UGL REGIONAL LINX

SURVEY

CRN-MAN-CVL-713026361-670

CRN CM 212

LINKING COMMUNITIES. CONNECTING CUSTOMERS.

Table of Contents

Document Control

Function	Position	Name	Date
Approver	A&E Manager	Lucio Favotto	24.01.2022

Revision	Issue Date	Revision Description
1.4	17.11.2021	UGLRL Operational Standards Template applied
2.0	01.12.2021	First approved and issued UGLRL version
3.0	24.01.2022	Issued for publish to intranet and webpage

Summary of changes made from previous version

Section	Summary of change
All	This document is based on the previous rail infrastructure maintainer (RIM). Full revision history is available on request from UGLRL

Chapter 1 Introduction

C1-1 Purpose

This manual provides requirements, processes documentation and guidelines to be used when conducting surveys and collecting spatial data.

C1-2 Context

The manual is part of UGLRL CRN's engineering standards and procedures publications. More specifically, it is part of the Civil Engineering suite that compriseC1-3 s standards, installation and maintenance manuals and specifications.

Manuals contain requirements, processes and guidelines for the management of track assets and for carrying out examination, construction, installation and maintenance activities.

The manual is written for persons undertaking installation and maintenance activities.

C1-3 How to read the manual

The best way to find information in the manual is to look at the Table of Contents. Ask yourself what job you are doing? The Table of Contents is written to reflect work activities.

When you read the information, you will not need to refer to CRN Engineering standards. Any requirements from standards have been included in the sections of the manual and shown like this:

The following requirements are extracted from CRN Standard CRN CS 210
The location of track infrastructure shall be established by Track Control.

Reference is however made to other manuals and specifications.

C1-4 References

C1-4.1 Australian and International Standards

Standards for the Australian Survey Control Network Special Publication 1 (SP1)

Surveying and Spatial Information Regulation 2017.

Surveyor General Directions

AS7634:2017 – Railway Infrastructure – Survey

T HR TR 13000 ST – Railway Surveying

Unless otherwise specified, all references relate to the latest standard versions, including amendments and relevant superseding standards.

C1-4.2 CRN Documents

CRN CS 210 – Track Geometry and Stability

CRN CP 211 – Survey Specification

Chapter 2 Types of control survey

The following requirements are extracted from CRN Standard CRN CS 210
The location of track infrastructure shall be established by Track Control. Track Control shall be established from UGLRL CRN Survey Control All surveys for CRN purposes shall be established using Map Grid of Australia (MGA) and Australian Height Datum (AHD). Alternative systems shall only be used with the approval of the Principal Track and Civil Engineer.

C2-1 Rail Survey Control Network

This section outlines the field procedure requirements to be followed when conducting a survey for Rail Survey Control purposes.

The location of track infrastructure shall be established from the Track Control Mark (TCM) Network (see C2-2). The Track Control Mark Network shall be established from the Rail Survey Control Network.

Surveys referred to in this section must be carried out in accordance with the requirements of the Standards for the Australian Survey Control Network Special Publication 1 (SP1) and require approval from the Principal Surveyor prior to use.

All surveys shall be established using the Map Grid of Australia (MGA) and Australian Height Datum (AHD). Alternative systems shall only be used with the approval of the Principal Surveyor. The Principal Surveyor shall be consulted to ensure use of the appropriate geodetic datum.

C2-1.1 Placement of Rail Survey Control Network marks

A major control survey forms the framework for rail survey control. The major control is established more accurately to prevent the propagation of errors through the rail survey control. It is generally established for surveys greater than 2 kilometers in length or when a project requires high accuracy and no existing survey control is in the vicinity.

Surveys referred to in this section must be carried out in accordance with the requirements of SP1.

The interval between major control marks along the rail corridor is usually greater than 500m. These marks are usually in areas that are outside the railway corridor. The major control marks are either existing permanent marks sourced from the Survey Control Information Management System (SCIMS). However, if they are installed as new major controls the mark type shall be compliant with the Surveyor Generals Directions, including preparation of locality sketch plans.

Examples of these marks are shown in Figure 1 to Figure 4.

Minor rail survey control surveys infill the major control survey. They are used to increase the density of survey control marks in the railway corridor near the track.

The interval between rail survey control marks is less than 200m, to keep radiation lengths less than 100m. Examples of these marks are shown in Figure 1 to Figure 4.

All Rail Survey Control Marks (Rail SCM) shall be installed in stable structures clear of running lines. , As far as is practicable, the survey control mark must be suitable for Global Navigation Satellite Systems (GNSS) observations, in that it is to be clear of access roads and other locations that can pose a risk to survey staff and instrument safety when occupying the mark. The safety of survey personnel and equipment shall be of paramount importance when designing Rail Survey Control Networks and installing the Rail SCMs.

When undertaking work on the Rail Survey Control Mark Network, record the location of any rail survey control mark that is not found or is known to have been removed, damaged, destroyed, displaced, obliterated or defaced, or is in a state of disrepair. Report the location to the UGLRL CRN maintenance superintendent for rectification and notify the Principal Surveyor. The Surveyor General ‘s Directions provides reporting requirements for SCIMS marks.

In order to allow authorised access to Permanent Marks and State Survey Marks (PMs and SSMs), these marks should only be placed:

- in public access areas (e.g. on platforms), or
- in 'off-track' areas as defined by safeworking requirements
- where access to the mark does not require the public to enter 'on-track' areas

Figure 1 - NSW Permanent Mark (PM) on Platform

Figure 2 - Railway Survey Mark on Platform

Figure 3 - NSW State Survey Mark (SSM)

Figure 4 - Railway Survey Mark

C2-1.2 Observations and adjustments for Rail Survey Control Network marks

The Principal Surveyor is the custodian of the rail survey control network and shall be consulted prior to any work being undertaken. A search of the CRN Rail Survey Control Mark database is also to be conducted prior to the commencement of any work. The survey method and proposed

network design, shall be approved by the Principal Surveyor prior to commencing the survey work. The approval may be subject to a reconnaissance survey being conducted of the proposed survey area to identify any issues and constraints.

Where GNSS observations are used, the network design, equipment and procedures are to comply with the guidelines for surveys by GNSS as shown in SP1. Real-time surveys for control purposes are not suitable unless approved by the Principal Surveyor.

For conventional (terrestrial) survey observations, the network design, equipment and procedures are to comply with Guideline for Conventional Traverse Surveys – SP1 to achieve a survey uncertainty of < 10 mm and a relative uncertainty of < 10 mm, unless otherwise advised by the Principal Surveyor.

Heights for rail survey control shall be determined using differential levelling techniques to enable a maximum allowable misclose. That is between forward and back of 12 mm * √ (km) (where k=distance in kilometers) as described in Guideline for Control Surveys by Differential Levelling – SP1.

For both horizontal and vertical observations a network adjustment of the observations shall be carried out using an industry-recognised least squares survey adjustment package and as described in Guideline for the Adjustment and Evaluation of Survey Control – SP1. For smaller survey projects that include the installation of minor control only, the control adjustment method will be at the discretion of the experienced railway surveyor and as approved by the CRN Principal Surveyor.

A survey report shall be provided, and contain the following information —

1. job or project details
2. surveyors' details
3. equipment details, observation techniques, rail survey control network details, photographs and field notes / sketches\
4. data processing methods and software used
5. least squares adjustment details, accuracies and software used, constraints, options, analysis and results
6. A schedule of coordinates in the standard format shown in the CRN Rail Survey Control Mark database and any other relevant details as required by the Principal Surveyor.

All surveys for engineering design shall have rail-survey control installed to enable construction. All rail survey control marks shall be shown on the Issued For Construction (IFC) drawings as per CRN CP 203 Track Design. It is the responsibility of the railway surveyor to forward all survey control details to the design head contractor for inclusion in the design drawings.

C2-1.3 Identification of Rail Survey Control Network marks

The Principal Surveyor shall be informed of the intention to install any rail survey control mark used on the CRN. Before any survey work is undertaken a search of the CRN Rail Survey Control Mark database shall be conducted.

A reconnaissance survey of the proposed survey area may be required to identify any potential issues with the survey. During the reconnaissance survey, all existing Survey Control and Track Control Marks (TCMs) shall be identified.

All control marks shall be uniquely numbered. All marks are to be indicated by white paint marks on nearby structures and/or with three steel pickets. The paint mark on the rail should be a filled-in triangle with an offset to the mark.

Note: Yellow paint is not permissible for survey use on the actual rail.

C2-2 Track Control Marks

The framework of the Rail Survey Control Marks is used to establish Track Control Marks at defined intervals along the track (see Section C4-3). The design location (horizontal and vertical) of each track is determined as an off-set distance from each Track Control Mark. For TCMs placed on structures a survey plaque is placed at the mark and the vertical offset to the design reference rail shall be engraved. (See Figure 5 and Figure 14) Where there is no structure a tag must be securely fixed to a star picket placed a maximum of 200mm further from the rail and perpendicular to the track. See Figure 6.

The TCM plaques and tags record the most accurate information of the design geometry of the track and is used by track staff to check and correct track alignment, level, superelevation and track centres. It is also used when determining the official kilometrage of the track.

Each TCM placed shall have its three-dimensional coordinates and kilometrage measured. The coordinates are based on the MGA coordinate system and Australian Height Datum and all measurements are to be shown to the nearest millimetre (mm). The l TCM is recorded in the asset management system, the 3D coordinate value and kilometrage are recorded as attributes.

When undertaking work on the TCM network, record the location of any rail survey control mark that is not found or is known to be removed, damaged, destroyed, displaced, obliterated or defaced, or is in a state of disrepair. Report the location to the UGLRL CRN maintenance superintendent for rectification and notify the Principal Surveyor.

Surveyors with qualifications that satisfy CRN CM 001 Civil Technical Competencies & Engineering Authority, are the only personnel who can undertake the observation requirements and techniques for placing new track control marks.

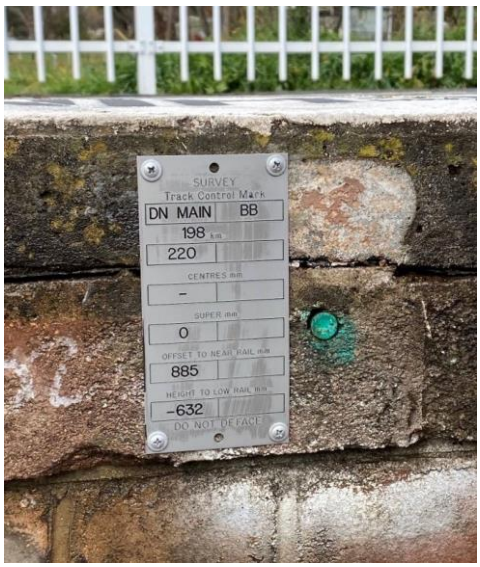


Figure 5 - Track Control Mark and Survey Plaque

Figure 6 - Track Control Mark

Chapter 3 Equipment for railway Surveying and Spatial Data collection

C3-1 Instruments and Equipment

All survey instruments and equipment used on the CRN shall meet minimum standards to ensure the integrity and accuracy of the rail survey network.

All instruments, equipment and calibration requirements used to undertake a survey of the CRN Survey Control Network shall be in accordance with T HR TR 13000 ST Railway Surveying.

All instruments, equipment and calibration requirements used to undertake a survey of the Track Control Mark Network shall be in accordance with T HR TR 13000 ST Railway Surveying.

For track surveys and surveys for construction and maintenance of railway infrastructure the equipment and methodology must be able to comply with CRN CS 210 Track Geometry and Stability. Up-to-date calibration records are required prior to use on the CRN.

The following equipment shall only be used on the CRN with the approval of the Principal surveyor:

1. Survey Trolley Systems
2. Terrestrial Laser Scanners
3. Airborne-mounted systems to capture LiDAR and digital orthophotography
4. Mobile Laser Scanners and digital cameras
5. Drones data collection equipment
6. Other data collection for asset management and GIS

C3-2 Types of Survey Mark

The types of marks that may be placed for the purpose of the CRN Rail Survey Control Network are as described in Table 1.

Type	Description	Reference	Remark
Rail Survey Control Mark (RSCM)	Long brass pin and triangle. Short Brass pin and triangle	Figure 7	Placed in bed rock, concrete, stone or masonry. RSCM to be recessed so that the top of the triangle is flush with the surrounding material.
	Long brass pin and triangle cast in concrete with cast iron box cover.	Figure 8	Placed in stable soil or firm ground.
	Long brass pin and triangle cast in concrete with cast iron box cover. Galvanised iron or aluminium star picket set in concrete below ground level.	Figure 9	Placed in locations where additional support is required. This type of mark is to be used only if above types are unsuitable.
	Punch Mark in 800mm (min) galvanised iron or aluminium star picket set in concrete at ground level.		Placed in locations where additional support is required. This type of mark is to be used only if above types are unsuitable.
Benchmark	Rail Survey Mark		As above for RSCM.

Table 1 – Survey Control Marks

C3-3 Placement of Survey Control Marks

Rail Survey Control marks shall be placed at a maximum spacing of 200m. At intervals of approximately 500m the placement of the Rail Survey Control mark shall allow for connection to an established survey control mark that is listed in the Survey Control Information Management System (SCIMS) maintained by the Surveyor General. This connection is conducted by line-of-sight techniques with a minimum distance of 200m. Where an established survey control mark cannot be connected by line-of-sight, GNSS and traversing techniques may be used in accordance with CRN CP 211, Control Surveys.

Rail Survey Control Marks shall be placed in stable structures clear of running lines and as far as is practical, clear of access roads and other areas that may pose a risk to survey staff when occupying the mark.

Where the above criteria cannot be met, approval to vary the criteria must be sought from the Principal Track and Civil Engineer.

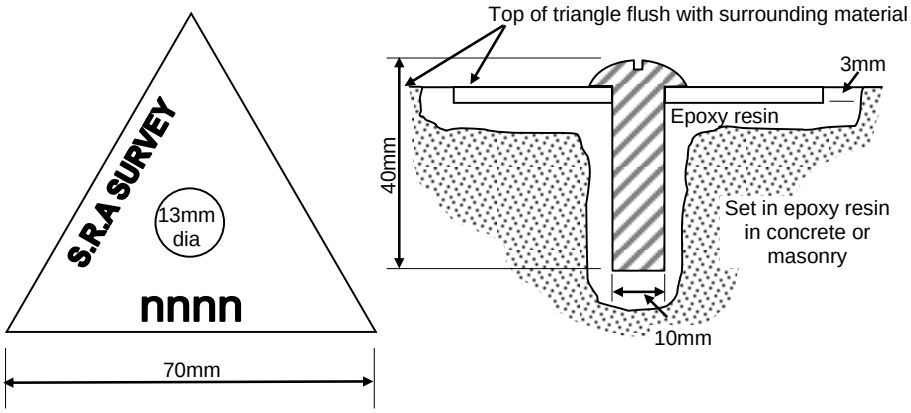


Figure 7 – Rail survey Mark – Triangle type

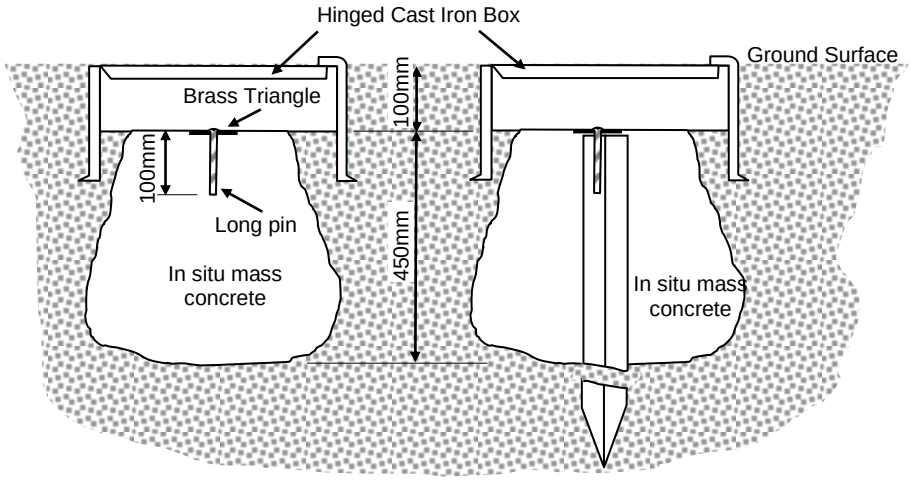


Figure 8 – Survey mark with Triangle

Figure 9 – Survey mark with Star picket

C3-4 Documentation

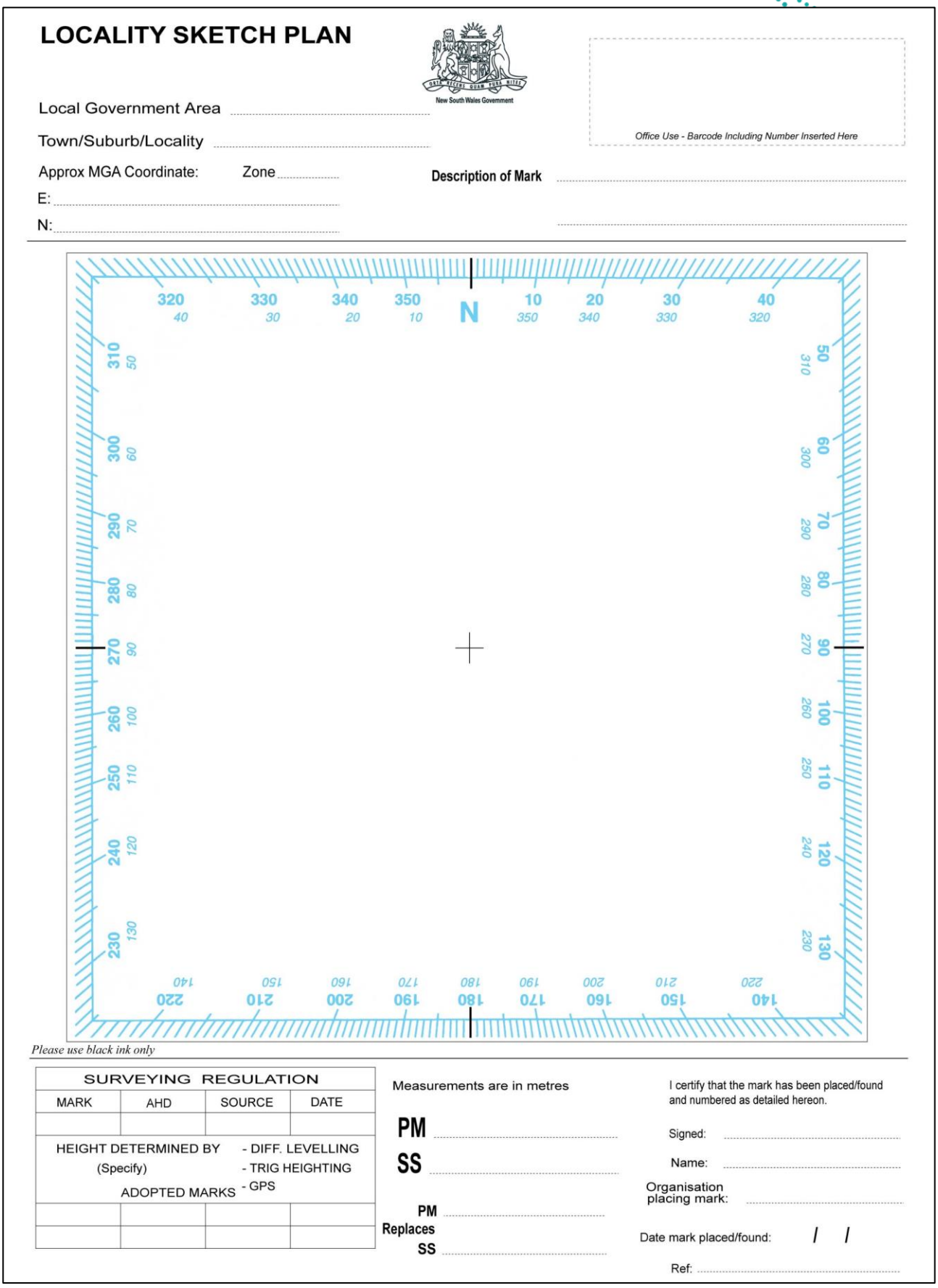
Each Rail Survey Control Mark (RSCM) is documented in the UGLRL CRN Rail Survey Mark Master register maintained by UGLRL CRN Engineering Services. A sketch plan suitable for upload to SCIMS is required for major control marks. The sketch plan in Figure 10 is available for download from the Surveyor General's Directions web site.

The Rail Survey Mark master register contains the following information:

RPM No.	Railway Permanent Mark No.
Line	Railway line name
Locality	Nearest locality name
Km	Kilometrage of the mark from Sydney
Location	With your back to Sydney, Down Side is on your left, Up Side is on your right
O/S to NR	Offset of the mark from the running face of the nearest rail
Type of Mark	Type of mark e.g. Brass triangle (BT) in concrete, conc block
Co-ordinates	Easting, Northing and Reduced Level (RL)
System	Co-ordinate system e.g. MGA
Zone	Grid Zone
Datum	Datum for levels e.g. AHD
Source	Information source for co-ordinates of marks adopted
Date of Survey	Date of the field survey
Placed by	Name of the surveyor supervising the field survey

The detail on the sketch for Major Survey Control must comply with the Surveyor General Directions and also include:

- Distance to adjacent Rail Survey Control Marks
- A minimum of three connections with bearing and/or distances to nearby identifiable features
- Features such as tracks, fences, poles, etc. should be shown with measurements of appropriate accuracy
- Each sketch should be oriented to the north with either grid or magnetic bearings shown
- Rail Survey Mark Sketch Plans are documented in both hard copy and electronic TIFF formats



LOCALITY SKETCH PLAN

New South Wales Government

Local Government Area .....

Town/Suburb/Locality .....

Approx MGA Coordinate: Zone .....

E: .....

N: .....

Office Use - Barcode Including Number Inserted Here

Description of Mark .....

.....

N

320 330 340 350 10 20 30 40
40 30 20 10 350 340 330 320

310 300 290 280 270 260 250 240 230
50 60 70 80 90 100 110 120 130

220 210 200 190 180 170 160 150 140

Please use black ink only

SURVEYING REGULATION			
MARK	AHD	SOURCE	DATE
HEIGHT DETERMINED BY (Specify) - DIFF. LEVELLING - TRIG HEIGHTING - GPS			
ADOPTED MARKS			

Measurements are in metres

PM .....

SS .....

PM .....

Replaces

SS .....

I certify that the mark has been placed/found and numbered as detailed hereon.

Signed: .....

Name: .....

Organisation placing mark: .....

Date mark placed/found: / /

Ref: .....

Figure 10 - Rail Survey Mark Sketch Plan

Chapter 4 CRN Track Control Network

This chapter outlines the field procedures to be followed when conducting a survey of the CRN Track Control Network.

C4-1 Instruments and Equipment

All instruments and equipment used for surveying the CRN Track Control Network shall be in accordance with CRN CP 211.

C4-2 Types of Track Control Mark

The types of marks that may be placed for the purpose of the CRN Track Control Network are as described in Table 2.

Type	Description	Reference	Remark
Track Control Mark (TCM)	Brass pin (type 3).	Figure 11	Placed in stable rock, concrete or masonry, see Figure 11. Pin requires 12mm drill for softer material such as brick or 13mm drill for hard materials such as concrete. When using 13mm drill adhesive such as Araldite must be used during installation.
Track Control Mark (TCM)	Pipes TCM 21mm OD Medium GIP, 400mm (min)		Placed in stable soil or firm ground. A picket is required beside all TCMs. A tag is required (as indicated in Table 4) attached to an adjacent picket with stainless steel tie wire.
Track Control Mark (TCM)	Punch Mark in 800mm (min) galvanised iron or aluminium star picket set in concrete at ground level.		Placed at ground level in locations where additional support is required e.g. ballast or ash. This type of mark to be used only if above types are unsuitable. A picket is required beside all TCMs. A tag is required (as indicated in Table 4) attached to an adjacent picket with stainless steel tie wire or set in the concrete adjacent to the picket.

Table 2 – Track Control Marks

In special circumstances other types of marks may be proposed for approval of the Principal Track and Civil Engineer.

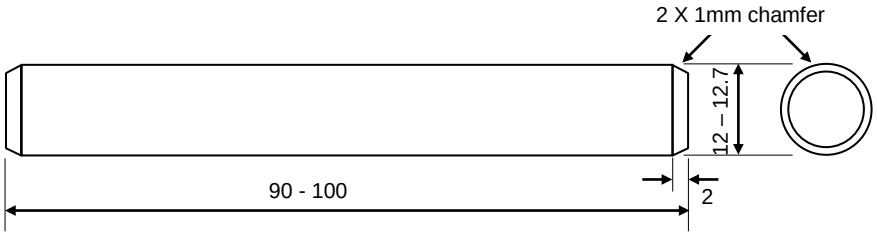


Figure 11 – Brass Pin Type 3 (Brass Rod)

C4-3 Placement of Track Control Marks

Track control marks shall be placed, as far as is practical, in a stable, permanent structure adjacent to the tracks.

Track Control Marks shall be placed to allow rail maintenance activities to be undertaken without disturbing the track control mark.

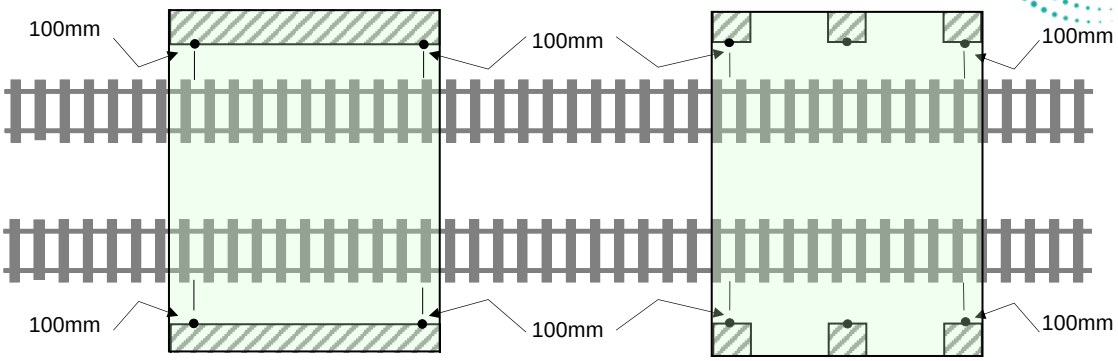
Record the location of any track control mark that is not found or is known to be removed, damaged, destroyed, displaced, obliterated or defaced, or is in a state of disrepair. Report the location to the UGLRL CRN maintenance superintendent for rectification.

Location	Spacing
Straights ≤ 500m	TPs and one mark placed evenly between TPs except where the spacing will be ≤ 20m.
Straights > 500m	TPs and maximum of 500m (at km and ½ km pegs).
Curves >400m radius	Every 20m.
Circular curves ≤ 400m radius and transition curves	Every 10m.
Platforms	Either end (100mm in) and every 10m.
Overbridge/underbridge Abutments and tunnels	Either end (100mm in) and every 10m.
Underbridges >20m	Every 20m
Bends	Single mark.
Other locations where clearance is limited ie retaining walls	Either end (100mm in) and every 10m.
Other critical clearance points	Single mark

Table 3 - Placement of Track Control Marks

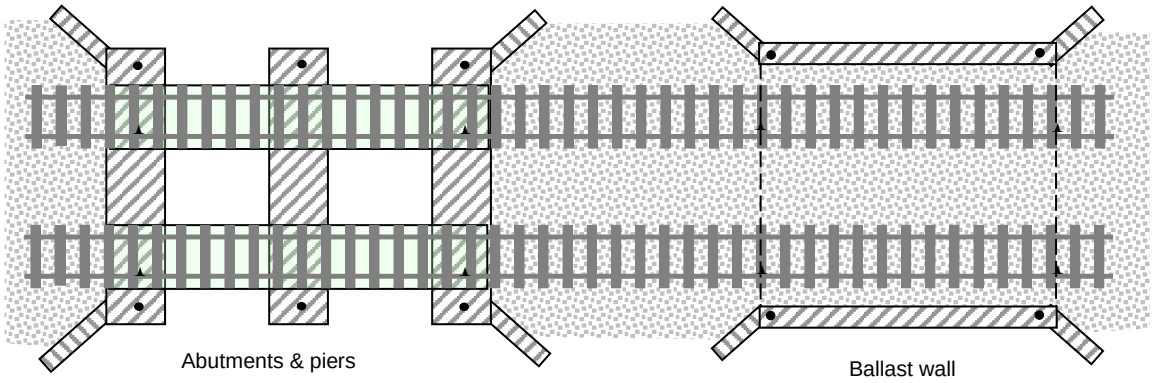
Indicative location of marks is shown in Figure 12.

Track Control marks will be assigned a unique identifier by the Principal Surveyor after the Track Control Mark has been coordinated by the surveyor and the coordinates have been approved by the Principal Surveyor.



TCMs shown as ●
Required track location shown as ✦

Sketch A - Overbridges



Sketch B - Transom Top Underbridges **Sketch C - Ballast Top Underbridges**

Figure 12 – Location of Track Control Marks (TCM)

C4-4 Standards of accuracy

The following requirements are extracted from CRN Standard CRN CS 210
Where standards of accuracy are not nominated in the design, all marks shall be placed to an accuracy, relative to adjacent marks, of at least twice the accuracy standards defined in “Accuracy to Survey” Acceptance limits of (of CRN CS 210) for track construction standards.

C4-5 Documentation

The Track Control Mark (TCM) shall be documented by recording the following information on the UGLRL CRN Track Control Mark spreadsheet Form TCM1:

- Asset No: Infor - Track Asset Number
- Line Name: - Infor Track Asset Description
- Date: - Date the surveyor placed the TCMs
- Surveyor: - Surveyor with engineering authority to undertake the work
- Company: - Surveying Company Name
- Define direction of negative pulls here: - Surveyor to specify the reference rail and direction of a negative pull

The UGLRL CRN Track Control Mark spreadsheet is documented in both hard copy and electronic (*.xls) formats.

TRACK CONTROL MARK SCHEDULE

JOHN HOLLAND

Asset No.:													
Line Name:												Date:	
Surveyor:					Company:								
Define direction of negative pulls here													
Design Easting and Design Northing are the calculated coordinates using the design TCM offset and design kilometrage													
Measured O/S TO DESIGN is a check measurement from the placed TCM to the design kilometrage													
Mark	Kilometrage	Design TCM to UR/DR	Radius	Aspect	Design Easting	Design Northing	Reduced Level	Super	Track Aspect Symbol	Point ID/Comment	Measured O/S TO DESIGN	PULLS	
PICKET	621978.999	3		STR				0		BEND			
PICKET	621979.134	3.000			712972.78	6658184.783	177.124	0		215	3.002		
PICKET	622497.498	3.000			712454.425	6658190.267	176.392	0		207	3.006	0.01	
PICKET	622978.900	3.000			711973.05	6658195.367	176.371	0		208	3.002	-0.027	
PICKET	623497.190	3.000			713454.789	6658200.857	176.548	0		209	2.998	-0.072	
PICKET	623996.574	3.000		STR						BEND			
PICKET	623996.644	3.000			710955.363	6658206.139	175.556	0		210	3.003		
PICKET	624497.408	3.000			710454.628	6658211.494	175.18	0		211	2.999	-0.003	
PICKET	624996.737	3.000			709955.327	6658216.836	175.285	0		212	3.012	0.012	
PICKET	625497.592	3.000			709454.503	6658222.38	175.043	0		213	3.000	0.009	
PICKET	625998.182	3.000			708953.94	6658227.527	174.[illegible]	0		214	3.001		
PICKET	625998.207	3.000		STR						BEND			
PICKET	626247.408	3.000		STR						TP		-0.013	
PICKET	626270.459	3.000			708681.652	6658230.341	174.[illegible]84	-19		203	3.009	0.016	
PICKET	626277.407	3.000	1,205.000	RIGHT					><	TRS			
PICKET	626277.315	3.000	1,205.000	RIGHT	708674.979	6658230.[illegible]	174.374	-25	))	202	3.003	0.024	
PICKET	626280.000	3.000	1,205.000	RIGHT	708671.456	6658230.[illegible]	[illegible].433	-25	))	201	3.007	0.043	
PICKET	626300.483	3.000	1,205.000	RIGHT	708651.[illegible]	6658231.2[illegible]	174.[illegible]	-25	))	200	3.002	0.03	
PICKET	626320.433	3.000	1,205.000	RIGHT	708631.[illegible]	6658232.225	174.3[illegible]	-25	))	199	3.009	0.015	
PICKET	626340.364	3.000	1,205.000	RIGHT	708611.63[illegible]	6658[illegible].71	174.411	-25	))	198	2.993	0.009	
PICKET	626360.461	3.000	1,205.000	RIGHT	708591.526	[illegible]235.2[illegible]	[illegible].46	-25	))	197	3.005	0.014	
PICKET	626380.756	3.000	1,205.000	RIGHT	[illegible]71.271	665[illegible].266	174.503	-25	))	196	3.004	0.006	
PICKET	626400.725	3.000	1,205.000	RIGHT	70[illegible]	6658[illegible].[illegible]	174.407	-25	))	195	3.005	0.018	
PICKET	626420.325	3.000	1,205.000	RIGHT	7085[illegible]	[illegible]242.108	174.407	-25	))	194	3.003	0.067	
PICKET	626440.397	3.000	1,205.000	RIGHT	[illegible]51.[illegible]	665[illegible]246.21	174.419	-25	))	193	3.000	0.077	
PICKET	626460.301	3.000	1,205.000	RIGHT	70[illegible]291	6658248.51	174.39	-25	))	192	3.002	0.049	
PICKET	626480.307	3.000	1,205.000	RIGHT	70[illegible]558	6658252.159	174.434	-25	))	191	2.998	0.064	
PICKET	626500.208	3.000	1,205.000	RIGHT	708[illegible]995	6658256.106	174.326	-25	))	190	3.001	0.074	
PICKET	626520.208	3.000	1,205.000	RIGHT	708[illegible]998	6658260.4	174.399	-25	))	189	3.003	0.038	
PICKET	626540.247	3.000	1,205.000	RIGHT	708413.835	6658265.037	174.38	-25	))	188	2.997	0.013	
PICKET	626560.241	3.000	1,205.000	RIGHT	708394.398	6658269.978	174.226	-25	))	187	2.999	0.021	
PICKET	626580.257	3.000	1,205.000	RIGHT	708375.022	6658275.241	174.278	-25	))	186	3.007	0.056	
PICKET	626600.167	3.000	1,205.000	RIGHT	708355.843	6658280.81	174.282	-25	))	185	2.999	0.043	
PICKET	626620.234	3.000	1,205.000	RIGHT	708336.604	6658286.73	174.333	-25	))	184	3.004	0.031	
PICKET	626640.298	3.000	1,205.000	RIGHT	708317.473	6658292.978	174.296	-25	))	183	3.000	0.041	
PICKET	626660.213	3.000	1,205.000	RIGHT	708298.587	6658299.486	174.291	-25	))	182	3.003	0.059	
PICKET	626680.052	3.000	1,205.000	RIGHT	708279.88	6658306.273	174.252	-25	))	181	3.013	0.053	
PICKET	626700.156	3.000	1,205.000	RIGHT	708261.043	6658313.474	174.288	-25	))	180	3.012	0.045	
PICKET	626720.208	3.000	1,205.000	RIGHT	708242.377	6658320.966	174.4	-25	))	179	3.013	0.054	
PICKET	626740.127	3.000	1,205.000	RIGHT	708223.964	6658328.723	174.261	-25	))	178	3.006	0.05	
PICKET	626760.342	3.000	1,205.000	RIGHT	708205.411	6658336.906	174.216	-25	))	177	2.998	0.039	
PICKET	626780.198	3.000	1,205.000	RIGHT	708187.209	6658345.249	174.213	-25	))	176	2.993	0.038	

Figure 13 – Track Control Mark spreadsheet

C4-6 Field identification of TCMs

C4-6.1 Requirments

Each TCM shall be identified as follows.

The following requirements are extracted from CRN Standard CRN CS 210
Each Track Control Mark shall be referenced by a label containing, at least, the following information: Track referenced. Kilometrage of TCM to 1mm (eg 49km 357.345m). Design Track Centres from referenced track to adjacent track (if applicable). Design superelevation of referenced track (mm). Horizontal offset from TCM to design-running face of nearest rail of referenced track (mm). Vertical offset from TCM to design low (datum) rail of referenced track (mm).

The label shall be:

- Track Control Mark Plaque – for use on structures only. To be placed at every TCM on a structure
- Track Control Mark Tag – for attachment to star pickets located adjacent to TCMs. To be placed according to the requirement detailed in Table 4

Other labelling systems are to be approved by the Principal Track and Civil Engineer.

Location	Tag Requirement
Frame points e.g. TP, TRS, CTP	At each frame point
Offset change	Two tags on adjacent TCMs across offset change
Straights	All TCMs
Curves and transitions	Maximum spacing 100m between tags
Bends	All TCMs

Table 4 – Tag requirements

The label shall be placed adjacent to the Track Control Mark. If a Track Control Mark references more than one track, then an additional label is required for each track referenced.

The information to be shown on the label is as described in Table 5.

Item	Description	Example
Track Control Mark:	Track referenced (max. 10 characters)	UP MN WEST
km	Kilometrage of TCM (Km metres and mm)	176 425.325
Centres	Design track centres of referenced track to adjacent track (if applicable) (mm)	3 810
Super	Design superelevation of referenced track (mm)	110
Offset to near rail	Horizontal offset from TCM to design running face of near rail of referenced track (mm)	2422
Offset to low rail	Vertical offset from TCM to design low (datum) rail of referenced track (mm)	-354
Mark No.	The Identifier is included to enable the plaque to be fixed to the correct structure, i.e. this information ties the plaque /plaques to a particular TCM.	2503

Table 5 – Label data requirements

C4-6.2 TCM plaque

The plaque shall meet the requirements specified in Table 5. Other types of marks may be proposed for approval of the Principal Track and Civil Engineer.

The information is to be engraved on the plaque.

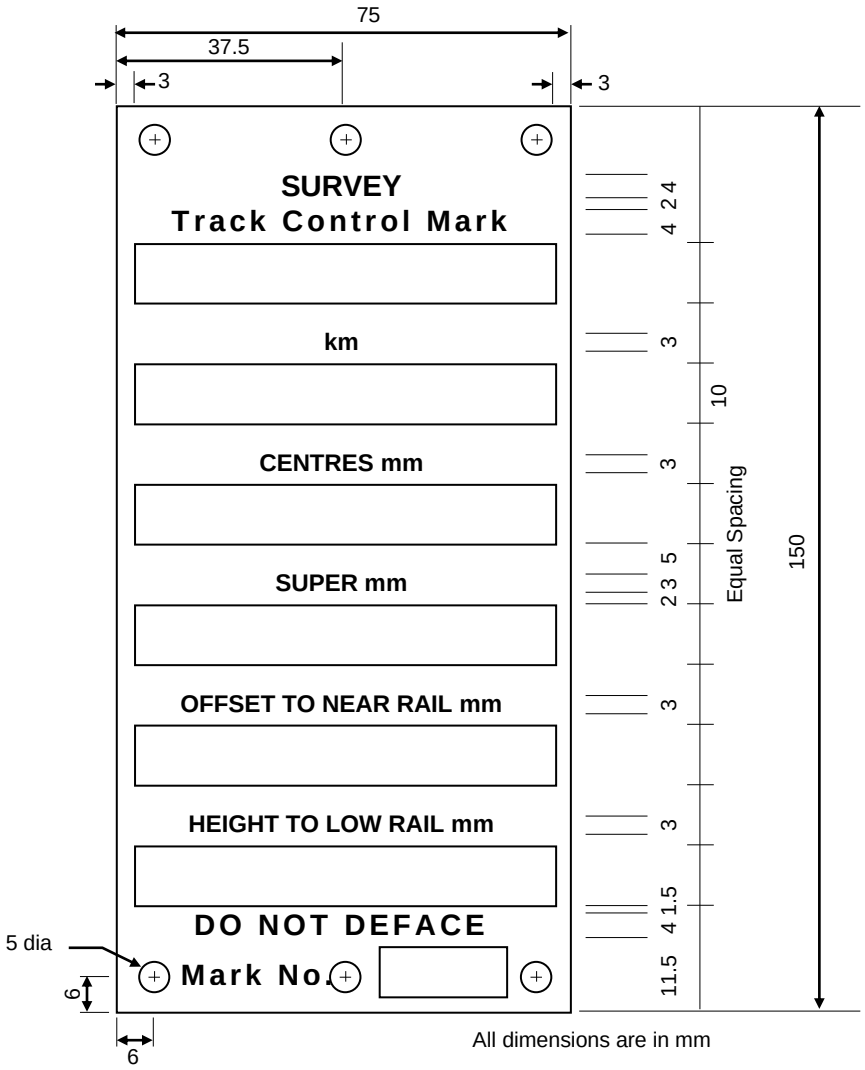


Figure 14 – Specification for plaques

Lettering	Height	Top and Bottom Headings	4mm	**Depth**	0.4mm
		Elsewhere	3mm		
		Lowercase = 75% of uppercase			
	Height : Thickness	5 : 1			
	Style	Gothic			
Lines	Thickness	0.6mm			
Material	Type	Marine Grade Aluminium 5251 W34 Anodised 20 micron			
	Thickness	1.5mm			

C4-6.3 TCM tag

The tag shall be constructed of aluminium sheets of sufficient thickness and durability to the external environmental conditions experienced on UGLRL CRN infrastructure and shall be large enough to contain all the information required.

The information shall be punched on the tag and shall remain legible for at least 10 years.

C4-7 Installation of labels

TCM Labels shall be attached as follows:

Plaques on structures: : Attach plaques to metal structures with 4mm diameter aluminium pop rivets (3.2mm to 4.8mm material thickness). Only two rivets are required in the centre holes at the top and bottom of the plaque. Use drill size No.20 as used for the stainless steel TCM for this purpose. Coat the internal surface of drill holes with a paint product (such as Galmet) prior to the placement of the rivet.

Attach plaques to non-metallic structures using four (one in each corner) 5mm diameter, 25mm depth, nylon anchors. These anchors require the use of a 5mm masonry drill for installation.

Tags: Attach tags to star pickets placed near TCMs. The tag shall be securely fastened to the star picket with stainless steel wire.

Where other methods of identifying TCMs are approved, installation methods will be documented as part of the approval.