS 02402 for the MRA and TS 01004 for the CRN.
- Embedded rail – the rail is attached without the use of traditional rail fastenings, it is anchored in a concrete or steel channel by embedding it with adhesive. Embedded rail is only permitted for sidings and at maintenance facilities for the MRA network, in accordance with TS 02402.
- Floating slab – a track slab isolated from the ground or supporting structure by the use of resilient bearings. Design and dynamic behaviour of floating slabs shall be in accordance with TS 02402 for the MRA and TS 01004 for the CRN.
- Type approved proprietary slab systems – in accordance with TS 00021 for the MRA and CRN.

- Plinth type ballastless track – the continuous plinth track system is a continuously supported rail with discrete shoulders retained by rail clips.

6.6 Transition tracks

Transition section trackforms shall be provided in locations where two trackforms with different track stiffness abut, such as bridge ends, in accordance with TS 02402 and TS 01713 for the MRA and TS 01004 and TS 01002 for the CRN.

7 Prohibited configurations

7.1 Ballasted track

Table 9 shows which configurations shall not be used for permanent works for the MRA and the CRN.

Table 9 – Prohibited configurations

Configurations	MRA	CRN
Steel sleepers	Not permitted	Permitted
Non-elastic fastening systems with 60kg/m rail	Not permitted	Not permitted
Non-elastic fastening systems with concrete sleepers	Not permitted	Not permitted
Non-elastic fastening systems with steel sleepers	Not permitted	Not permitted
LWR with concrete sleepered track	Not permitted	Permitted
LWR with elastic fastened track (permitted if no more than 1 in 3 sleepers are elastic fastened)	Not permitted	Not permitted (Note 1)
Joints in 60kg rail	Not permitted (Note 2)	Not permitted (Note 2)
Joints on concrete sleepered track	Not permitted (Note 2)	Not permitted (Note 2)

Notes:

1. Unless a management strategy has been approved by the CRN in accordance with the requirements detailed in TS 01048.
2. Joints may be permitted on concrete sleepered track as a part of temporary works, in conjunction with track renewal, restoration or in an emergency. In such cases the design shall include maintenance controls (e.g. speed restriction, increased monitoring).

7.2 Ballastless track

Track slabs with embedded rail systems shall not be used, except at sidings and at maintenance facilities, as per TS 02402 for the MRA.

Track slab configuration with embedded rail systems shall not be used for the CRN, as per TS 01004.

Concrete upstand located between the running rails with a solid surface between gauge faces shall not be used, in order to reduce the lateral movement of a derailed train, as per TS 02402 for the MRA.

8 Mixed configurations

There are some limitations and special requirements when configurations are mixed. These are only applicable to existing track. These limitations and requirements are:

- Concrete sleepers may be interspersed with timber sleepers in accordance with TS 03612 for the MRA.
- Steel sleepers may be interspersed with timber sleepers in accordance with the requirements of TS 01048 for the CRN.
- Elastic fastenings on timber or steel sleepers may be installed with partial resleepering on CWR, provided a consistent tie pattern is maintained.
- Elastic fastenings shall not be installed with partial resleepering on LWR where this would result in them being more frequent than 1 in 3. A consistent tie pattern shall be maintained. Before further elastic fastenings are installed, the track shall be converted to CWR.
- When configuration changes are being undertaken by partial resleepering methods, they shall be followed through in successive partial resleepering cycles until the changeout is complete. Mixed configurations as a final outcome shall not be used.

9 Changing configurations

The following configurations are obsolete. Renewal strategies shall be directed to the elimination of:

- LWR on main line track – replace with CWR
- timber sleepers on curves of less than 400 m radius on main line track – replace with concrete sleepers
- non-elastic fastenings in timber sleepers on main line track – replace with elastic fastenings.

The following requirements apply when selected track components are being renewed as part of rerailing or track reconstruction:

- replace 53kg/m rail on main line track with 60kg/m rail
- replace 47kg/m rail on main line track with 50kg/m or 60kg/m rail
- ballast depth on main line track shall meet the requirements for new track
- replace insulated joints on main line track with type A bonded insulated joints.

Appendix A System Map – MRA

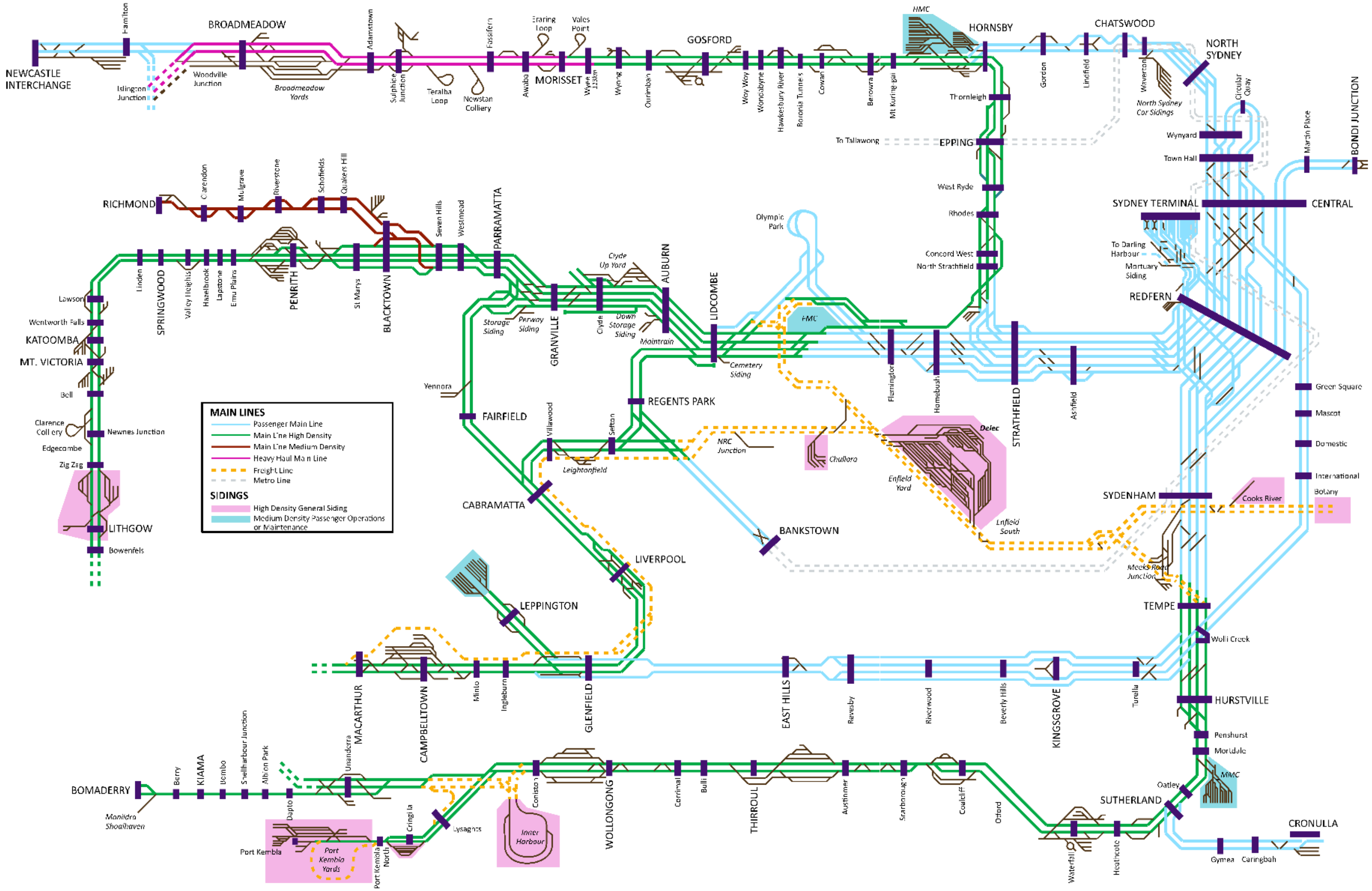

Figure 3 – MRA system map

Appendix B System Map – CRN

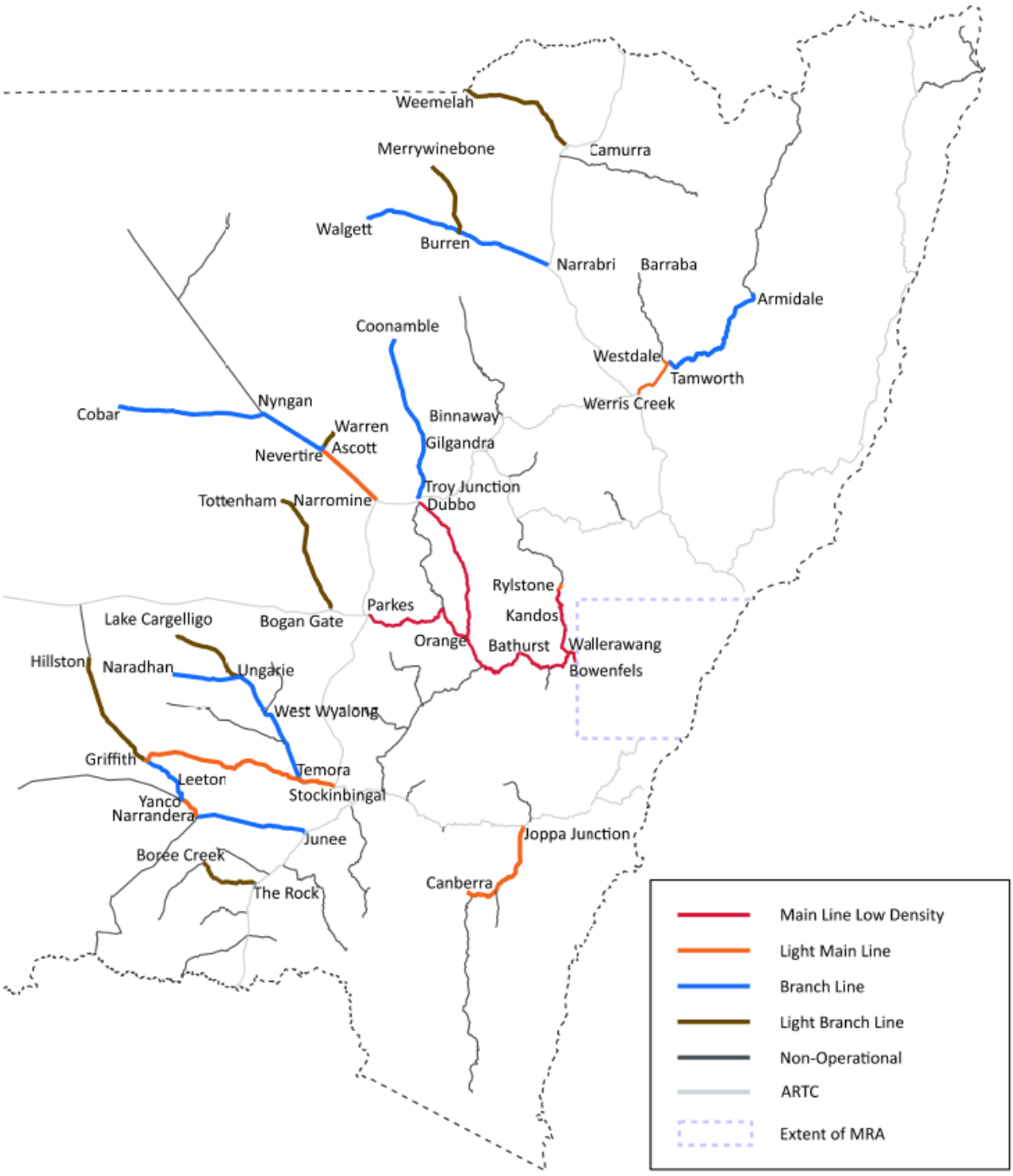

Figure 4 – CRN system map

Table 10 sets outs corridor locations and their associated track classes for CRN.

Table 10 – CRN corridor location with track class

Corridor no.	Corridor location	Start (km)	Finish (km)	Track class
N00	Werris Creek to West Tamworth	411.201	454.900	OC-6
N00	West Tamworth to Armidale	454.900	579.500	OC-7
N23	Camurra to Weemelah	679.040	762.746	OC-8
N44	Tamworth to Westdale	453.093	457.220	OC-6
N80	Narrabri to Walgett	564.799	733.130	OC-7
N82	Burren Junction	648.480	649.420	OC-7
N82	Burren Junction to Merrywinebone	649.420	716.737	OC-8
S45	The Rock	551.075	554.000	OC-7
S45	The Rock to Boree Creek	554.00	607.763	OC-8
S50	Joppa Junction to Queanbeyan	230.610	322.500	OC-6
S54	Queanbeyan to Canberra	321.665	329.663	OC-6
S70	Stockinbingal to Temora	454.906	489.433	OC-6
S70	Temora to West Wyalong	489.433	553.900	OC-7
S70	West Wyalong to Ungarie	553.900	597.811	OC-7
S70	Ungarie to Lake Cargelligo	597.811	669.175	OC-8
S78	Ungarie to Naradhan	597.803	658.251	OC-7
S80	Junee to Narrandera	486.021	584.032	OC-6
S80	Narrandera to Yanco	584.032	605.812	OC-6
S85	Yanco to Leeton	605.812	614.273	OC-6
S85	Leeton to Griffith	614.273	660.478	OC-6
S86	Temora to Griffith	489.433	640.689	OC-6
S86	Griffith to Hillston	605.812	748.045	OC-8
W00	Bowenfels to Orange	158.800	379.000	OC-5
W00	Orange to Dubbo	379.000	460.890	OC-5
W00	Narromine to Nevertire	497.809	564.000	OC-6
W00	Nevertire to Nyngan	564.000	622.462	OC-7
W20	Orange to Parkes	320.813	446.950	OC-5

Corridor no.	Corridor location	Start (km)	Finish (km)	Track class
W32	Bogan Gate to Tottenham	486.050	598.446	OC-8
W34	Orange to Parkes	627.491	628.744	OC-5
W43	Nevertire to Ascott	563.930	580.300	OC-7
W43	Ascott to Warren	580.300	584.089	OC-8
W44	Nyngan to Cobar	627.000	754.700	OC-7
W50	Wallerawang to Kandos	171.920	249.368	OC-5
W50	Kandos to Rylstone	249.368	257.330	OC-6
W61	Troy Junction to Gilgandra	466.231	526.000	OC-7
W61	Gilgandra to Coonamble	526.000	616.175	OC-7