



Surveyor-General's Direction

No. 7

*Surveying and Spatial Information
Regulation 2017 - Applications*



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Surveying and Spatial Information Regulation 2017 - Applications

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1. Preamble

The *Surveying and Spatial Information Regulation 2017* ('the Regulation'), a Regulation under the *Surveying and Spatial Information Act 2002* ('the Act'), has been developed by the Office of the Surveyor-General within DCS Spatial Services and the Office of the Registrar-General, both being units of the Department of Customer Service. The Act and the Regulation are administered by the Minister for Customer Service, except those parts so far as they relate to the registration of surveyors which the Minister for Better Regulation and Innovation is responsible for.

The Act incorporates all aspects of the regulation and oversight of land and mining surveys in NSW. The major objectives of the Act are to:

- ensure competent surveyors provide the public with professional survey services; and
- ensure the maintenance and on-going development of the State control survey and State cadastre, which provide a reliable and accurate spatial referencing system underpinning surveying, spatial information and mapping systems in NSW.

The Regulation prescribes minimum standards for surveys that are lodged with a public authority or carried out on behalf of a public authority, including Deposited Plans of survey lodged with the Registrar-General.

The standards relate to the accuracy of measurements, the calibration of equipment, the connection to the current horizontal and vertical datums of NSW, the marking of surveys, the preparation of the plan of survey and the administration of Registered Surveyors.

Maintaining the standards assures the competency of surveyors and ensures cadastral boundaries comprising the State cadastre to be traceable and reliable.

2. Introduction

Surveyor-General's Direction No. 7 ('the Direction') has been modelled on the structure of the Regulation. Each clause is dealt with only if it is considered additional advice or direction is required to clarify the wording or application of the Regulation. Additional directions for relevant clauses are given in ascending clause order as they appear in the Regulation.

The Direction is to be used in conjunction with the Regulation, other *Surveyor-General's Directions* and the *Registrar-General's Guidelines*.

Clause numbers referred to in the Direction are clause numbers within the Regulation unless otherwise stated.

3. Interpretation

3.1 Clause 4 – Mining Surveys

Clause 4 has been updated to include references to current orders and Acts.

3.2 Clause 5 – Definitions

3.2.1 “Accurate AHD value”

An “accurate AHD value” or height for the purposes of the Regulation is a survey mark with an AHD value recorded in SCIMS with a Vertical Class of “L2A, LA, LB, LC, LD, A or B” (see *Surveyor-General's Direction No. 4 – “Using SCIMS”*). SCIMS is the Survey Control Information Management System (SCIMS).

Survey marks recorded in SCIMS with a Vertical Class of LE, C, D, E, U or “Null” are not “accurate AHD values”. The SCIMS mark status must be appropriate for the use of the mark.

Only the Surveyor-General can determine an “accurate AHD value”, for part of the definition of “accurate AHD value” requires the value to be recorded in SCIMS.

3.2.2 “Accurate MGA orientation”

An “accurate MGA orientation” means an orientation of a survey adopted from either:

- the grid bearing derived from the MGA coordinates of 2 established survey marks, where the MGA coordinates are obtained from SCIMS, or
- the grid bearing derived from the MGA coordinates, determined using an approved GNSS method, of 2 permanent survey marks or reference marks, where the coordinates so determined have an accuracy of Class “D” or better.

An MGA orientation adopted from a plan filed or recorded by the Registrar-General or a public authority is not an “accurate MGA orientation” (this includes plans to which the “policy 3” general exemption applies); in such a case, to state the horizontal datum adopted as orientation on the survey plan as per Clause 61(2), the number of the plan from which the MGA orientation is being adopted (usually a registered Deposited Plan) should be stated adjacent to the north point of the survey plan along with the notation “MGA” (see [Diagram 7.32 - Example north points](#)).

In the case where a survey adopts an “accurate MGA orientation”, the survey plan should show “MGA” adjacent to the north point and the origin of the MGA coordinates (see [Diagram 7.32 - Example north points](#)).

3.2.3 “Established survey mark”

An “established survey mark” is any Survey Mark (TS, PM, SS, MM, CR etc), recorded in SCIMS as having a horizontal position equal to or better than Class “D”. The horizontal Class must be one of the following: “3A, 2A, A, B, C or D” (see *Surveyor-General's Direction No. 4 – “Using SCIMS”*).

Survey Marks with horizontal Class of E or U are not established. SCIMS MGA coordinates with a horizontal Class of “E” or “U” cannot be used to adopt an “accurate MGA orientation”.

3.2.4 “Positional uncertainty”

“Positional uncertainty” (PU) means the uncertainty of the coordinates or height of a point, in metres, at the 95% confidence level, with respect to the defined reference frame, as described in the *Standards and Practices for Control Surveys (SPI)* Version 1.7, published by the Intergovernmental Committee on Surveying and Mapping (ICSM).

“Positional uncertainty” is used in Clause 70(2) to refer to a coordinate determined to a “positional uncertainty” of 3 metres or better, being the “positional uncertainty” that is considered to approximate the quality of a coordinate obtained by current hand-held GNSS devices. See section [3.31.2 Coordinate schedule](#).

The definition of “established survey mark” (see section [3.2.3 “Established survey mark”](#)) does not use “positional uncertainty” as not all marks within SCIMS have been given a “positional uncertainty” as yet. The determination of “positional uncertainty” for all marks within SCIMS is a future goal of the Office of the Surveyor-General.

3.2.5 “Reference Mark”

A reference mark as defined by Clause 5 of the Regulation is a survey mark of the kind referred to in Schedules 3 or 4 of the Regulation. Simply, a reference mark is a survey mark that takes the form and style of a mark as detailed in Schedules 3 and 4 of the Regulation and is shown on a survey plan filed or recorded by the Registrar-General or a public authority.

The actual usage of a reference mark, being prescribed in other clauses of the Regulation, is not part of the definition of the reference mark itself.

Therefore, any survey marks on a survey plan filed or recorded by the Registrar-General or a public authority taking the form and style of a reference mark as described in Schedules 3 or 4 the Regulation are reference marks; consequently, removal of such marks after placement requires authorisation from the Surveyor-General as per Clause 90 of the Regulation.

Regarding the symbology to be shown on the plan, Clause 67 of the Regulation states that:

“In the preparation of any survey plan, the conventional signs and symbols set out in Schedule 5 must be used to indicate the matters to which they are referred by that Schedule.”

Schedule 5 shows the symbol to be used to refer to a reference mark (a “double circle”) on a survey plan. On survey plans that define cadastral boundaries, for a reference mark that is referenced to a cadastral boundary corner under Clause 62, the Registrar-General’s Guidelines state that a double circle “must be shown at the corner to which it references not at the actual position of the mark”. This does not preclude the use of the double circle to show the actual position of reference marks not referencing a cadastral boundary corner in other situations (e.g. datum line terminal, position of a reference mark in a Plan for Survey Information Only etc.).

3.2.6 “Road”

The definition of a “road” has been expanded to include accessways within Community Schemes.

Surveyors who are in doubt as to whether they need to mark part of a survey to comply with the requirements of the Regulation as regarding roads should apply a simple test: if the part of the survey raising doubt is, to all intents and purposes, primarily used for the foot or vehicular traffic of members of the public, then the best approach is to mark that part of the survey as a “road” to negate the possibility of future requisitions.

3.2.7 “Spline”

A “spline” means a continuous curve that:

- is constructed so as to pass through a given set of points, and
- has continuous first and second derivatives (has minimum curvature)

The term “spline” is referred to in Clause 64(b) as the method of showing a natural feature boundary on the survey plan. See section [3.28 Clause 64 – Method of showing natural feature boundaries](#) for further details.

It is important to note that the use of a “spline” in Clause 64(b) refers to the graphical representation of the natural feature only (i.e. the [plan drafting](#) of the natural feature), not its legal definition. The definition of the natural feature boundary remains the feature itself, subject to the doctrine of accretion and erosion and other provisions in the Regulation.

The definition of “spline” refers to a commonly used form of a spline, that being a piecewise polynomial known as an interpolating cubic spline also known as a piecewise polynomial of degree three. Many popular CAD programs have the functionality to produce a spline.

3.3 Clause 7 – Surveyor to obtain information

This clause of the Regulation is fundamental to all surveys. The cause for many requisitions is the lack of a proper search being conducted before the survey is undertaken. The clause was amended slightly in October 1994 to emphasise the need to obtain all available information that is held on public record, i.e. held in government departments or public authorities. Surveyors are instructed to obtain all information that is necessary to locate and relocate boundaries of land to be surveyed.

As is current practice, other sources pertinent to the survey such as existing field books, should also be obtained if necessary.

Prior to every survey, a search must be undertaken to obtain the latest survey information. This includes the cadastral search from NSW Land Registry Services (LRS) and the Survey Control search from SCIMS which can be accessed on the [Spatial Services Portal](#); user registration and login is required to access SCIMS Online, however user registration and information from SCIMS Online is free of cost (see *Surveyor-General's Direction No. 4* for a full description).

3.4 Clause 9 – Surveys not requiring strict accuracy

To enable the Regulation flexibility to cater for new technology and differing land uses, if a survey of land results on a plan being lodged on public record, the Surveyor-General has the flexibility of setting standards that are more appropriate to the survey technique used and the land use involved.

The class of surveys for which the Surveyor-General has approved directions under Clause 9(3)(a) are specified in section [4.3 Appendix C – Forestry right surveys](#).

3.5 Clause 10 – Surveys for identification or re-marking

All remarking and identification surveys must use appropriate equipment and field techniques so that boundaries are accurately measured (Clauses 14 & 22-26), redefined (Clause 19) and marked. It is recommended that boundary marking is carried out as per Clauses 27 & 28.

3.6 Clause 12 – Datum line

3.6.1 Datum line overview

“If it’s not on MGA, why not?”.

Establishing datum is paramount to the reliability, traceability and spatial enablement of the survey. To maintain a reliable State control survey and State cadastre, boundaries must not only be accurately measured but must be related to survey marks and the existing State control survey network. To achieve this, the datum line and survey marks must be based on the most reliable, traceable and up-to-date information available.

Clause 12 seeks to place as many plans as possible on an MGA orientation with an MGA position, with only one exception regarding urban surveys.

The requirements of Clauses 12(2) & (3) are summarized below:

- All surveys that are within **300m (urban)** or **1000m (rural)** of two established survey marks will be required to adopt an MGA orientation and MGA position from those marks.
- All **rural** surveys are required to adopt an MGA orientation and MGA position; that is, all rural surveys must adopt an “accurate MGA orientation” as described in section [3.2.2 “Accurate MGA orientation”](#).
- Urban surveys which use an **approved GNSS** method will be required to adopt an MGA orientation and MGA position.
- Urban surveys that are **not within 300 metres** of two established survey marks and have **not used an approved GNSS method** may adopt an orientation from a plan filed or recorded by a public authority.

3.6.2 Datum line requirements for urban surveys

To determine the datum line requirements for an urban survey, the following procedures should be followed (in order):

3.6.2.1 Urban “300m rule”

If there are two established survey marks within 300m of the land surveyed, the surveyor must adopt the grid bearing derived from the SCIMS MGA coordinates of those marks as the orientation of the datum line as per Clause 12(2)(a) (see [Diagram 7.1 - Urban “300m rule”](#)). The “300m rule” for urban surveys takes precedence over all other datum line requirements for urban surveys.

3.6.2.2 Urban survey – approved GNSS method used

If there are not two established survey marks within 300m of the land surveyed and an approved GNSS method has been used to conduct any part of the survey, then the surveyor has the choice of two options as described in Clause 12(2)(b):

1. Adopt, as the orientation of the datum line, the grid bearing derived from the SCIMS MGA coordinates of two established survey marks within 1500m of the land surveyed, (see [Diagram 7.1 - Urban “300m rule”](#)), or
2. Adopt, as the orientation of the datum line, the grid bearing derived from the MGA coordinates, determined using an approved GNSS method, of two permanent survey marks or reference marks within 300m of the land surveyed (see [Diagram 7.3 - Urban approved GNSS method](#)).

If a surveyor wishes to adopt, as the orientation of the datum line, the grid bearing derived from:

- the SCIMS MGA coordinates of two established survey marks greater than 1500m from the land surveyed, or
- the MGA coordinates, determined using an approved GNSS method, of two permanent survey marks or reference marks greater than 300m from the land surveyed,

then the surveyor must obtain an exemption from the Surveyor-General.

3.6.2.3 Urban survey – approved GNSS method not used

If there are not two established survey marks within 300m of the land surveyed and an approved GNSS method has not been used to conduct any part of the survey, then the surveyor has the choice of two options as described in Clause 12(2)(c):

1. Adopt, as the orientation of the datum line, the grid bearing derived from the SCIMS MGA coordinates of two established survey marks within 1500m of the land surveyed (see [Diagram 7.1 - Urban “300m rule”](#)), or
2. Adopt the orientation of the datum line from a survey for which a plan is filed or recorded by the Registrar-General or a public authority.

It is preferable that a SCIMS MGA orientation is adopted as this will give the survey MGA position and orientation, making the plan far more useful to multiple users of the plan.

If a surveyor wishes to adopt, as the orientation of the datum line, the grid bearing derived from the SCIMS MGA coordinates of two established survey marks greater than 1500m from the land surveyed then the surveyor must obtain an exemption from the Surveyor-General.

Clause 12(2)(c)(ii) contains the only non-MGA datum line orientation option; this option can only be utilised where an urban survey uses total station traversing as its sole measurement method (i.e. no GNSS) and there are not two established survey marks within 300m of the land surveyed.

URBAN "300m RULE"

2 ESTABLISHED PERMANENT SURVEY MARKS
WITHIN 300m OF THE LAND SURVEYED

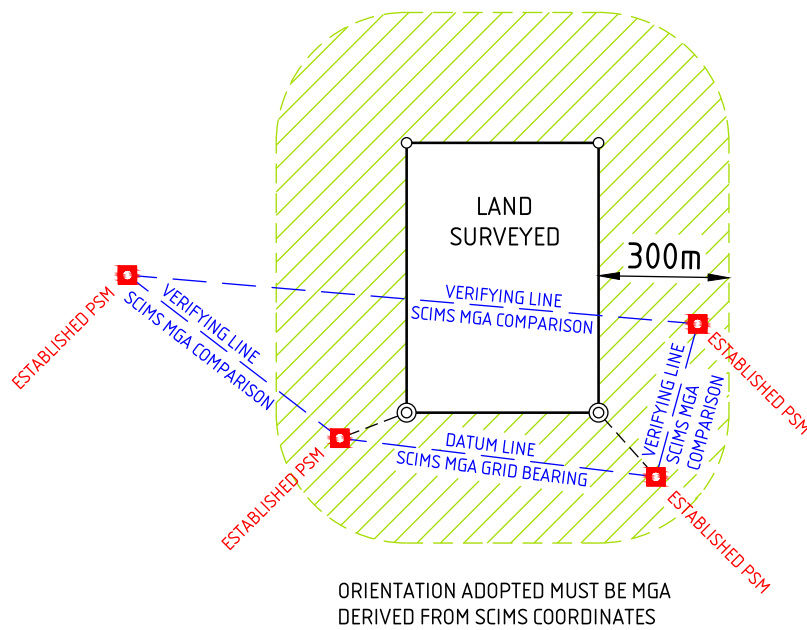


Diagram 7.1 - Urban "300m rule"

URBAN "1500m CHOICE"

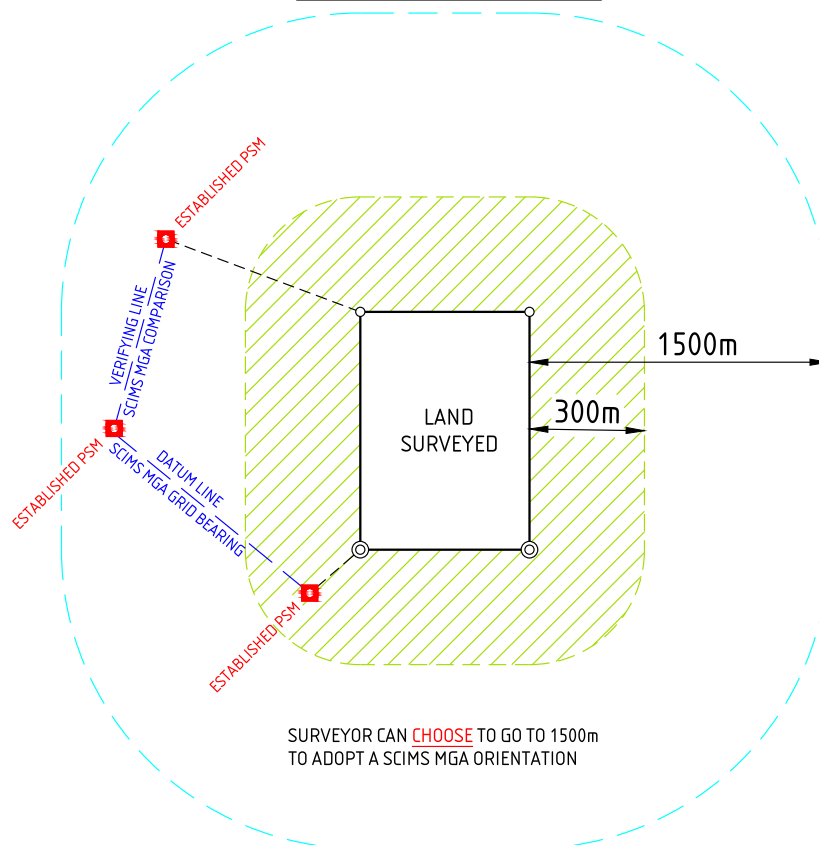


Diagram 7.2 - Urban "1500m choice"

URBAN APPROVED GNSS METHOD

SCIMS MGA ORIENTATION **HAS NOT** BEEN ADOPTED
AND AN **APPROVED GNSS METHOD** HAS BEEN USED

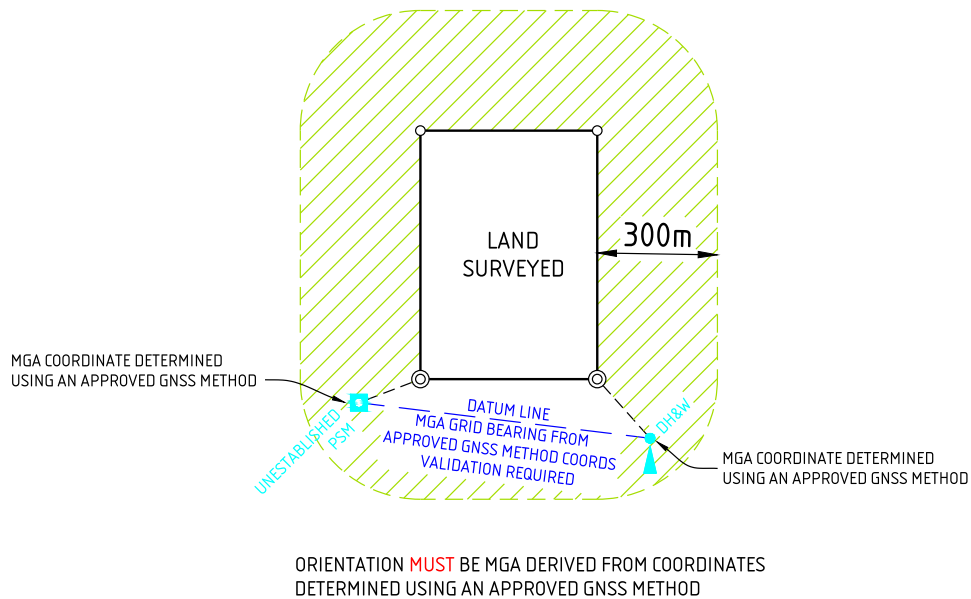


Diagram 7.3 - Urban approved GNSS method

3.6.2.4 Urban surveys – adoption of “bearing only” datum line

Surveyors wanting to adopt a “bearing only” datum line (i.e. sighting to a distant Trigonometrical Station) will need to apply for an exemption (see sections [3.34.1 Applying for an exemption](#) & [4.7 Appendix G - Contact information](#)) as it is expected that the surveyor must provide a distance connection for the datum line so as to affirm its validity.

3.6.3 Datum line requirements for rural surveys

To determine the datum line requirements for a rural survey, the following procedures should be followed (in order):

3.6.3.1 Rural “1000m rule”

If there are two established survey marks within 1000m of the land surveyed, the surveyor must adopt the grid bearing derived from the SCIMS MGA coordinates of those marks as the orientation of the datum line as per Clause 12(3)(a) (see [Diagram 7.4 - Rural “1000m rule”](#)). The “1000m rule” for rural surveys takes precedence over all other datum line requirements for rural surveys.

3.6.3.2 Rural survey – no established survey marks within 1000m

If there are not two established survey marks within 1000m of the land surveyed, then the surveyor has the choice of two options as described in Clause 12(3)(b):

1. Adopt, as the orientation of the datum line, the grid bearing derived from the SCIMS MGA coordinates of two established survey marks within 5000m of the land surveyed, (see [Diagram 7.5 - Rural “5000m choice”](#)), or
2. Adopt, as the orientation of the datum line, the grid bearing derived from the MGA coordinates, determined using an approved GNSS method, of two permanent survey marks or reference marks within 1000m of the land surveyed (see [Diagram 7.6 - Rural approved GNSS method](#)).

RURAL "1000m RULE"

2 ESTABLISHED PERMANENT SURVEY MARKS
WITHIN 1000m OF THE LAND SURVEYED

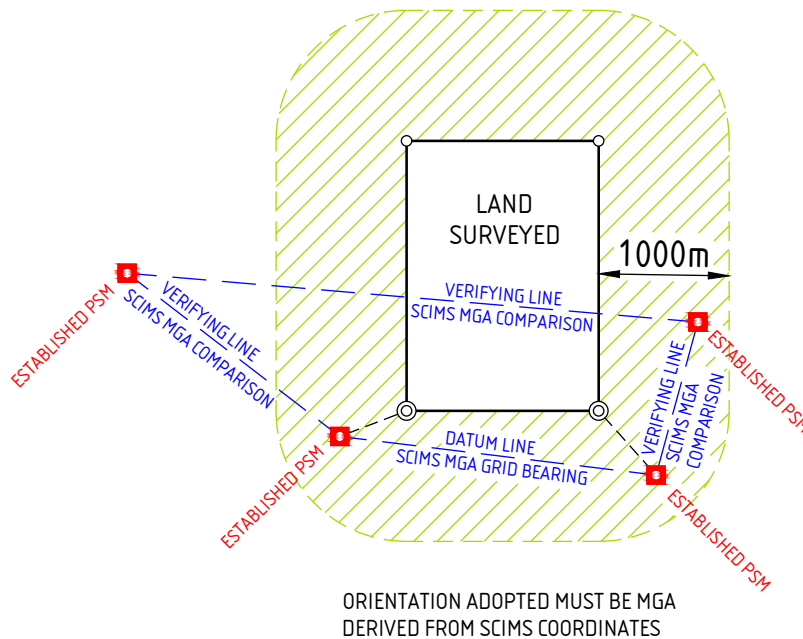


Diagram 7.4 - Rural "1000m rule"

If a surveyor wishes to adopt, as the orientation of the datum line, the grid bearing derived from:

- the SCIMS MGA coordinates of two established survey marks greater than 5000m from the land surveyed, or
- the MGA coordinates, determined using an approved GNSS method, of two permanent survey marks or reference marks greater than 1000m from the land surveyed,

then the surveyor must obtain an exemption from the Surveyor-General.

3.6.3.3 Rural surveys – adoption of “bearing only” datum line

Surveyors wanting to adopt a “bearing only” datum line (i.e. sighting to a distant Trigonometrical Station) will need to apply for an exemption (see sections [3.34.1 Applying for an exemption](#) & [4.7 Appendix G – Contact information](#)) as it is expected that the surveyor must provide a distance connection for the datum line so as to affirm its validity.

RURAL "5000m CHOICE"

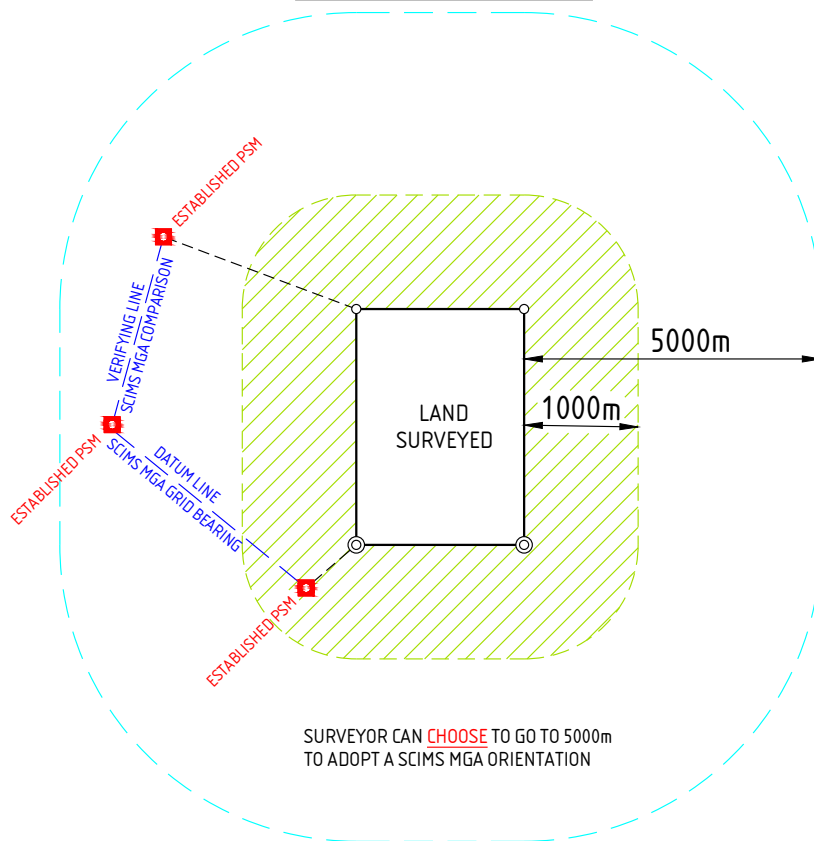


Diagram 7.5 - Rural "5000m choice"

RURAL APPROVED GNSS METHOD

SCIMS MGA ORIENTATION **HAS NOT** BEEN ADOPTED
 AN **APPROVED GNSS METHOD** **MUST** THEN BE USED

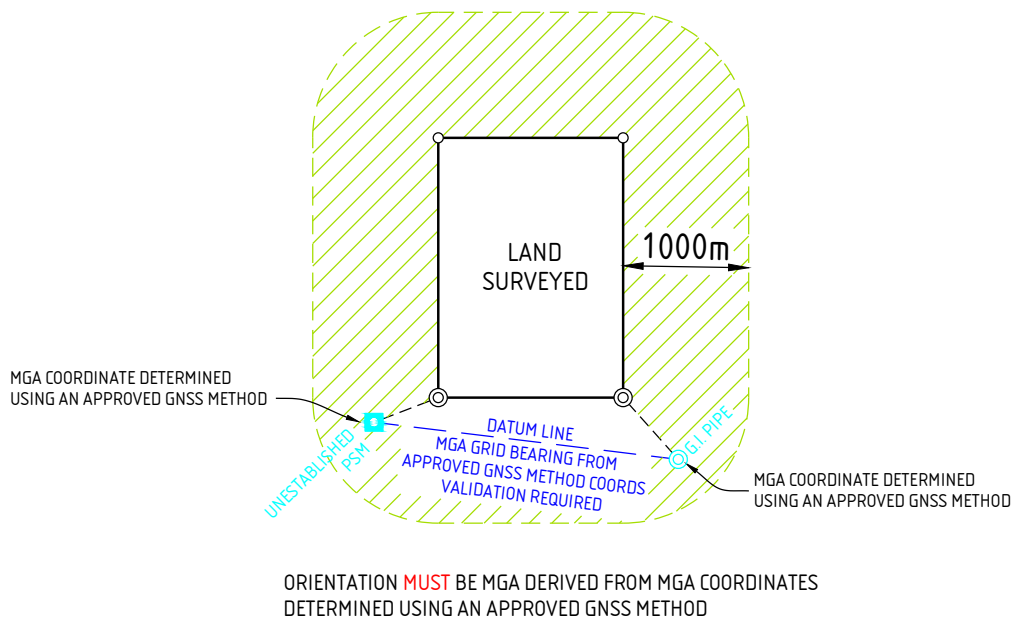


Diagram 7.6 - Rural approved GNSS method

3.6.4 Currency of MGA coordinates adopted

Any MGA coordinates used to determine the orientation of the datum line must:

- for an established survey mark, have been obtained from SCIMS, or
- have been determined using an approved GNSS method

within 6 months before the date of completion of the survey as per Clause 12(5)(a).

3.6.5 Verification of the datum line

The term “bearing” used in sections [3.6.5.1 SCIMS MGA orientation](#) & [3.6.5.2 Verification of SCIMS MGA orientation by “bearing only”](#) should be taken to mean the grid bearing of a line, as distinct from the plane bearing.

3.6.5.1 SCIMS MGA orientation

A datum line that adopts a SCIMS MGA orientation must be verified as per Clause 12(6) by connection to at least one other established survey mark.

A datum line orientation can be verified by “bearing only”; it is verification by bearing and distance to which the term “if practicable” in Clause 12(6) refers. See section [3.6.5.2 Verification of SCIMS MGA orientation by “bearing only”](#) for detailed directions on verification of the datum line by “bearing only”.

Established survey marks used to verify the SCIMS MGA orientation do not need to be within the limits imposed on the datum line by Clause 12(2) and 12(3) of 300m & 1500m (urban) or 1000m & 5000m (rural) of the land surveyed; however, surveyors should use, for a verifying line with a distance connection, an established survey mark contiguous to the applicable limit. For example, use of an established survey mark for the verifying line that is 3000m (urban) or 10,000m (rural) from the land surveyed is NOT considered contiguous.

Comparisons of measured bearings and distances with those calculated from the SCIMS MGA coordinates of the established survey marks must be shown on the survey plan for the datum line and all verifying lines as per Clause 61(4) – (see section [3.26 Clause 61 – Method of recording datum line](#)). Verification by “bearing only” will require a “bearing only” comparison (see section [3.6.5.2 Verification of SCIMS MGA orientation by “bearing only”](#)).

If the comparison on the datum line or a verifying line reveals differences exceeding 40mm+175ppm between measured values and those calculated from the SCIMS MGA coordinates (see [Diagram 7.7 - Comparison difference](#)), then the surveyor has the choice of two options as described in Clause 12(7) & (8):

1. Measure and show on the survey plan an additional connection to at least one other established survey mark, with comparisons shown, or
2. Obtain an exemption from the Surveyor-General (see sections [3.34.1 Applying for an exemption](#) & [4.7 Appendix G – Contact information](#))

The comparison difference shown for the datum line will apply to the distance only as the datum line adopts the SCIMS MGA grid bearing; the comparison of the measured and calculated distances for the datum line is still subject to the 40mm+175ppm criteria.

It is important to note that both the datum line and all verifying lines (excepting verification by “bearing only”) must be related to the survey by closed connection. See section [3.26 Clause 61 – Method of recording datum line](#).

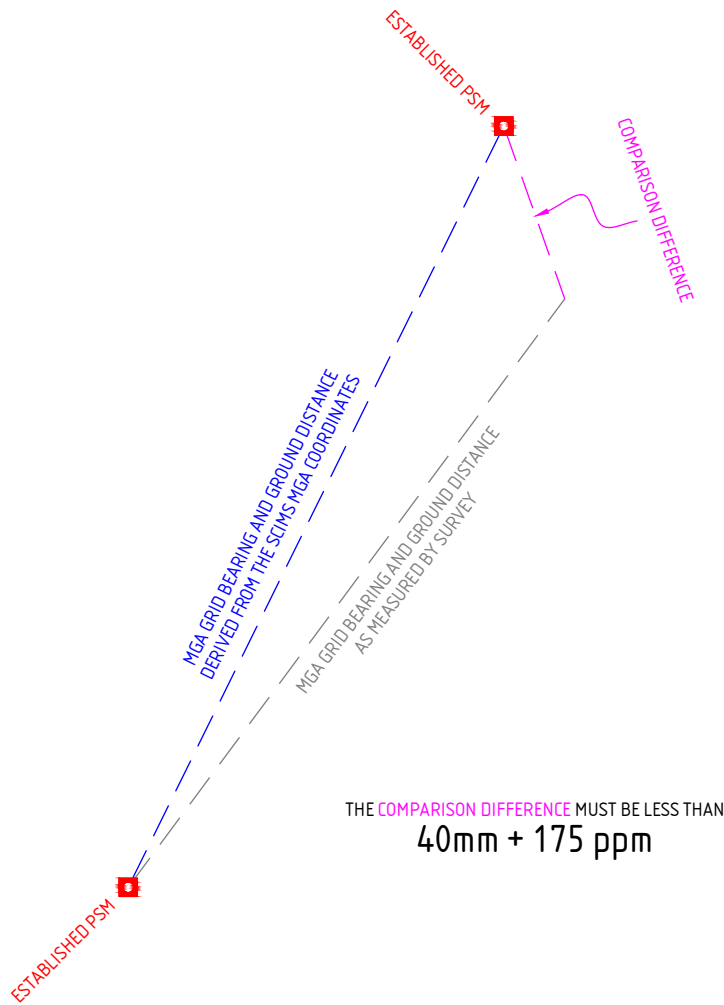


Diagram 7.7 - Comparison difference

3.6.5.2 Verification of SCIMS MGA orientation by “bearing only”

A datum line that adopts a SCIMS MGA orientation can be verified by “bearing only”. In such a case, only a bearing comparison need be shown as verification of the datum line. The comparison on the “bearing only” verifying line must be shown between the measured grid bearing and that calculated from the SCIMS MGA coordinates. Verification by “bearing only” cannot be shown by closed connection to the survey.

Verification by “bearing only” must only be used for sighting by total station or theodolite to a distant established Trigonometrical Station. Examples of “bearing only” verification are shown in [Diagram 7.8 - Single “bearing only” verification by total station observation](#) and [Diagram 7.9 - Multiple “bearing only” verification by total station observation](#).

The term “if practicable” in Clause 12(6) refers to established survey marks which will require physical occupation (e.g. tripod) to measure or sight to; in these cases, a distance is required to be measured and comparisons of measured bearings and distances with those calculated from the SCIMS MGA coordinates must be shown by closed connection on the survey plan. If distance measurement is not a practical option (i.e. sighting to a distant Trigonometrical Station), then verification of a SCIMS MGA datum line orientation is then by “bearing only”.

Due to the nature of “bearing only” verification, being an observation to a distant Trigonometrical Station with no distance connection, the requirement for a bearing and distance verification stated in section [3.6.5.1 SCIMS MGA orientation](#) for the verifying established survey mark to be contiguous to the survey does not apply.

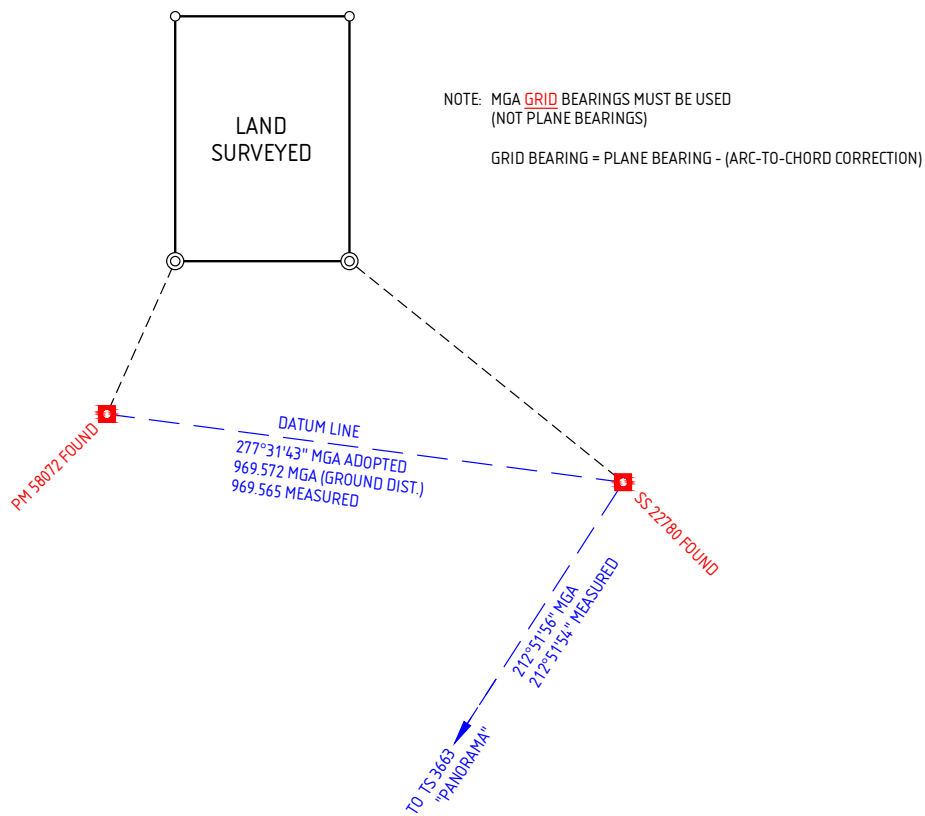


Diagram 7.8 – Single “bearing only” verification by total station observation

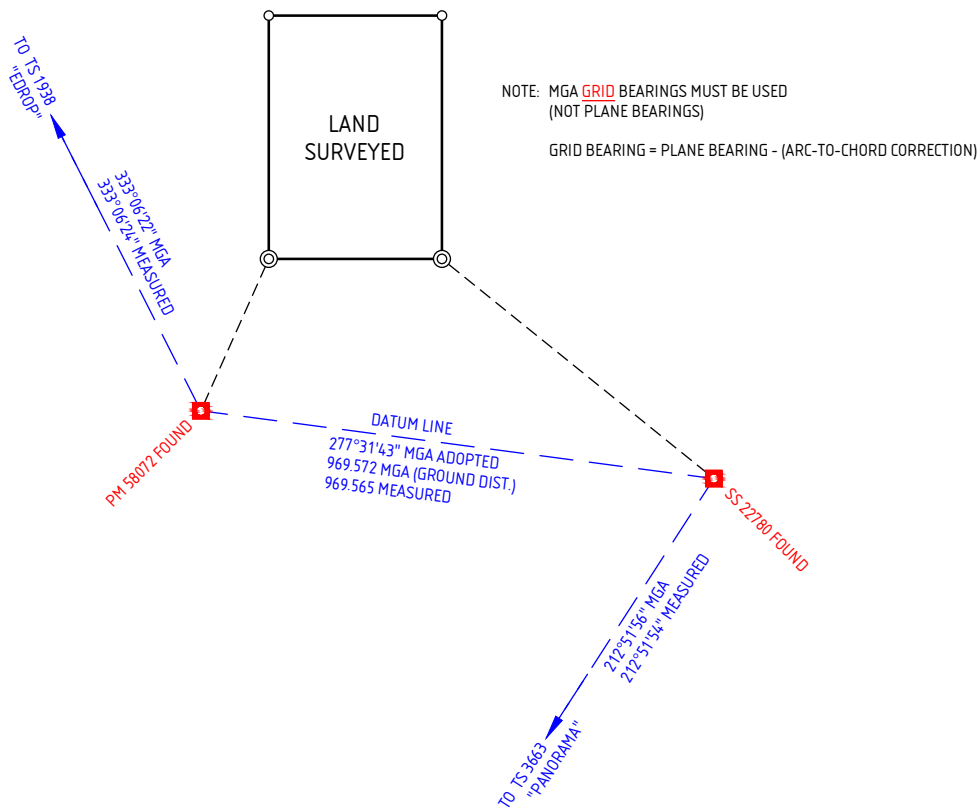


Diagram 7.9 – Multiple “bearing only” verification by total station observation

3.6.5.3 Orientation from a plan filed or recorded by the Registrar-General or a public authority

If a survey adopts as orientation a bearing calculated from or shown on a plan filed or recorded by the Registrar-General or a public authority under Clause 12(2)(c)(ii), then a comparison for the datum line must be shown between the measured bearing and distance and those calculated or shown on the plan being adopted as per Clause 61(6). See section [3.26 Clause 61 – Method of recording datum line](#).

While the 40mm+175ppm rejection criteria referred to in [3.6.5.1 SCIMS MGA orientation](#) does not formally apply to a comparison with a plan filed or recorded by the Registrar-General or a public authority, it can be used as a useful quality indicator for datum lines adopted from contemporary survey plans. If the comparison difference to an existing contemporary survey plan exceeds the 40mm+175ppm specification, then it is recommended that the surveyor investigate further to confirm the validity of the datum line adopted.

In some cases, with older survey plans, differences of greater than 40mm+175ppm may be found and the datum line adopted is valid; for example, a datum line adopted via survey marks found from a very old Crown Plan.

Note that Clause 68(2) requires a surveyor to disclose any discrepancy greater than 40mm + 200ppm, as distinct from the 40mm + 175ppm SCIMS MGA verifying line rejection criteria referred to in section [3.6.5.1 SCIMS MGA orientation](#).

MGA coordinates shown determined by a previous survey must not be adopted from a survey for which a plan is filed or recorded by the Registrar-General or a public authority. Any coordinates to be used for datum line orientation of a survey must be published in SCIMS or determined by an approved GNSS Method as part of the subject survey.

3.6.6 Use of approved GNSS methods to determine datum line orientation

Clause 12 specifies two methods by which a survey can be required to adopt MGA position and MGA orientation:

- Adopting the grid bearing derived from the SCIMS MGA coordinates of two established survey marks, or
- Adopting the grid bearing derived from Class “D” MGA coordinates as determined by the surveyor using an approved GNSS method.

Surveyor-General's Direction No. 9 specifies the GNSS methods that are approved by the Surveyor-General.

Not all approved GNSS methods are valid for determining Class “D” MGA coordinates used to orient the datum line under Clause 12.

However, all the approved GNSS methods are otherwise valid for carrying out the survey, subject to the provisions of the Regulation and Directions.

The approved GNSS methods that can be used to determine Class “D” MGA coordinates from which a grid bearing is derived and adopted for datum line orientation are as follows:

- AUSPOS
- CORS NRTK (Network Real-Time Kinematic)
- CORS single-base RTK
- CORS static

Users of geodetic GNSS equipment usually have the option to generate an MGA coordinate using an “autonomous” GNSS position. An autonomous GNSS position is considered in this Direction to be a

position determined by a single GNSS receiver relative to datum as realized by the satellite control segment only, with no error modelling other than broadcast models.

Accuracy of an autonomous GNSS position is generally better than 10m and can, in many instances, have an accuracy better than 3m. An example of a commonly used autonomous GNSS position is a GNSS position obtained using a mobile phone.

The use of an autonomous GNSS position to:

- determine an MGA coordinate used as a coordinate origin, and
- determine other coordinates based on that autonomous position using either single-base RTK or GNSS static observations,

is not an acceptable method to determine MGA coordinates adopted for datum line orientation under Clause 12.

The reasons the use of autonomous GNSS positioning is not acceptable for datum line orientation are as follows:

- an MGA coordinate determined using an autonomous GNSS position does not achieve the required accuracy of Class “D”, and
- an MGA coordinate determined using an autonomous GNSS position has no traceability to a national standard.

When selecting the datum line for a survey where the datum line will adopt, as orientation, the grid bearing derived from Class “D” MGA coordinates as determined by the surveyor using an approved GNSS method, the surveyor should select the datum line with reference to the following matters:

- The site of either terminal of the datum line needs to be selected to minimise unwanted influences on the accuracy obtained by use of an approved GNSS method. Some of the elements that may influence the accuracy obtained using an approved GNSS method include the satellites in view, site stability, site obstructions and multipath reflectors.
- The length of the datum line must be commensurate with the size of the survey. As a general rule, the length of the datum line should not be less than 300m, however, the surveyor must determine what length is appropriate for the survey. Generally, the longest length of the datum line practically feasible is desirable while having regard to the size of the survey. Note that *Surveyor-General's Direction No. 9* specifies 100m to be the minimum length of a line derived by GNSS methods.
- The position of the datum line with respect to the land surveyed has certain restrictions; the datum line must be within 300m of the land surveyed for an urban survey and 1000m for a rural survey. The datum line should, if practically feasible, be integral or immediately adjacent to the land.

It is important to note that a datum line that adopts the grid bearing derived from Class “D” MGA coordinates as determined by the surveyor using an approved GNSS method must show a GNSS validation schedule for the datum line as per Clause 66. The GNSS validation schedule must be in the form of the approved schedule as shown in [Table 9 - Approved GNSS validation schedule](#).

Also, the datum line must be related to the survey by closed connection as per Clause 61(3) (see section [3.26 Clause 61 – Method of recording datum line](#)).

As the GNSS validation must be performed and shown for the datum line, verification of a datum line under this section by connecting to a third mark is not necessary. A surveyor may, if they choose,

determine Class “D” MGA coordinates of a third mark using an approved GNSS method, then verify by showing angular and distance comparisons with an independent method (e.g. total station).

The MGA coordinates as determined by the surveyor using an approved GNSS method for datum line orientation must be of Class “D” or better. Class is dependent on a number of conditions, e.g. mark type, observation techniques, measurement standards, station density, the results of rigorous minimally constrained least squares adjustments and analysis of error ellipses. *Surveyor-General's Direction No. 12* and SP1 Version 1.7, published by ICSM have comprehensive details regarding the determination of the Class of a survey. See [Table 1 - Class derived from station density and point error ellipse size \(at one sigma\)](#).

The form and style of marks that can be used to define the terminals of the datum line under this section are reference marks or permanent survey marks as detailed in Schedules 3 & 4 of the Regulation. The marks comprising the terminals of the datum line do not have to be of the same form and style (i.e. a reference mark at one terminal and a permanent survey mark at the other terminal is acceptable).

If a mark of the form and style of a reference mark is being used exclusively to define a terminal of the datum line, that is, if the mark has not been referenced to a boundary corner, then that mark does not need to be within 30 metres of a boundary corner. In such a case, the mark should be shown by the appropriate symbol (the “double circle”) as described in Schedule 5 of the Regulation and have a direct connection to a corner of the land surveyed.

Surveyor-General's Directions No. 9 & 12 have comprehensive details regarding use of approved GNSS methods and should be read in conjunction with this section.

3.6.6.1 Using AUSPOS to determine datum line orientation

AUSPOS is a free online GPS only processing facility provided by Geoscience Australia, available for static GPS observations. Details on the use of the AUSPOS processing facility can be found at the [Geoscience Australia AUSPOS website](#).

AUSPOS GDA2020 coordinates are derived by applying transformation parameters from the current global reference frame (ITRF20xx) to GDA2020.

For datum line orientation, logging of static GPS data on the marks comprising the datum line should be continuous for a minimum of two hours to obtain Class “D” accuracy. Site conditions may require more observation time to achieve the required accuracy. It is also recommended if GPS data is being logged over different GPS days additional data should be logged to obtain Class “D” accuracy results. GPS midnight is 10am in NSW during EST months and 11am during EDST.

The accuracy of the AUSPOS result is dependent on observation length, number and distribution of GPS reference stations used in the AUSPOS solution, the antenna model, the satellite orbit data adopted for processing and the transformation parameters used.

AUSPOS processing of the GPS observations must use rapid orbit data or final orbit data.

Having observed the data required, the relevant RINEX file/s should be submitted to the [AUSPOS processing facility](#) (see [Diagram 7.10 - AUSPOS submission website](#)).

Point and (Relative) error ellipse Station Density (km)	0.005m (0.007m)	0.010m (0.014m)	0.015m (0.021m)	0.020m (0.028m)	0.025m (0.035m)	0.030m (0.042m)	0.035m (0.049m)
0.1	C	D	E	E	-	-	-
0.2	C	D	E	E	E	-	-
0.4	B	C	D	D	E	E	E
0.6	B	C	C	D	D	E	E
0.8	A	B	C	C	D	D	D
1	A	B	B	C	C	D	D
2	A	A	B	B	C	C	C
5	2A	2A	A	A	A	B	B
10	3A	2A	2A	2A	A	A	A

Table 1 - Class derived from station density and point error ellipse size (at one sigma).

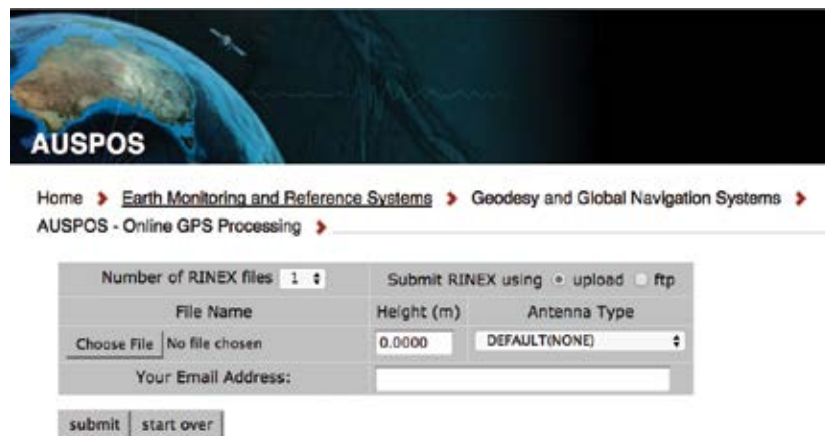


Diagram 7.10 - AUSPOS submission website

An AUSPOS report will be emailed to you (often in less than 5 minutes) that includes MGA2020 coordinates and their horizontal positional uncertainty. See [Diagram 7.11 - AUSPOS report cover](#), [Diagram 7.12 - AUSPOS MGA coordinate report](#), [Diagram 7.13 - AUSPOS positional uncertainty report](#) and [Diagram 7.14 - AUSPOS ambiguity resolution report](#).

As Class “D” is an accuracy classification based on many considerations, and as rigorous positional uncertainties have not yet been assigned to all marks stored in SCIMS, specifying a positional uncertainty range for Class “D” is not feasible at this stage.

When assessing AUSPOS results to be used for datum line orientation, the following criteria must be met:

- Minimum data logging period of 2 hrs (preferably in a single GPS day)
- GDA PU Horizontal: less than 0.1m;
- If a comparison of the connection between the adopted AUSPOS coordinates reveals differences exceeding 40mm + 175 parts per million the orientation must not be used.

If AUSPOS processing of the data shows GDA positional uncertainty significantly in excess of the acceptance criteria, then the coordinate results cannot be used for datum line orientation.

Positional uncertainty significantly in excess of the acceptance criteria would most commonly be caused by site obstructions (e.g. tree, buildings); these obstructions would limit the data able to be used by the AUSPOS processing service. Another cause might be discontinuous data caused by disturbing of the antenna during the observation period.

Another quality indicator that can be used is the ambiguity resolution. The AUSPOS report contains results of the ambiguity resolution per baseline. As a general indicator, an average ambiguity resolution of 50% or better is required for a reliable solution. See [Diagram 7.14 - AUSPOS ambiguity resolution report](#).



AUSPOS GPS Processing Report

October 31, 2019

This document is a report of the GPS data processing undertaken by the AUSPOS Online GPS Processing Service (version: AUSPOS 2.3) . The AUSPOS Online GPS Processing Service uses International GNSS Service (IGS) products (final, rapid, ultra-rapid depending on availability) to compute precise coordinates in International Terrestrial Reference Frame (ITRF) anywhere on Earth and Geocentric Datum of Australia (GDA) within Australia. The Service is designed to process only dual frequency GPS phase data.

An overview of the GPS processing strategy is included in this report.

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Diagram 7.11 - AUSPOS report cover

3.3 MGA Grid, GRS80 Ellipsoid, GDA2020

Station	East (m)	North (m)	Zone	Ellipsoidal Height (m)	Derived AHD (m)
04GJ	619222.937	6337595.399	54	59.276	50.586
ALIC	386353.243	7381852.298	53	603.238	587.502
BKNL	544405.748	6459879.206	54	307.406	294.135
HOB2	535873.805	5260778.654	55	41.039	44.741
IRYM	609725.187	6212840.753	54	72.169	66.309
KAT1	192975.042	8408794.957	53	184.286	137.330
LIPO	501035.040	6226159.972	54	64.046	59.929
MENO	574253.122	6207351.930	54	62.282	57.419
MNDE	633362.710	6415139.254	54	79.791	69.060
MOBS	321820.085	5811181.511	55	40.581	35.873
PERT	394477.884	6480974.432	50	12.661	45.043
POON	645742.285	6305208.614	54	56.589	48.622
RUUS	524827.090	6233100.805	54	39.044	34.483
SYDN	328743.034	6260602.796	56	85.582	62.646
TOW2	505852.114	7869376.776	55	88.091	29.459

Diagram 7.12 - AUSPOS MGA coordinate report

3.4 Positional Uncertainty (95% C.L.) - Geodetic, GDA2020

Station	Longitude East (m)	Latitude North (m)	Horizontal (m)	Ellipsoidal Height(Up) (m)	Derived AHD(m)
04GJ	0.015	0.017	0.020	0.064	0.213
ALIC	0.011	0.011	0.014	0.025	0.231
BKNL	0.012	0.012	0.015	0.036	0.162
HOB2	0.011	0.012	0.014	0.025	0.160
IRYM	0.012	0.013	0.016	0.039	0.161
KAT1	0.012	0.012	0.014	0.026	0.193
LIPO	0.013	0.013	0.016	0.041	0.177
MENO	0.012	0.013	0.016	0.038	0.173
MNDE	0.012	0.013	0.015	0.038	0.178
MOBS	0.011	0.011	0.014	0.024	0.160
PERT	0.013	0.013	0.016	0.028	0.171
POON	0.012	0.013	0.015	0.036	0.158
RUUS	0.012	0.013	0.016	0.039	0.198
SYDN	0.011	0.012	0.014	0.027	0.163
TOW2	0.011	0.011	0.014	0.026	0.188

Horizontal positional uncertainties are calculated according to Guideline for Adjustment and Evaluation of Survey Control of ICSM, see <http://www.icsm.gov.au/publications/standard-australian-survey-control-network-special-publication-1-sp1>.

Diagram 7.13 -AUSPOS positional uncertainty report

6 Ambiguity Resolution - Per Baseline

Baseline	Ambiguities Resolved	Baseline Length (km)
MNDE - POON	64.7 %	110.643
04GJ - POON	70.4 %	41.867
MENO - RUUS	95.5 %	55.752
MENO - POON	75.0 %	121.217
MOBS - POON	93.3 %	539.283
BKNL - POON	93.8 %	184.961
HOB2 - MOBS	87.5 %	590.524
IRYM - MENO	82.4 %	35.905
ALIC - PERT	66.7 %	1978.711
LIPO - MENO	75.0 %	75.624
BKNL - TOW2	86.7 %	1513.162
ALIC - KAT1	84.6 %	1043.680
ALIC - BKNL	83.3 %	1184.810
MOBS - SYDN	71.4 %	715.774
AVERAGE	80.7%	585.137

Please note for a regional solution, such as used by AUSPOS, ambiguity resolution success rate of 50% or better for a baseline formed by a user site indicates a reliable solution.

Diagram 7.14 - AUSPOS ambiguity resolution report

When the datum line adopts, as orientation, the grid bearing derived from Class "D" MGA coordinates as determined by the surveyor using AUSPOS (see [Diagram 7.11 - AUSPOS report cover](#)), the AUSPOS report must be lodged with the survey plan if the survey plan is lodged with the Registrar-General or a public authority.

The Surveyor-General requires all AUSPOS solutions shown on survey plans and encourages those AUSPOS solutions undertaken as part of any other type of survey project to be submitted via the AUSPOS Submission web portal.

A link to this portal can be found on the Surveyor-General's Directions webpage under Direction No.7.

www.spatial.nsw.gov.au/surveying/publications/surveyor_generals_directions

This will allow survey marks with suitably verified AUSPOS coordinate solutions to be updated in SCIMS as established survey marks at a Class of "D" and further propagates the State control survey across NSW. The submission of AUSPOS solutions which do not meet the verification requirements will still be used to more accurately plot the subject marks in SCIMS and these marks will generally be assigned a horizontal Class of "E".

Surveyor-General's Directions No. 9 & 12 have comprehensive details regarding the use of AUSPOS and should be read in conjunction with this section.

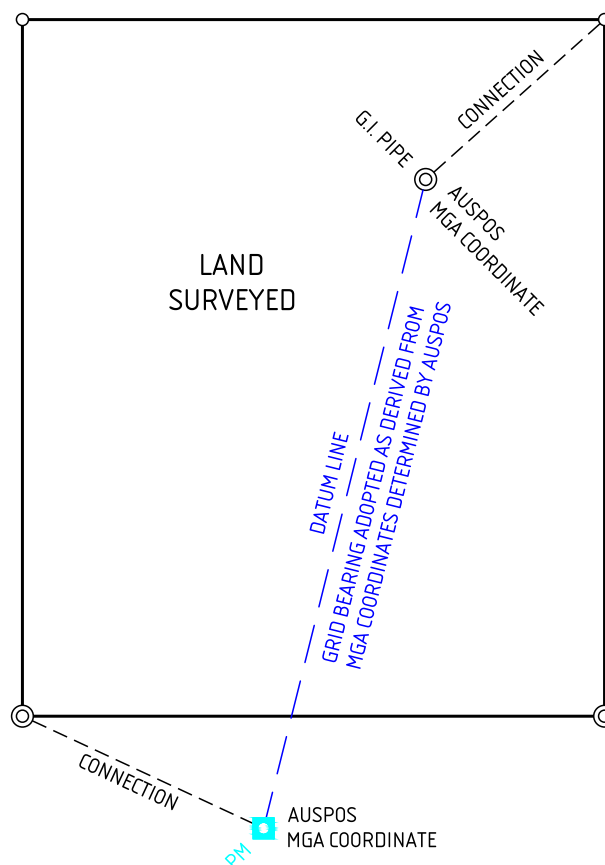


Diagram 7.15 - AUSPOS datum line example

3.6.6.2 Using CORS NRTK to determine datum line orientation

CORS NRTK is a Network RTK (NRTK) solution, where a single roving GNSS receiver computes a position in real time after receiving corrections transmitted via a communication link from multiple CORS sites surrounding the user.

NRTK observations are point position type solutions and require different analysis techniques. A point observation solution provides little in the way of relativity between adjacent marks because it does not provide a baseline to a single reference station. DCS Spatial Services maintains that NRTK accuracy is at least as good as single-base RTK accuracy.

The MGA coordinates determined using CORS NRTK for each terminal of the datum line (see [Diagram 7.16 - CORS NRTK datum line example](#)) must be a result of at least two observations on each mark defining the datum line terminals. A single observation determines the coordinates only. Additional observations provide redundancy to assess the quality of the observations. The observations on each mark should be made for a minimum of two minutes (using the averaging technique) with at least 30 minutes between re-occupations to remove biases.

The estimate of Class of the coordinates so determined is based upon the repeatability of observed coordinates and station density (see [Table 1 - Class derived from station density and point error ellipse size \(at one sigma\)](#)). Good repeatability equates to smaller error ellipses and vice versa. Similarly, multiple occupations of marks will provide an indication of the achievable precision of the system/survey and the performance of the employed GNSS method at individual marks.

Surveyor-General's Directions No. 9 & 12 have comprehensive details regarding the use of CORS NRTK and should be read in conjunction with this section.

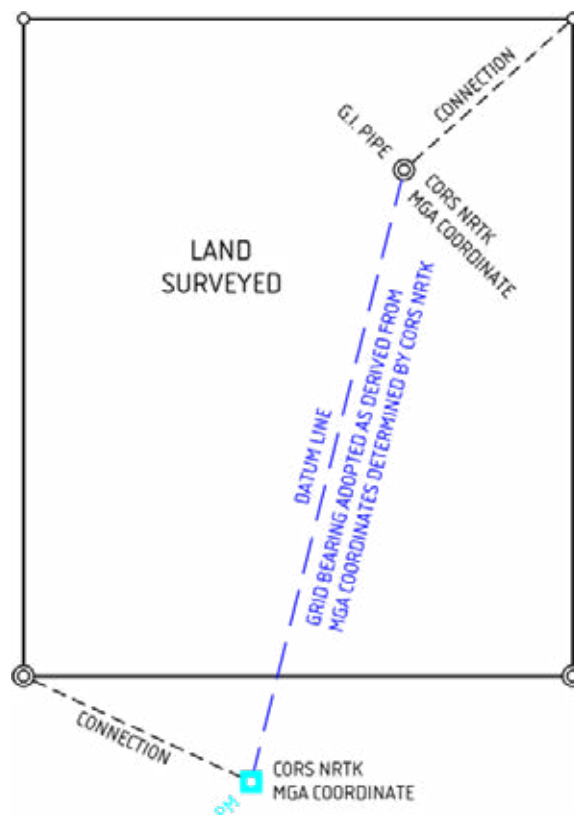


Diagram 7.16 - CORS NRTK datum line example

3.6.6.3 Using CORS single-base RTK to determine datum line orientation

CORS single-base RTK is a GNSS observation method where a single roving GNSS receiver computes a position via an observed baseline vector from a single CORS using correction data transmitted via a communication link in real time.

CORS single-base RTK produces radiations, therefore careful network design and redundancy considerations, including multiple occupations, are essential to achieve an acceptable survey outcome.

The MGA coordinates determined using CORS single-base RTK for each terminal of the datum line must be a result of at least two observations on each mark defining the datum line terminals. The two observations to each mark must comprise at least two independent occupations, with each occupation using a separate CORS site (i.e. occupation 1 from CORS site A and occupation 2 from CORS site B) (see [Diagram 7.17 - CORS single base RTK datum line example](#)).

Additional observations provide redundancy to assess the quality of the observations. The observations on each mark should be made for a minimum of two minutes (using the averaging technique) with at least 30 minutes between re-occupations to remove biases.

The estimate of Class of the coordinates so determined is based upon the repeatability of observed coordinates and station density (see [Table 1 - Class derived from station density and point error ellipse size \(at one sigma\)](#)). Good repeatability equates to smaller error ellipses and vice versa. Similarly, multiple occupations of marks will provide an indication of the achievable precision of the system/survey and the performance of the employed GNSS method at individual marks.

Surveyor-General's Directions No. 9 & 12 have comprehensive details regarding the use of CORS single-base RTK and should be read in conjunction with this section.

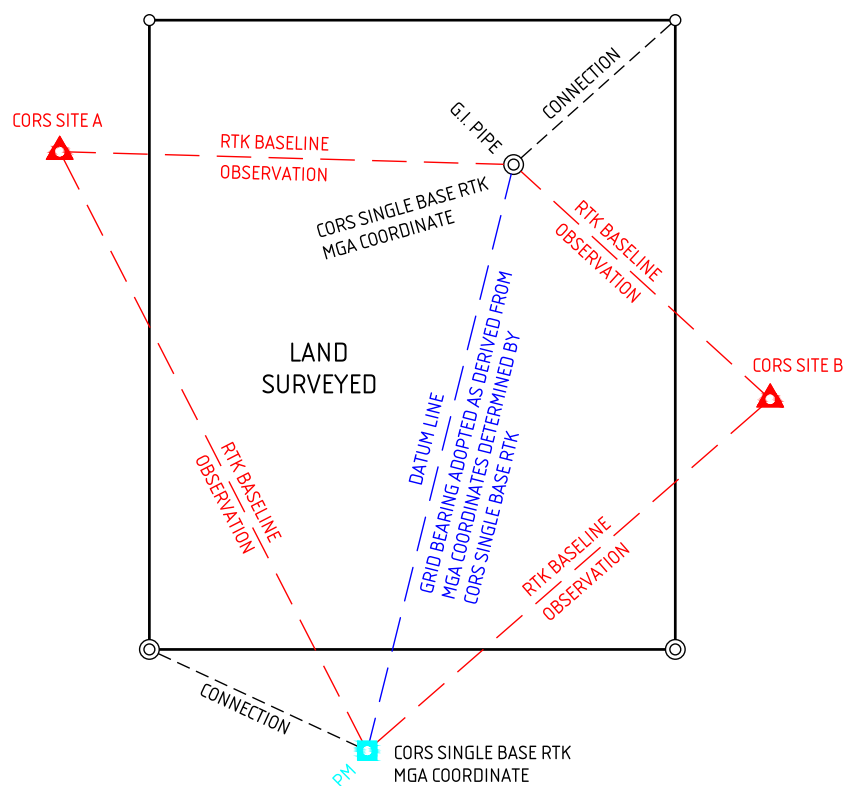


Diagram 7.17 - CORS single base RTK datum line example

3.6.7 Established survey mark status

Established survey marks used to adopt and verify a SCIMS MGA orientation must have the appropriate mark status in SCIMS. Only use survey marks that are assumed to be stable and reliable as the basis of a datum line or verifying line (i.e. Mark Status “F” = Found, “N” = Not found, “Null” = nothing recorded-assumed OK). Do not use survey marks that have been reported as “D” = Destroyed, “S” = Subsided “U” = Uncertain; do not occupy survey marks reported as “R” for Restricted Access. The marks with a “D, S or U” have already been reported as being destroyed or subsided/disturbed and therefore, not reliable marks. Survey Marks with a “Restricted” Status are all elevated Trigonometrical Stations (i.e. located on water reservoirs, silos, buildings, CORS, etc) where access is controlled and marks in areas where public safety or Work Health & Safety issues have been identified e.g. rail corridor, motorways, etc. The “Restricted” marks may still be used for “bearing only” verification as described in section [3.6.5.2 Verification of SCIMS MGA orientation by “bearing only”](#) when visibility allows, however access to the mark is restricted. CORS sites are also “Restricted” but access to the data is available via CORSnet-NSW, therefore, virtual access to the CORS pillar is possible.

3.6.8 Accurate MGA orientation adopted using an approved GNSS method - how to incorporate single established survey mark.

When a SCIMS MGA2020 coordinate is available for an established survey mark that is to be used in conjunction with MGA2020 coordinates determined using an approved GNSS method (AUSPOS or CORS), the established survey mark must also have its coordinate derived using the approved GNSS method as part of the survey. While the MGA2020 coordinates obtained from AUSPOS or CORS are on the same horizontal datum as the MGA2020 coordinates obtained from SCIMS, small differences might exist due to differing measurement error and its adjustment.

A surveyor must show the SCIMS coordinates for the established survey mark in the Coordinate Schedule on the final plan of survey as is stipulated by Clause 70(1)(b) and Clause 70(2)(b) of the Regulation. The surveyor must undertake a coordinate **block shift** of all the coordinates determined using the approved GNSS method to the SCIMS published coordinate of that established survey mark to ensure that the relativity of all marks measured is maintained. The SCIMS published coordinates of the established survey mark can then be shown in the Coordinate Schedule with a method of SCIMS, Class and PU as published. All other marks subject to the block shift will be shown in the Coordinate Schedule with an approved GNSS method (CORS NRTK GNSS, AUSPOS, CORS STATIC GNSS etc.), have a coordinate shown as determined from the above block shift to a minimum accuracy of Class D, and have a PU shown as “N/A”.

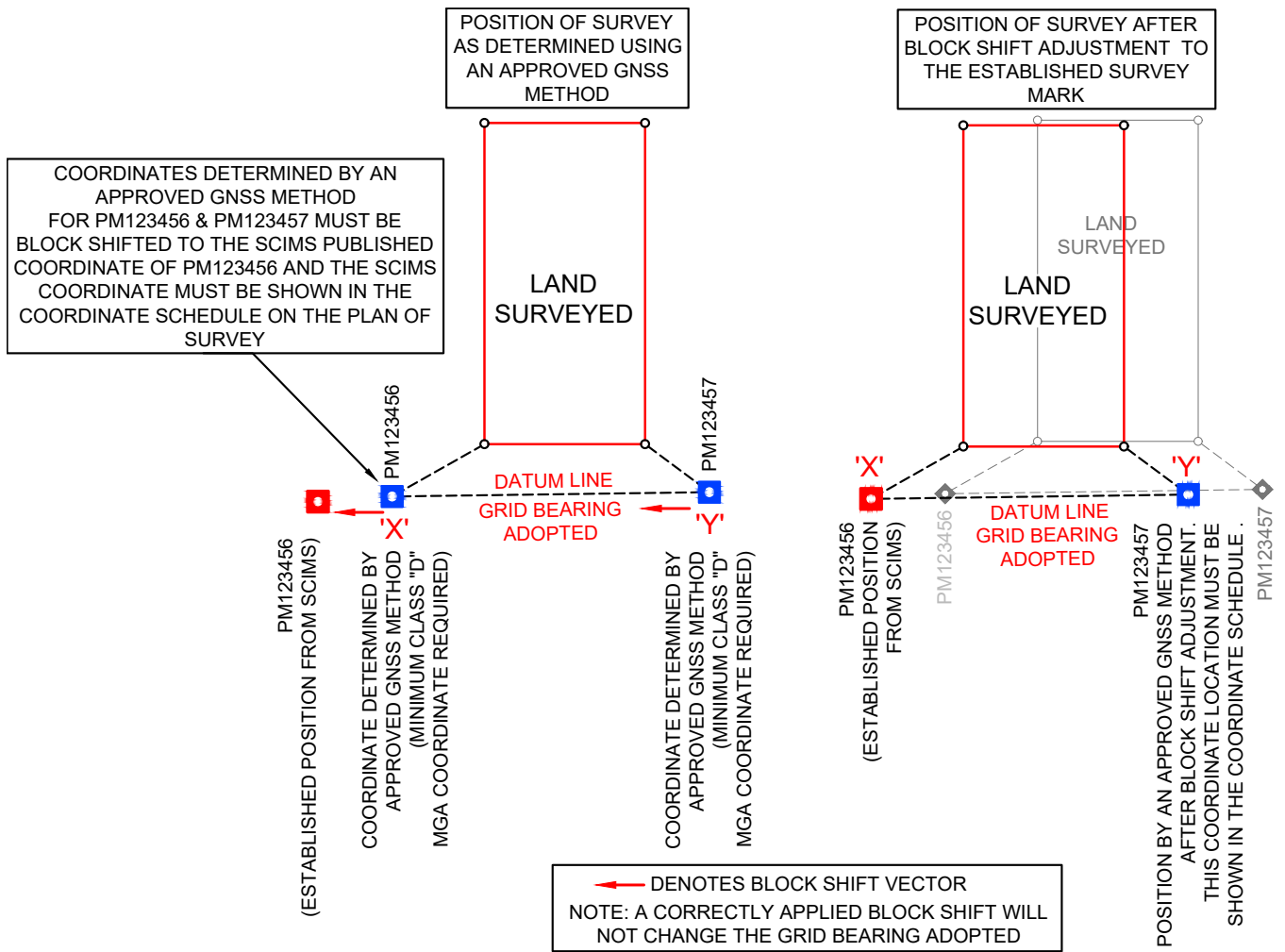


Diagram 7.18 - Block Shift Method when adopting a single established survey mark and using coordinates determined by an approved GNSS method.

3.6.9 Datum line flowchart

A flowchart (see [Diagram 7.19 - Datum line flowchart](#)) has been prepared to enable users to determine the datum line requirements of the Regulation that apply to their survey. A [separate PDF version](#) of the flowchart is available from the [Surveyor-General's Directions](#) area of the Spatial Services website under “Direction No. 7”.



Diagram 7.19 - Datum line flowchart

3.6.10 GridCalc (GDA2020) for NSW – Geodetic calculation tool.

“GridCalc_GDA2020_NSW.xlsm” is currently being developed and will be available early 2020. In the interim “GridCalc_GDA94_NSW.xlsm” will suffice for most cadastral purposes. Be aware that N value output reflects the AUSGeoid09 model, however differences in Combined Scale Factor, ground distance and slope distance will be negligible in the cadastral context.

Due to recent Regulatory changes, NSW Registered Land Surveyors have the ability to use not only geodetic coordinate data from the NSW Survey Control Information Management System (SCIMS) but also to derive (“bring your own”) geodetic coordinate data for unestablished permanent survey marks and reference marks using an approved GNSS method for survey plan orientation purposes.

“GridCalc_GDA2020_NSW.xlsm” is an augmented version of Geoscience Australia’s “GridCalc” Microsoft Excel spreadsheet; it has been built specifically for NSW and utilises the following Geoscience Australia spreadsheets:

- “Gridcalc.xls”
- “Krueger n-series.xlsx”
- “Transformation_Conversion.xlsx”
- “WINTER_interpolation.xls”

The primary purpose of “GridCalc_GDA2020_NSW.xlsm” is to enable NSW Registered Land Surveyors (cadastral surveyors) to easily calculate a grid bearing, ground distance, Combined Scale Factor and other relevant geodetic elements between two points given the Map Grid of Australia 2020 (MGA2020) coordinates and Australian Height Datum (AHD) values of two points within the same MGA zone.

“GridCalc_GDA2020_NSW.xlsm” is intended for distances between points less than 50km.

“GridCalc_GDA2020_NSW.xlsm” and its associated user manual will be available for download in early 2020.

3.7 Clause 13 – Bench marks

All height determinations are to be related to the Australian Height Datum (AHD). However, if a surveyor wishes to use another datum, approval for an exemption to use such a datum is required from the Surveyor-General. See [3.34.1 Applying for an exemption](#) & [4.7 Appendix G – Contact information](#).

Clauses 13(1) & (2) relate to the adoption and verification of AHD. See section [3.2.1 “Accurate AHD value”](#) for the definition of “accurate AHD value”.

Clause 13(3) specifies the accuracy a surveyor must attain for height differences in a survey.

Clause 13(4) & (5) specify the requirements for the bench marks that must be related to the site of the subject survey. The bench marks that must be related to the site of the subject survey may or may not include those bench marks required by Clauses 13(1) & (2) to acquire and verify AHD.

Clause 13(6) ensures that accurate AHD values obtained from SCIMS are current to the survey.

3.8 Clause 14 – Equipment for measurement of surveys

“A surveyor must not use any equipment in making a survey unless the surveyor knows the accuracy obtained by its use”.

It is the responsibility of the surveyor to determine the accuracy of the measurements taken in any survey. The Regulation contains several accuracy specifications; the Regulation is specifying the outcomes required, not the methods to be used by the surveyor.

The methods which are used to carry out the survey, process the observation data and determine the accuracies obtained are at the discretion of the surveyor; the surveyor must be satisfied that the outcomes required by the Regulation have been met.

Approved procedures for verification are given in *Surveyor-General's Direction No. 5 “Verification of Distance Measuring Equipment”* and *Surveyor-General's Direction No. 9 “GNSS for Cadastral Surveys”*.

3.9 Clause 18 – Surveys for affecting interests

This clause applies to any survey which is carried out for the purpose of defining an affecting interest, including affecting interests created within a survey that are external to the land surveyed.

It should be noted that marking of the delineation of the affecting interest (the corners of the affecting interest) is optional and is a matter between the surveyor and their client. This option does not, however, include the requirements of the clause regarding reference mark placement and permanent survey mark connection, which the surveyor must comply with.

It is recommended that reference marks are placed to refer to the intersection of an affecting interest with a boundary of land held in different ownership.

3.10 Clause 19 - Re-survey of property boundaries

This clause is designed to ensure the hierarchy of evidence is supported by fact and evidence observed during field survey for the redetermination of cadastral boundaries in NSW. A thorough review of the hierarchy of evidence is outlined in “Legal Aspects of Boundary Surveying as Apply in NSW” by Hallman and “[Some Aspects of Title Boundary Location in NSW](#)” by K E Hamer.

The hierarchy of evidence is summarized below:

1. Natural features
2. Original crown marking of grant boundaries
3. Monuments
4. Original undisturbed marking of private surveys
5. Occupations
6. Measurements.

The relative importance of each matter is subject to other evidence to the contrary.

It is a principal of law that a transfer or conveyance is construed more strongly against the grantor.

Clause 19(2) & (3) and 68 of the Regulation requires the surveyor to disclose and describe any differences in cadastral redefinition. If the boundary discrepancy is greater than 40mm + 200ppm then a report must be furnished with the survey plan. The 40mm + 200ppm should be approximately 2 - 3 times the difference expected.

If it is proven that the original plan has an error, then the original plan may be corrected. The report regarding the error should be sent to the Surveyor-General via the Cadastral Management Unit and also to the Office of the Registrar-General (see section [4.7 Appendix G – Contact information](#)).

If it is proven that an error exists, the original Deposited Plan or Crown Plan can, upon application to NSW LRS, be amended in order to correct and convey the latest information on the public record.

3.11 Clause 23 – Accuracy of angular measurements

All angular work must be checked on all surveys. The methods that may be used for checking are as follows:

1. Complete angular close, or
2. Comparison with the State Control Survey, or
3. Comparison with GNSS observations

It is at the surveyor's discretion to determine the most appropriate method to check angular work, however, the angular misclose must be determined. The GNSS observations used to check an angular misclose must attain an accuracy of Class “C” or better.

3.11.1 Accuracy of included angles on a survey plan

If 2 surveyed lines shown on the survey plan have a common vertex and those lines have bearings shown, the accuracy of the included angle must be within the tolerance of:

$$206265 \left(\frac{0.01 + \left(\frac{d}{20000} \right)}{d} \right) \text{ seconds of arc}$$

d = length of the shortest line

Formula 3A - Accuracy tolerance of included angles on a survey plan

Note that neither of the lines can be a compiled line; this is a tolerance for surveyed lines only.

The term 'tolerance' within the Regulation means the maximum permissible departure of a measurement from the true value, as allowed by the Regulation.

[Formula 3A - Accuracy tolerance of included angles on a survey plan](#) is based on the accuracy of length specification of 10mm + 50 ppm; it is the angular displacement that results from 10mm + 50ppm of a length applied as an arc at 1 terminal of that length with the centre of the arc being the other terminal. 206265 is the conversion from radians to seconds of arc. See section [4.4.1 Derivation of the formula for the required angular accuracy](#) for derivation of [Formula 3A - Accuracy tolerance of included angles on a survey plan](#).

The length of the shortest line of the two lines comprising the subject angle is used as the input to determine the tolerance required; this is due to the fact that for a given distance displacement applied as an arc at one terminal of a line with the centre of the arc being the other terminal, a shorter surveyed line will give a larger angular displacement.

Practically speaking, the shortest line of the pair comprising the angle has the most angular variance when measuring the angle. If the length of the longest line were used as input in [Formula 3A - Accuracy tolerance of included angles on a survey plan](#), it might result in an unobtainable measurement tolerance for the angle to the shortest line.

Compliance with the angular accuracy tolerance can only be determined by field measurement of the marks comprising the subject survey. The Office of the Surveyor-General and the Office of the Registrar-General carry out audit surveys to determine compliance with the Regulation. When determining compliance with the angular accuracy tolerance and other measurement specifications, the accuracy of the audit survey is taken into account; that is, the audit survey is not assumed to be "perfect".

It should be noted that compliance with the angular accuracy tolerance cannot be determined by desktop examination alone.

When carrying out a survey, the surveyor must use the estimates of precision resulting from their adjustment of the measured data, the equipment calibration values and the estimate of uncertainty of the calibration values to determine whether they have complied with the Regulation regarding the accuracy of angular measurement.

In this regard, the use of the "least squares" method of adjustment is recommended, however it is not a requirement; as discussed in section [3.8 Clause 14 - Equipment for measurement of surveys](#),

the Regulation is specifying the outcomes required, not the methods to be used by the surveyor. The surveyor must be satisfied that the outcomes required by the Regulation have been met.

Surveyors should be aware that the angular accuracy tolerance specified in Clause 23(5) represents a tolerance for individual angles only; it is not intended to be used cumulatively. Should many angles in a survey be just inside the limit of the specified tolerance, Clause 23(5) will be complied with, however, the survey could well be in breach of Clause 25, the accuracy of relative position (see section 3.13 [Clause 25 – Accuracy of relative position](#)).

The angular accuracy specification in Clause 23(5) reflects current technologies that are readily available. The accuracy specifications within the Regulation, including clause 23(5), are to ensure reliable surveys of a minimum standard that benefit all stakeholders and ameliorate the cost of investigating and amending substandard surveys by future surveyors.

The angular accuracy tolerance standards are easily achievable using available equipment coupled with a satisfactory standard of field practice. This conclusion is based on testing and data analysis of audit surveys carried out by the Surveyor-General.

3.11.2 Example of determining an included angle accuracy tolerance

An example of how to determine the accuracy tolerance of an included angle on a survey plan is shown below.

Given an included angle, shown as a green sector in the diagram below, calculate the accuracy tolerance of that angle.

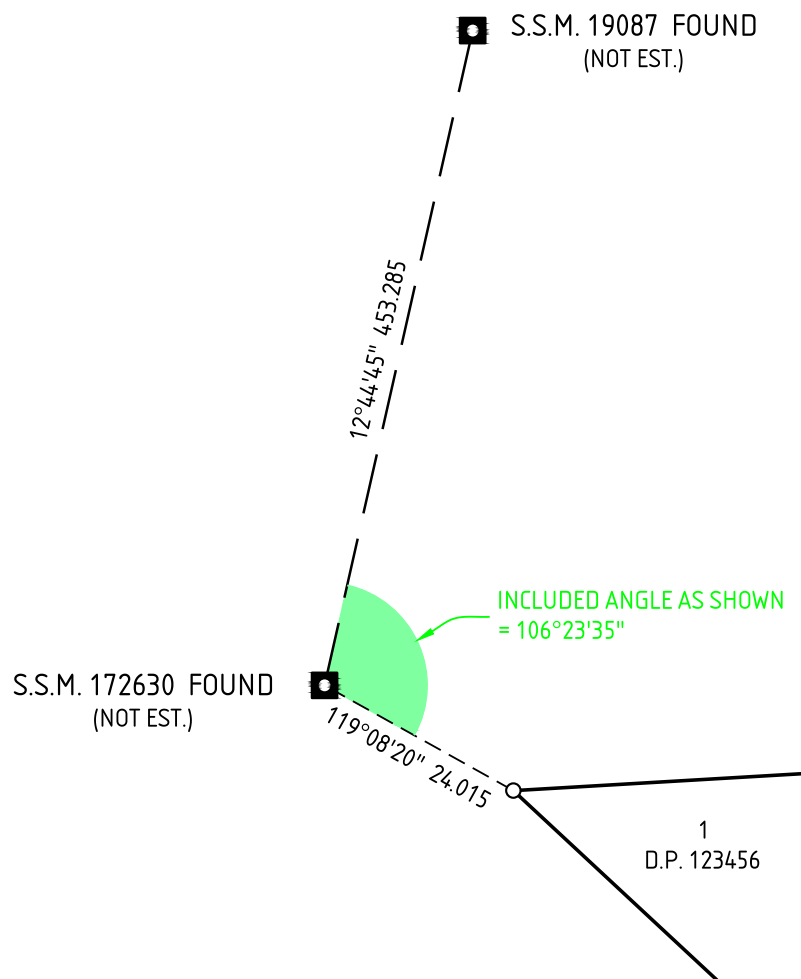


Diagram 7.20 - Determining the accuracy tolerance required for an included angle

Using [Formula 3A - Accuracy tolerance of included angles on a survey plan](#):

$$\text{Length of the shortest line} = 24.015$$

Angular accuracy required

$$= 206265 \left(\frac{0.01 + \left(\frac{24.015}{20000} \right)}{24.015} \right) \text{ seconds of arc}$$

$$= 206265 \left(\frac{0.0112}{24.015} \right) \text{ seconds of arc}$$

$$= 96 \text{ seconds of arc}$$

$$= 1'36''$$

Therefore, the included angle shown must be accurate to within 1'36".

A graphical representation of the accuracy required can be seen below in [Diagram 7.21 - Accuracy tolerance of an included angle - graphical representation](#). For the purposes of graphical representation, the longer line has been held fixed, though any error in the included angle could be present in either or both lines in the example.

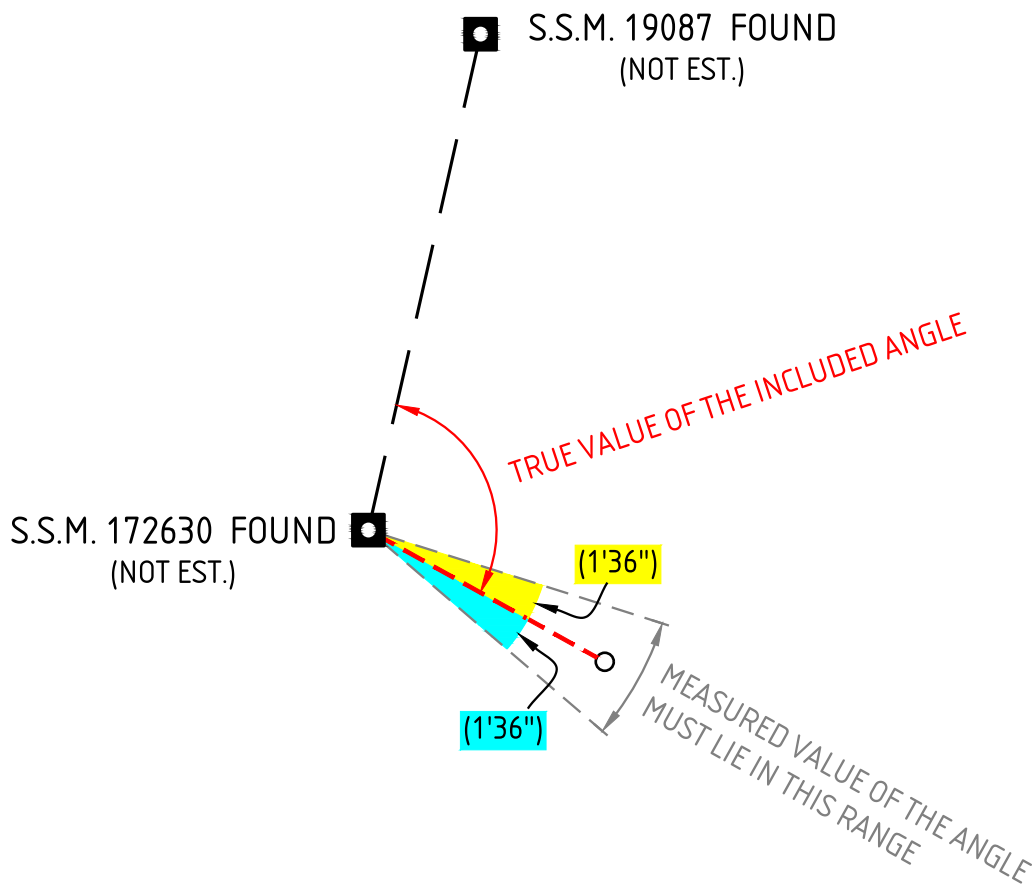


Diagram 7.21 - Accuracy tolerance of an included angle - graphical representation

3.11.3 Accuracy tolerance of included angles - selected values

Shortest Distance (metres)	Accuracy tolerance of included angle (D°M'S")
5	0°07'03"
10	0°03'37"
50	0°00'52"
100	0°00'31"
200	0°00'21"
300	0°00'17"
400	0°00'15"
500	0°00'14"
1000	0°00'12"

Table 2 - Accuracy tolerance of included angles - selected values

3.12 Clause 24 – Accuracy of length measurements

The confidence with which a length is measured is dependent upon the verification of measuring equipment, correct field procedure and well maintained equipment.

Under Clause 27 of the *Surveyors (Practice) Regulation 2001* all surveyed lines (e.g. survey connections, boundary and easement lines) had to attain an accuracy of 6mm + 30 ppm at a confidence level of 95%. That tolerance was extremely tight and not attainable from many surveys, so the tolerance was relaxed in 2006 to be more practicable and encourage the use of GNSS surveying techniques.

Under Clause 25 of the *Surveying & Spatial Information Regulation 2006* the accuracy tolerance was relaxed to 10mm + 15 ppm at a confidence level of 67%. As the confidence level was changed to 67% (to fit better with the accuracy descriptions contained within Special Publication No.1 “*Standards and Practices for Control Surveys*”) and the 6mm changed to 10mm, the effective accuracy requirement of cadastral survey measurements was effectively reduced approximately fourfold. The resultant outcome from surveys from this change allowed distances from reference marks and short boundaries (i.e. up to 30 metres) to be measured poorly. Due the poor measurement standards for short lines, surveyors were finding it problematical to define boundaries for intensive land use projects that required structures and walls to follow boundaries without encroaching. Therefore, Clause 25 of the *Surveying and Spatial Information Regulation 2012* specified a tighter accuracy tolerance for the measurement of length to 10mm + 50ppm at a confidence level of 95%.

The accuracy of length measurement under Clause 24 of the *Surveying and Spatial Information Regulation 2017* remains at 10mm + 50ppm at a confidence level of 95%. All measured lines on a plan of survey must achieve 10mm + 50ppm.

When measuring distances using Electronic Distance Measurement (EDM), surveyors must apply the appropriate corrections to account for differing meteorological conditions; for example, a change of 1°C in temperature is approximately equivalent to 1ppm of the distance measured using EDM.

As an example, for any surveyed line (whether it is a survey connection, a boundary line, an easement line, etc) 850 metres in length, the allowable tolerance for the line is 10mm + 43mm = 53mm. An acceptable length of the line is within the range 850.000 - 0.053 = 849.947 or 850.000 + 0.053 = 850.053. See [Diagram 7.22 - Accuracy of length measurements - graphical concept](#) below.

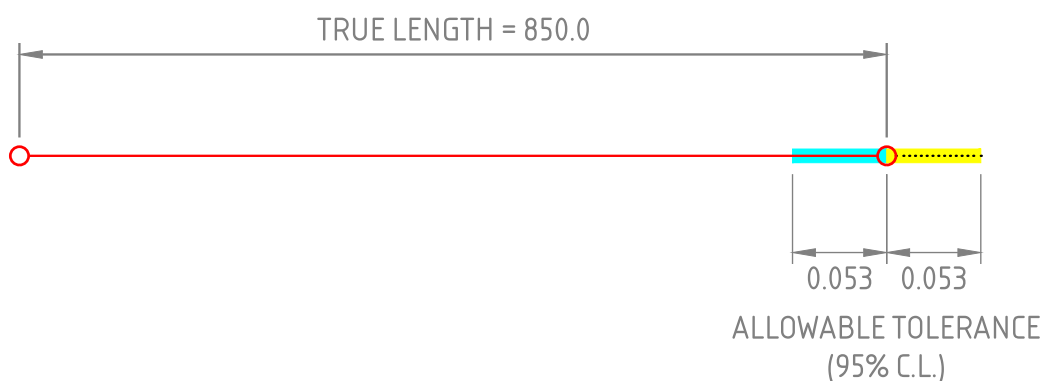


Diagram 7.22 - Accuracy of length measurements - graphical concept

3.13 Clause 25 – Accuracy of relative position

When conducting a survey, a surveyor must ensure that the accuracy of the relative positions between any 2 surveyed points is within the tolerance of:

$$\sqrt{2 \left(0.01 + \frac{d}{20000} \right)^2} \text{ metres}$$

where d is the distance in metres between the points

Formula 3B - Accuracy tolerance of relative position

Note that neither of the points can be a compiled point; this is a tolerance for surveyed points only.

The term ‘tolerance’ within the Regulation means the maximum permissible departure of a measurement from the true value, as allowed by the Regulation.

[Formula 3B - Accuracy tolerance of relative position](#) is based on the accuracy of length specification of 10mm + 50 ppm; formally it is the vector displacement that results from 10mm + 50ppm of the length of the subject vector between two surveyed points applied as two vector components; one being parallel to the subject vector, the other at right-angles to the subject vector. See section [4.4.2 Derivation of the formula for the required accuracy of relative position](#) for derivation of [Formula 3B - Accuracy tolerance of relative position](#).

Practically speaking, for a bearing and distance between any two surveyed points, it is 10mm + 50ppm of the distance applied as both distance and swing at one end of that bearing and distance.

Compliance with the accuracy of relative position tolerance can only be determined by field measurement of the marks comprising the subject survey. The Office of the Surveyor-General and the Office of the Registrar-General carry out audit surveys to determine compliance with the Regulation. When determining compliance with the accuracy of relative position tolerance and other measurement specifications, the accuracy of the audit survey is taken into account; that is, the audit survey is not assumed to be “perfect”.

When an audit surveyor is assessing compliance of a subject survey with the accuracy of relative position, the audit surveyor will seek, in the first instance, to acquire the horizontal datum of the subject survey by adopting the bearing shown for the datum line of orientation of the subject survey. If the position and orientation of the subject datum line with respect to the subject survey is in error, or the subject datum line is not appropriate for the size and shape of the subject survey, then the audit surveyor will seek to adopt an appropriate orientation from the subject survey such that the orientation residuals between the audit survey and subject survey are minimised. That is, the audit surveyor will seek to place the subject survey in the best light.

It should be noted that compliance with the accuracy of relative position tolerance cannot be determined by desktop examination alone.

When carrying out a survey, the surveyor must use the estimates of precision resulting from their adjustment of the measured data, the equipment calibration values and the estimate of uncertainty of the calibration values to determine whether they have complied with the Regulation regarding the accuracy of relative position.

In this regard, the use of the “least squares” method of adjustment is recommended, however it is not a requirement; as discussed in section [3.8 Clause 14 - Equipment for measurement of surveys](#), the Regulation is specifying the outcomes required, not the methods to be used by the surveyor. The surveyor must be satisfied that the outcomes required by the Regulation have been met.

3.13.1 Example of determining a relative position accuracy tolerance

An example of how to determine a relative position accuracy tolerance between two surveyed points is shown below.

Given the bearing and distance between R.M. G.I.P. A and R.M. G.I.P. B, determine the relative position accuracy between the two surveyed points.

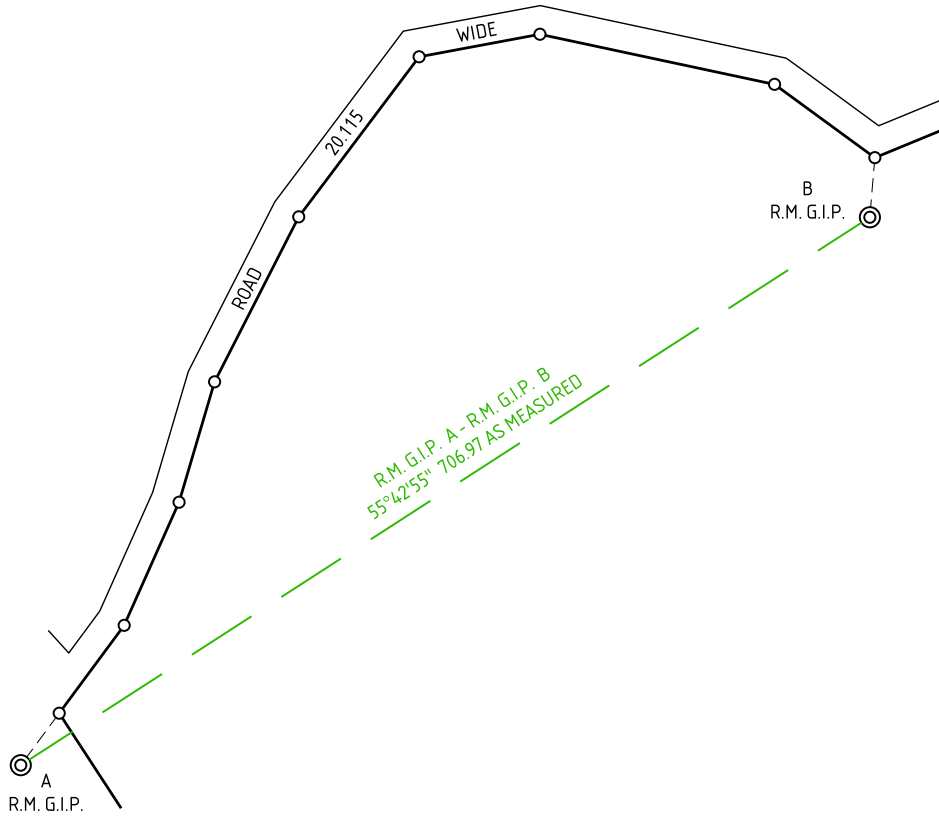


Diagram 7.23 - Example - accuracy of relative position

Using [Formula 3B - Accuracy tolerance of relative position](#):

Distance between the surveyed points = 706.97 metres

Accuracy tolerance of the relative position between the two points

$$\begin{aligned}
 &= \sqrt{2 \left(0.01 + \frac{706.97}{20000} \right)^2} \\
 &= \sqrt{2 (0.0454)^2} \\
 &= 0.064 \text{ metres}
 \end{aligned}$$

In the above example, the acceptable tolerance of the difference between the bearing and distance as measured, and the true bearing and distance is 0.064 metres. Put simply, the closing bearing and distance between the measured and true vectors must be less than 0.064. This is shown as a graphical concept in the diagram below.

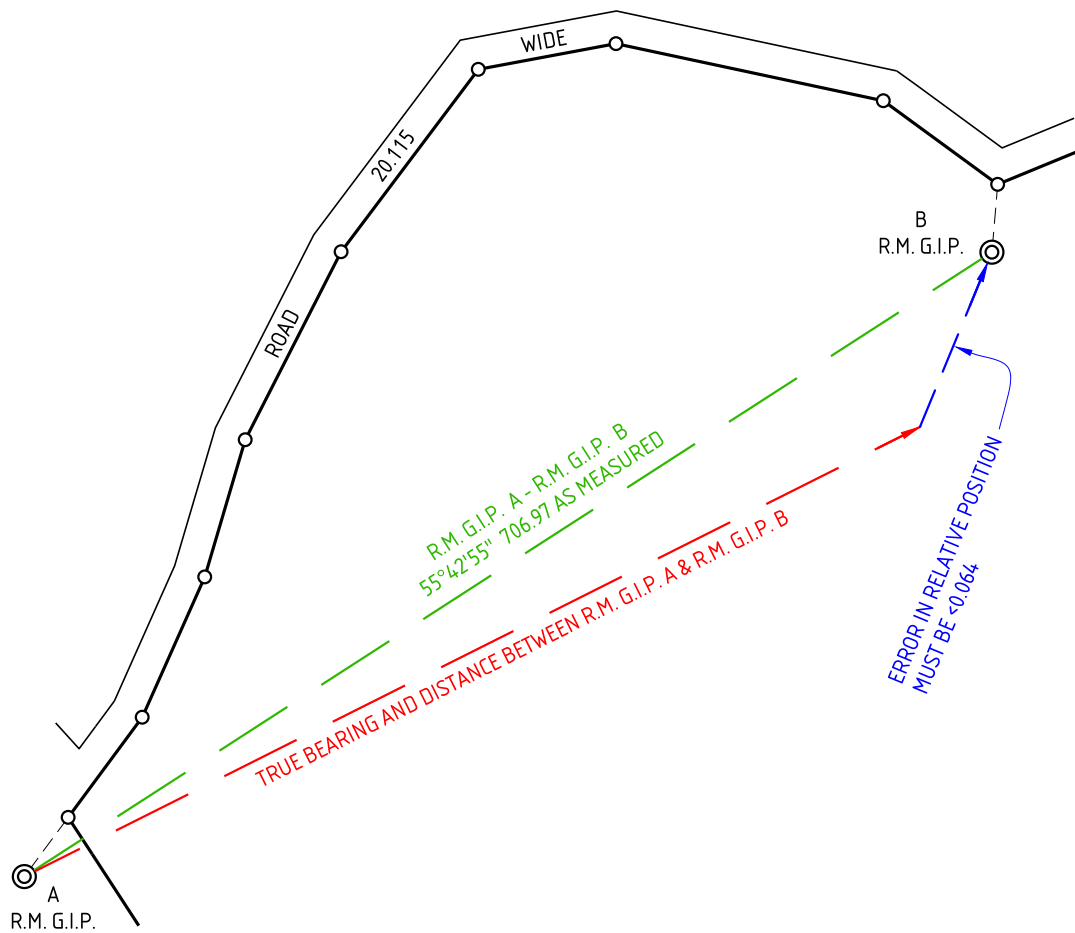


Diagram 7.24 - Accuracy of relative position - graphical concept

3.13.2 Accuracy tolerance of relative position – selected values

Distance (metres)	Accuracy tolerance of relative position (metres)	Class C precision Semi-major axis (m) REE (95% confidence level)
10	0.015	0.016
50	0.018	0.019
100	0.021	0.023
200	0.028	0.030
300	0.035	0.038
400	0.042	0.045
500	0.049	0.053
600	0.057	0.060
700	0.064	0.068
800	0.071	0.075
900	0.078	0.083
1000	0.085	0.090

Table 3 - Accuracy tolerance of relative position - selected values

It can be noted from [Table 3 - Accuracy tolerance of relative position - selected values](#) that the accuracy tolerance of relative position is very close to that of a Class “C” precision of the semi-major axis of a relative error ellipse (at the 95% confidence level) as specified by SP1 Version 1.7, published by ICSM.

The relative position accuracy tolerance standards are easily achievable using available equipment coupled with a satisfactory standard of field practice. This conclusion is based on testing and data analysis of audit surveys carried out by the Surveyor-General.

3.14 Clause 26 - Checking accuracy of measurements and calculations

All closes on the survey plan MUST be checked.

A sequence of bearings and distances that start and end at the same point is termed a “close”; it can be thought of as a closed “loop” of lines with complete dimensions.

3.14.1 Checking closes of surveyed lines on the survey plan.

Clause 26(1) states that the closure of “all measurements” of “all surrounds” comprising the survey must be checked.

This means that every “close” of surveyed lines shown on the survey plan MUST be checked for compliance with the misclose vector tolerance of 15mm + 100ppm required by Clause 26(2). **This is a fundamental requirement of a survey plan.** There are NO circumstances in which non-compliance with this requirement is acceptable.

The single misclose tolerance of 15mm + 100ppm applies for all surveyed closes for all forms of terrain. This means that for a survey with a perimeter of, for example, 850m, the misclose vector must not exceed (15mm + 85mm) = 100mm. This specification applies to both surveyed land parcels AND surveyed connections to the land surveyed that can be “closed”, such as connections from permanent survey marks to the land surveyed.

3.14.2 Checking closes of partially surveyed lots on the survey plan

The Regulation also requires complete dimensions (i.e. bearings and distances of all boundary lines) of all partially compiled residue lots are shown on the survey plan. This is required for two reasons:

1. Prevent systematic stripping of boundary dimensions whenever the partially compiled residue lot does not close or agree, and
2. Enable more flexible tolerances for systematic E-Plan preparation and assessment of partially compiled residue lots.

In this regard a table of misclose tolerances for the checking of closes for partially compiled residue lots is shown in Clause 26(3); it is also reproduced below in [Table 4 - Misclose vector tolerances for partially compiled lots](#). The *Registrar-General's Guidelines* for partially compiled plans must be adhered to; that is, the bearing and distance of each boundary must be derived only from the plan or plans that define the current title. The adjoining plans must not be used to source the boundary dimensions (i.e. bearings and distance). Only abuttal information is to be sourced from other survey plans.

Age of survey	Length of misclose vector for level or undulating terrain	Length of misclose vector for steep or mountainous terrain
1788 up to 1862	1000 ppm	2000 ppm
1862 up to 1975	500 ppm	1320 ppm
1975 up to 2001	500 ppm	1000 ppm
2001 up to present	60mm + 400 ppm	60mm + 400 ppm

Table 4 - Misclose vector tolerances for partially compiled lots

If the Lot does not close within the tolerances specified above the surveyor must either resolve the inaccuracy by surveying additional boundaries or explain the discrepancy in a comprehensive report. The report must be lodged with the survey plan.

Level/Undulating terrain has slopes less than 10 degrees, and Steep/Mountainous terrain has slopes greater than 10 degrees. See sections [3.25 Clause 60 – Survey plan to indicate name of locality, street address and type of survey](#) & [3.38.1 Form 1 – Survey certificate](#) for a full description. The terrain type must be completed on the Survey Certificate (see section [3.38.1 Form 1 – Survey certificate](#)) for all surveys that include a partially compiled lot (i.e. paragraph (b) of the Survey Certificate applies).

If parts of the dimensions of the partially compiled lot are compiled from plans that fall under different age categories in [Table 4 - Misclose vector tolerances for partially compiled lots](#), then the contribution of the compiled dimensions in each age bracket to the overall misclose vector must be calculated separately; in such a case, do not use a single overall misclose tolerance and apply it to all dimensions.

3.15 Clause 27 – Forms and styles of survey marks

The forms and styles of all survey marks are shown in Schedules 1 – 4 of the Regulation. Each Schedule outlines the specification for each mark type and how they must be placed to ensure good performance of the survey mark. The respective schedules are:

Schedule 1 Bench Marks

Schedule 2 Boundary Marks

Schedule 3 Reference Marks

Schedule 4 Permanent Survey Marks

The Surveyor-General has the authority to approve other mark types for each respective survey mark category excepting permanent survey marks. If a surveyor requires any other type of survey mark to be approved, then an application to the Surveyor-General showing the details of the proposed mark should be forwarded to the Office of the Surveyor-General, DCS Spatial Services via the Application for Surveyor-General's Approvals online form. This is available on the Surveyor General's Directions webpage under Direction No.7.

www.spatial.nsw.gov.au/surveying/publications/surveyor_generals_directions

See sections [3.35 Schedule 1 - Bench Marks](#), [3.36 Schedule 2 – Boundary marks](#) & [3.37 Schedule 3 – Reference marks](#) for further directions regarding the forms and styles of survey marks.

3.16 Clause 28 – Boundary marks

3.16.1 Obstructed boundary corners

Clause 28(3) refers to boundary corners where a surveyor is not able to place a mark.

If it is not possible to place a boundary mark on a corner, a surveyor has two options:

1. Place a reference mark within 30 metres of the relevant corner and note on the survey plan the reason the corner was not marked, or;
2. If the corner that cannot be marked is within the material of a structure that does not have a surface accessible for marking, the surveyor can show the corner on the survey plan using the obstructed boundary corner symbol in Schedule 5 and doesn't need to place a reference mark or state a reason on the survey plan.

Option No. 2 above refers to situations which include (however, are not limited to):

- Corners within a dividing wall (e.g. a party wall) where the face of the wall is **NOT** the boundary and the top of the wall cannot be practically accessed for marking;
- Stratum boundary corners that lie within the floor/ceiling of a building where a face of the floor/ceiling is **NOT** the boundary;
- Stratum boundary corners that lie within solid underground substrate

Option No. 2 above does **NOT** refer to situations which include (however, are not limited to):

- Fence posts that lie on a corner to be marked
- Low brick or concrete walls that lie on a corner to be marked
- Corners fronting a natural feature boundary
- Corners that lie on the face of a wall (e.g. the end of a party wall)

If a survey mark is able to be placed on the corner, the surveyor is expected to mark the corner; if there exists any doubt as to what constitutes “does not have a surface accessible for marking”, the surveyor should seek further direction from the Cadastral Management Unit of DCS Spatial Services (see section [4.7 Appendix G – Contact information](#)).

3.16.2 Corners liable to erosion

Clause 28(4) gives the surveyor some discretion on where to place boundary marks near mean high water mark or bank boundaries. If the foreshore is liable to erosion, the surveyor may place the boundary mark on the side boundary at a safe distance to avoid disturbance by erosion.

3.16.3 Unfenced rural boundaries

If a rural boundary is unfenced, the lines that form the boundary must also be marked with lockspits placed in the direction of the boundaries that extend from each corner. [Diagram 7.25 - Lockspit placement](#) below shows the required placement of lockspits.

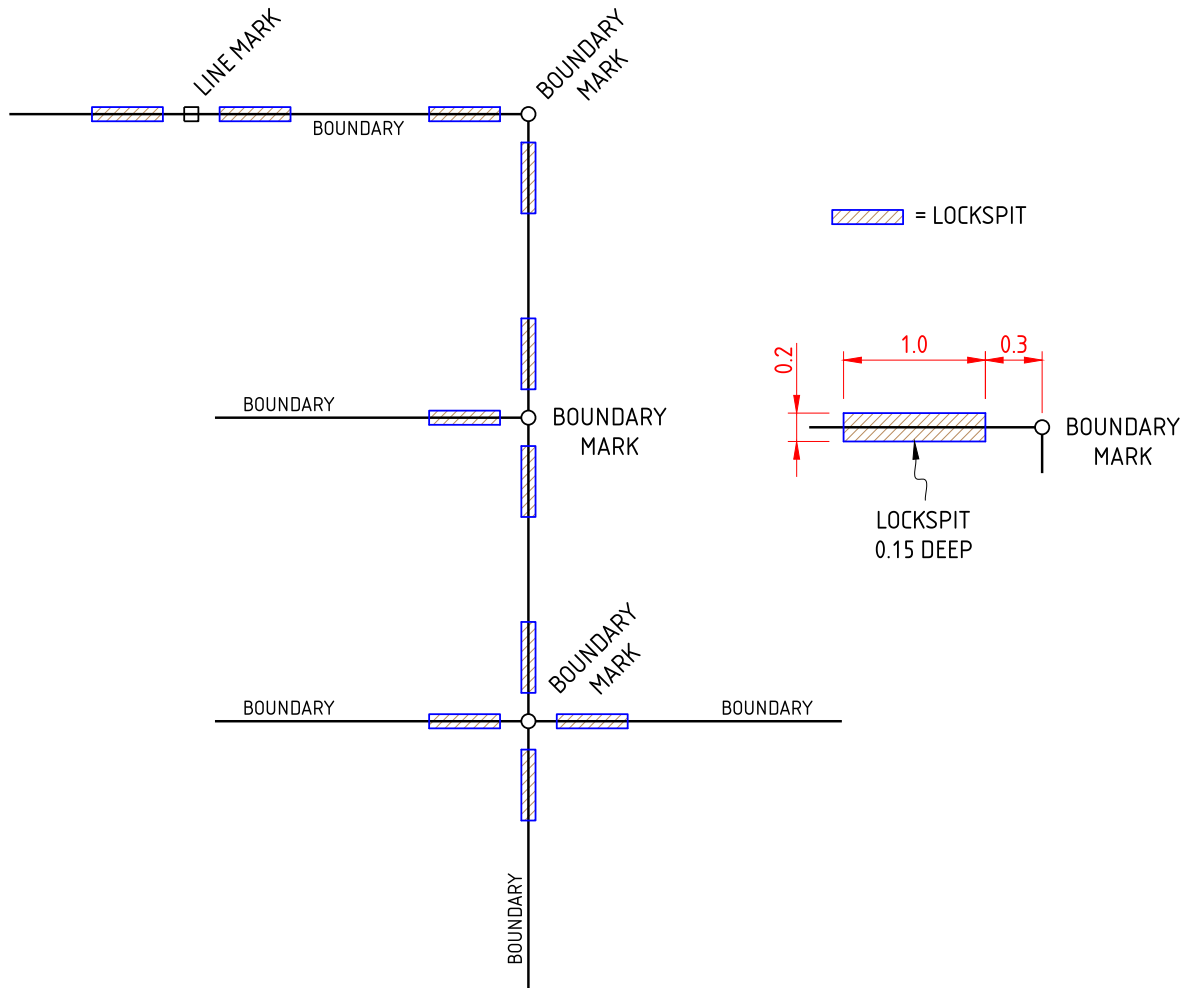


Diagram 7.25 - Lockspit placement

If a boundary of a rural survey is unfenced, the placing of blazes is lawful (that is, does not contravene any current local, State or Federal legislation) and environmental conditions do not prevent the blazing of trees, any tree trunk greater than 100mm in diameter and within 500mm of the boundary must be blazed. The centreline of the blaze should be offset slightly to indicate which side of the tree the boundary line passes.

Diagram 7.26 - Blazing trees near boundary line shows how blazes on trees within 500mm of the boundary line should be placed.

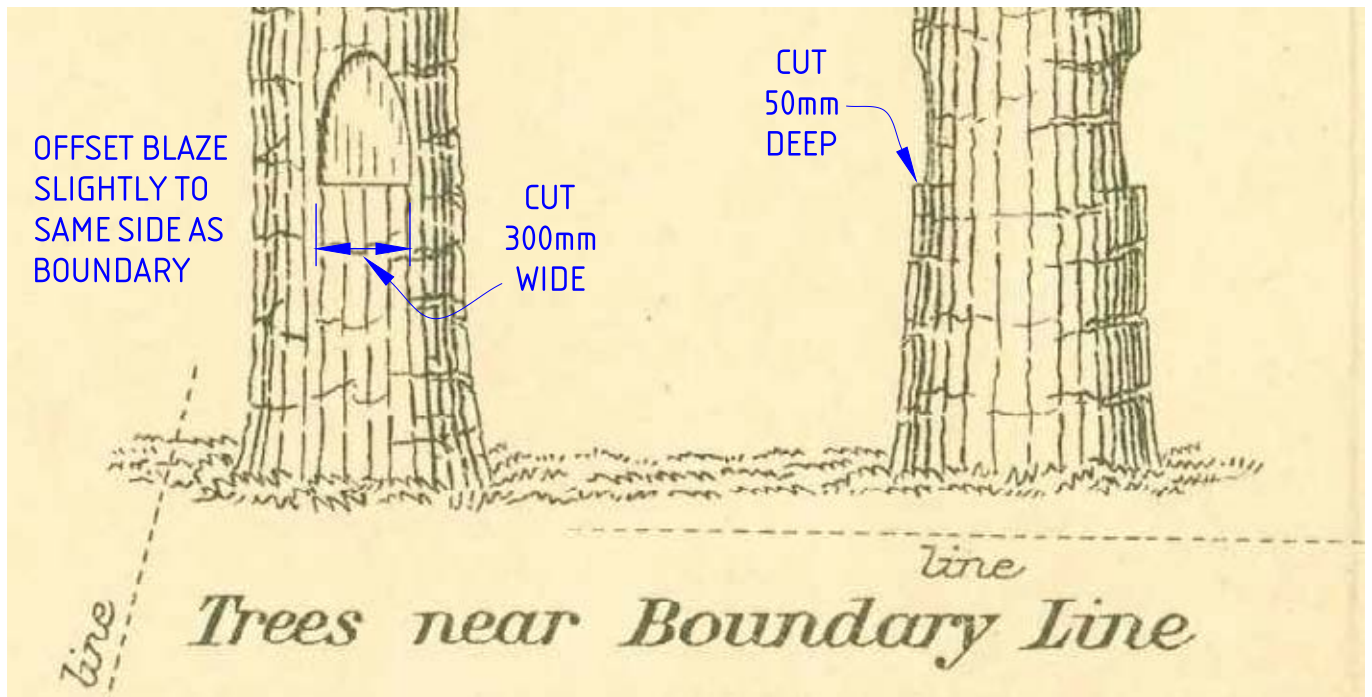


Diagram 7.26 - Blazing trees near boundary line

If the boundary line passes through the trunk of the tree, then the tree must be double blazed. When placing the double blaze, cut the top blaze first to ensure that tree bark remains to separate the two blazes. The base of the blaze shall be at least 300mm long cut at least 50mm deep horizontally into the tree, the bark and wood pared off to reveal a horseshoe shape as shown in the diagram below. If a tree requires to be double blazed the upper blaze shall have a cut at least 200mm long, 50 mm deep cut horizontally into the tree.

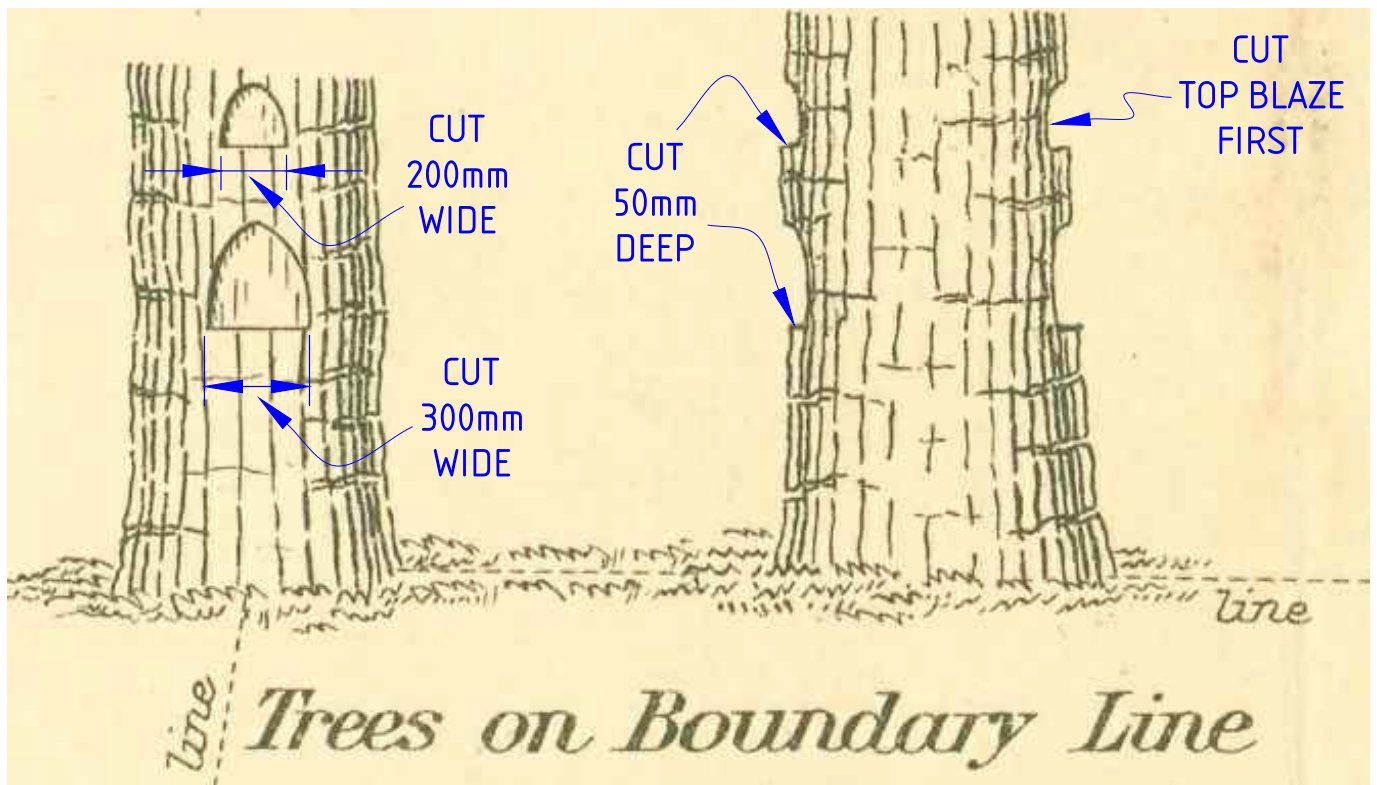


Diagram 7.27 - Blazing trees on boundary line

3.17 Clause 29 – Marking of urban surveys

Generally speaking, the majority of urban surveys have a minimum of 2 extremities where the survey abuts a road, therefore the surveyor must place or connect reference marks so as to refer to both of these extremities. An extremity of an urban survey abutting a road also refers to the junction or intersection of roads; therefore, for example, an urban survey that subdivides a lot that lies at the intersection of two roads must place reference marks so as to refer to the intersection of the roads AND the extremities of the survey abutting each of the two roads.

Also, reference marks must be placed along a road frontage of an urban survey that has intervening side boundaries so that the distance between corners referenced does not exceed 100 metres.

Clause 29(4) is a concession in the case where there is an existing reference mark, already referenced by a prior plan, within 10 metres of an extremity of the subject survey. It is important to note that the existing reference mark, not the corner it refers to, must be within 10m of the subject extremity. In such a case, a new reference mark need not be placed and the existing reference mark may be referenced to the extremity of the subject survey. This is the only case in which it is acceptable to reference an existing reference mark to two separate corners on two separate plans; this is also the only exception to the requirement of Clause 62(1) whereby a reference mark must not be referenced to more than one point on any survey plan. The reference should be shown on the plan to the effect of “additional reference by me” along with the plan that originally placed the reference mark. Be aware that a reference mark placed by the subject survey cannot be used to reference two corners on the subject survey plan in any circumstances. [Diagram 7.28 - Existing reference mark within 10m of an extremity](#) below shows the graphical concept of the concession by Clause 29(4).

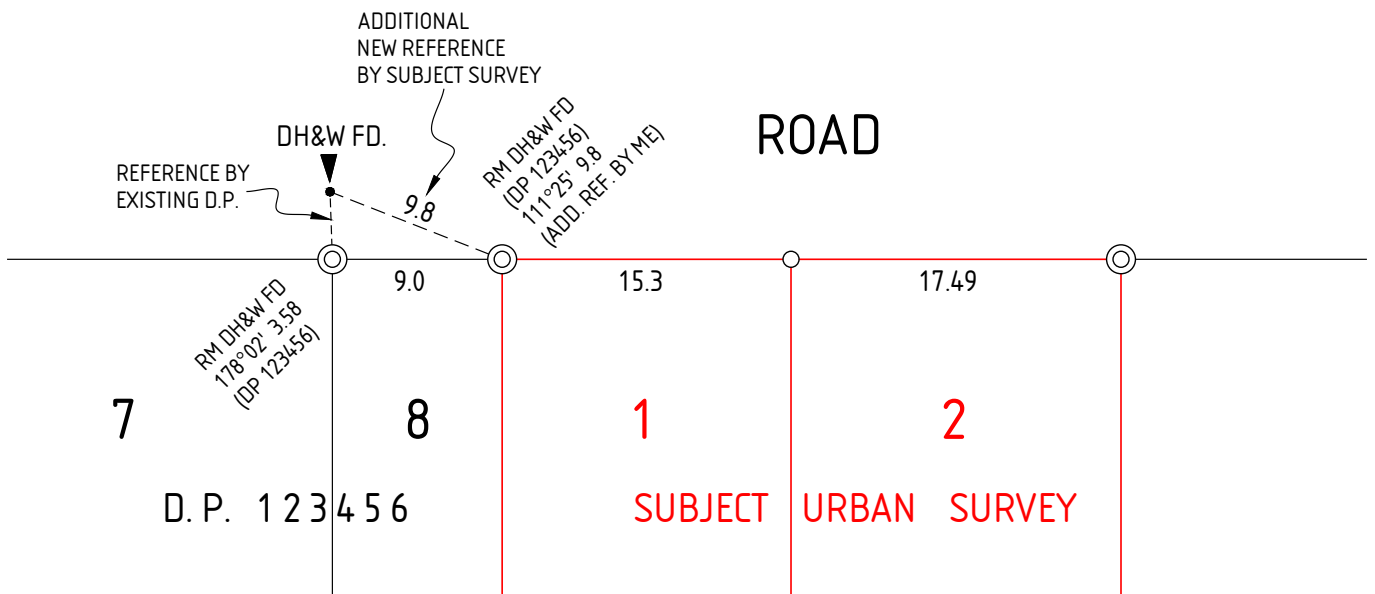


Diagram 7.28 - Existing reference mark within 10m of an extremity

3.18 Clause 30 – Marking of rural surveys

The Regulation requires, for rural surveys, the placement of a reference mark at the extremity of the land surveyed where the land abuts a road. In addition, if a boundary line exceeds 2400 metres in length (whether or not the boundary includes one of more bends) reference marks must be placed at intervals of not more than 1500 metres.

If the land surveyed has frontage to a stream where that frontage is greater than 500m, then reference marks must be placed so as to refer to each intersection of the stream bank with side boundaries.

3.19 Clause 35 – Surveyor to note nature and position of survey marks etc

Clause 35 emphasises that a surveyor must indicate on the plan of survey the nature, position and source of all survey marks found and all survey marks placed that are not pegs. The source is the plan number of the survey that originally placed the mark or the earliest plan of survey which adopted the mark.

Regarding reference marks, the following requirements must be followed when denoting the source of the mark:

- The survey plan on which the reference mark first occurs must be shown.
- The survey plan from which the subject survey has adopted the bearing and distance to the referenced corner must be shown.
 - o Where the reference bearing and distance has been adopted from a survey plan different from the survey plan on which the mark first occurs, both the survey plan on which the mark first occurs AND the survey plan from which the reference has been adopted must be shown.

3.20 Clause 38 – Deferment of placement of survey marks

See sections [4.1 Appendix A - Deferment of survey marks - application](#) & [4.2 Appendix B - Deferment of Survey Mark - Placement](#) for deferment of survey mark forms.

The provision to defer the placement of reference marks for roads was introduced in Clause 37 of the amended *Survey Practice Regulation 1990* on 1 October 1994. This was done to prevent survey marks being disturbed or destroyed by construction works. The remake of the *Survey Practice Regulation* in 1996 expanded those provisions to defer all types of survey marks.

Generally, only reference marks and permanent survey marks will be deferred. It is an assumption that surveys are carried out for the purpose of identifying land prior to subdivision or sale. As a survey service to clients, it is expected that all land is clearly identified in the field. This will require the placement of corner marking as a minimum. Generally there will be no deferral of corner marks.

The process for obtaining approval to defer the placement of survey marks is divided into the following three stages:

1. Prior to Construction
2. After approval by the Surveyor-General
3. After Construction

In order to gain the approval to defer the placement of survey marks, the following pre-requisites must be satisfied for each stage.

3.20.1 Prior to Construction

A comprehensive network of survey marks must be in safe and protected locations throughout the development.

Survey marks suitable to create the network are as follows:

- a permanent survey mark as defined in the Regulation, or
- a reinforced concrete block in the form of a truncated pyramid 400mm long, 150mm square at the lower and 100mm square at the upper end with a non corrosive metal plug not less than 80mm long inserted into the block, or
- a galvanised iron pipe not less than 600mm long and 20mm internal diameter of a rim not less than 3mm, or
- a galvanised iron pipe not less than 300mm long and 20mm internal diameter with a rim of not less than 3mm inserted vertically into concrete cast in situ with dimensions at least 400mm deep x 200mm wide, or
- a non-corrodible spike or nail at least 50mm long and 6mm in diameter inserted vertically in concrete cast in situ with dimensions at least 400mm deep x 200mm wide, or
- an existing reference mark that has proven to be reliable and stable.

The network must be sufficient so that survey marks are within 100m of points of the development suitable for defining the new lots.

The existing State control survey must be used where available.

An electronic copy (preferably as PDF) of the survey plan should be prepared showing:

- all existing survey marks
- all survey marks creating the network. These marks should be identified on the plan by double circles. When permanent survey marks are used the appropriate symbol as per Schedule 5 of the Regulation should be used. Direct connections between these marks should be shown on the plan or in a schedule. The network must consist of closed connections to provide greater integrity.
- connections from the network of survey marks to the cadastre.
- corners to be related to the deferred survey marks. The corners should be identified by double circles and a unique letter or number.
- all proposed cadastral information and road details.

The following statement must be included on the survey plan in either the “Statements” or “Signature and Seals” panels:

PLACEMENT OF REFERENCE/PERMANENT SURVEY MARKS IN ... [name of road(s) and/or lots]... HAS BEEN DEFERRED IN ACCORDANCE WITH CLAUSE 38 OF THE SURVEYING AND SPATIAL INFORMATION REGULATION 2017. WHEN PLACED, THE NATURE AND POSITION OF THE REFERENCE/PERMANENT SURVEY MARKS WILL BE SHOWN IN A SCHEDULE ON A SEPARATE SHEET ANNEXED TO THIS PLAN.

Send a digital copy of the plan, preferably as a PDF (Portable Document Format) file, along with a completed Deferred Marks application form (see section [4.1 Appendix A - Deferment of survey marks - application](#)) to the Surveyor-General at the e-mail address Surveyor-General-Approvals@customerservice.nsw.gov.au.

Payment of \$308 per deferred survey mark or \$929, whichever is the greater, is required as security to ensure that **all** marks are placed. When the survey marks are placed 85% of the security is refunded (cheques should be payable to DCS Spatial Services).

The Surveyor-General will approve, conditionally approve or reject the application. Any conditions are to be satisfied prior to final approval.

If the plan is approved by the Surveyor-General, it will be endorsed with a Deferred Mark number, and a digital copy of the plan returned via email.

The survey plan should then be suitably prepared for lodgement with the Registrar-General.

3.20.2 After Approval by the Surveyor-General

Once all other appropriate approvals and endorsements have been obtained, the survey plan should be lodged with the Registrar-General, quoting the deferred mark number adjacent to the Surveyor's Reference.

3.20.3 After Construction

Deferred survey marks **must** be placed within 28 days of the completion of the construction (as specified in Clause 38(5)).

Permanent survey marks, particularly State Survey Marks, can be used as reference marks to supplement the network. The total number of permanent survey marks placed and/or connected must satisfy Clause 41 of the Regulation.

All the deferred survey marks placed are to be shown in a schedule on Plan Form 6. This plan will be annexed to the original Deposited Plan lodged with the Registrar-General.

The surveyor must forward a copy of the final registered Deposited Plan of survey to the Surveyor-General at the email address Surveyor-General-Approvals@customerservice.nsw.gov.au together with a completed placement of Deferred Marks form (see section [4.2 Appendix B - Deferment of Survey Mark - Placement](#)) certifying that all deferred marks have been placed.

Upon completion of all requirements to place the deferred survey marks, including the satisfactory results of a field audit by the Surveyor-General, the Surveyor-General will return 85% of the original security deposited. **No payment will be released for partial completion of the survey.**

If you have any queries regarding the Deferred Mark guidelines, please contact the Cadastral Management Unit at the e-mail address CMU@customerservice.nsw.gov.au.

3.21 Clause 41 - Surveys redefining or creating multiple parcels, roads or affecting interests

This clause refers to the connection of surveys to the State control survey network.

All permanent survey marks found or placed must, at a minimum, show MGA coordinates of the mark to an accuracy equal to or better than a positional uncertainty of 3 metres.

For a survey that adopts an “accurate MGA orientation”, all unestablished permanent survey marks found or placed (excepting those connected to the survey by height only) must show MGA coordinates of the mark to an accuracy equal to or better than Class “D”.

The existing network should be used where ever it is available, and if not available provision made for future extension.

Most surveys must connect to or place and connect to at least 2 permanent survey marks unless an exemption is granted. The only exception is the connection to existing permanent survey marks for short easements (i.e. less than or equal to 200m). Emphasis is placed on using existing established or unestablished permanent survey marks in preference to placing more permanent survey marks.

Subdivisions of 2 lots or more including dual occupancies must connect or place and connect to 2 permanent survey marks. No exemptions to this requirement will be granted.

Clause 41(2) of the Regulation states that a maximum of 2 existing permanent survey marks at the time of survey may be used to satisfy Clause 41(1) and infers the placement of new permanent survey marks is needed for any additional connections required. If a survey is in an area where the existing permanent survey mark network is deemed sufficient and the requirement to place additional permanent survey marks redundant, an exemption to Clause 41(2) may be granted ([3.34.1 Applying for an exemption](#) & [4.5 Appendix E Surveyor-General's Approvals](#)); where such an exemption is granted, the surveyor may not be required to place additional permanent survey marks and compliance with Clause 41(1) is achieved by connection to the existing permanent survey mark network in the survey area.

Clause 41(3) of the Regulation requires the placement of permanent survey marks on formed roads or roads to be created under any Act. Unformed Crown Roads do not require permanent survey marks to be placed at regular intervals.

Areas used for access within “neighbourhood and community developments” are treated the same as roads. Therefore permanent survey marks must be placed and/or connected in accordance with all the provisions of clause 41(3).

Clause 41(4) of the Regulation requires all large easement surveys (i.e. greater than 200m in length) to connect, or place and connect a minimum of 2 permanent survey marks.

Clause 41(5) small surveys for the purpose of creating an affecting interest only (i.e. affecting interests less than or equal to 200 metres in length) are not required to place permanent survey marks; if two or more existing permanent survey marks are available within 300m of the survey, then connections must be made to at least two existing permanent survey marks. If two or more permanent survey marks are not available within 300m of the survey, then connection to permanent survey marks is not required.

All easements greater than 200m in length must connect or place and connect to at least 2 permanent survey marks.

Easements less than or equal to 200m in length must connect to existing permanent survey marks only, if two or more are available within 300m of the survey.

3.22 Clause 42 – Connection to permanent survey marks

Clause 42 of the Regulation states that all measurements **between permanent survey marks** must be proved by closed survey and shown on the plan of survey. Any permanent survey mark shown should have, as a minimum, connections to either:

- two adjacent permanent survey marks, or
- one adjacent permanent survey mark and a connection to the land surveyed,

And must not be left unchecked at the end of a radiation unless the radiation is a verification of SCIMS MGA orientation by “bearing only” see 3.6.5.2 Verification of SCIMS MGA orientation by “bearing only”.

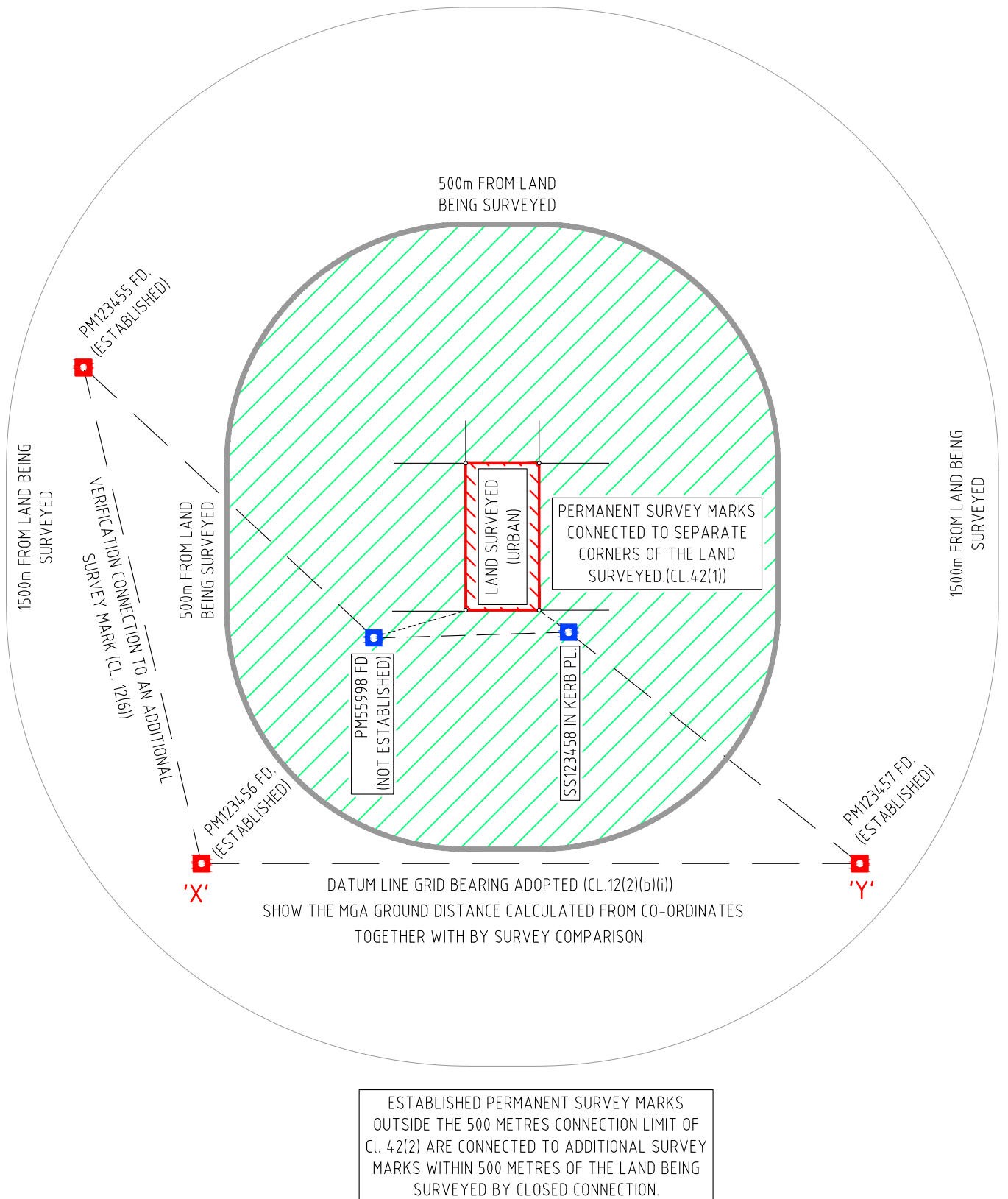
The connections between permanent survey marks are required and should be shown on the plan as direct connections expressed to the nearest millimetre and nearest second.

The permanent survey marks required by Clause 41 must be connected by direct lines to separate corners of the land surveyed.

No exemption will be granted from showing the complete information on the survey plan.

Where established permanent survey marks are used to define the accurate MGA orientation of either an urban or rural survey under Clause 12 of the Regulation and the connection of those established permanent survey marks to the land surveyed exceeds the 500 metre or 1000 metre connection distances stipulated in Clause 42(2), additional existing or newly placed permanent survey marks must be connected to the survey to meet the requirements of Clause 42. The permanent survey marks defining the accurate MGA orientation must be related to the land surveyed by closed connection (Clause 61(3)); it is preferable that the closed connection includes the permanent survey marks used to satisfy Clause 42 of the Regulation.

Simply, any established permanent survey marks comprising the datum line and/or verifying line of an accurate MGA orientation do not have to be used to comply with Clause 42 of the Regulation, however compliance with Clause 42 will still be required.



Diagrams 7.29 - Urban Survey examples of compliance with Clause 42 and Clause 61 of the Regulation.

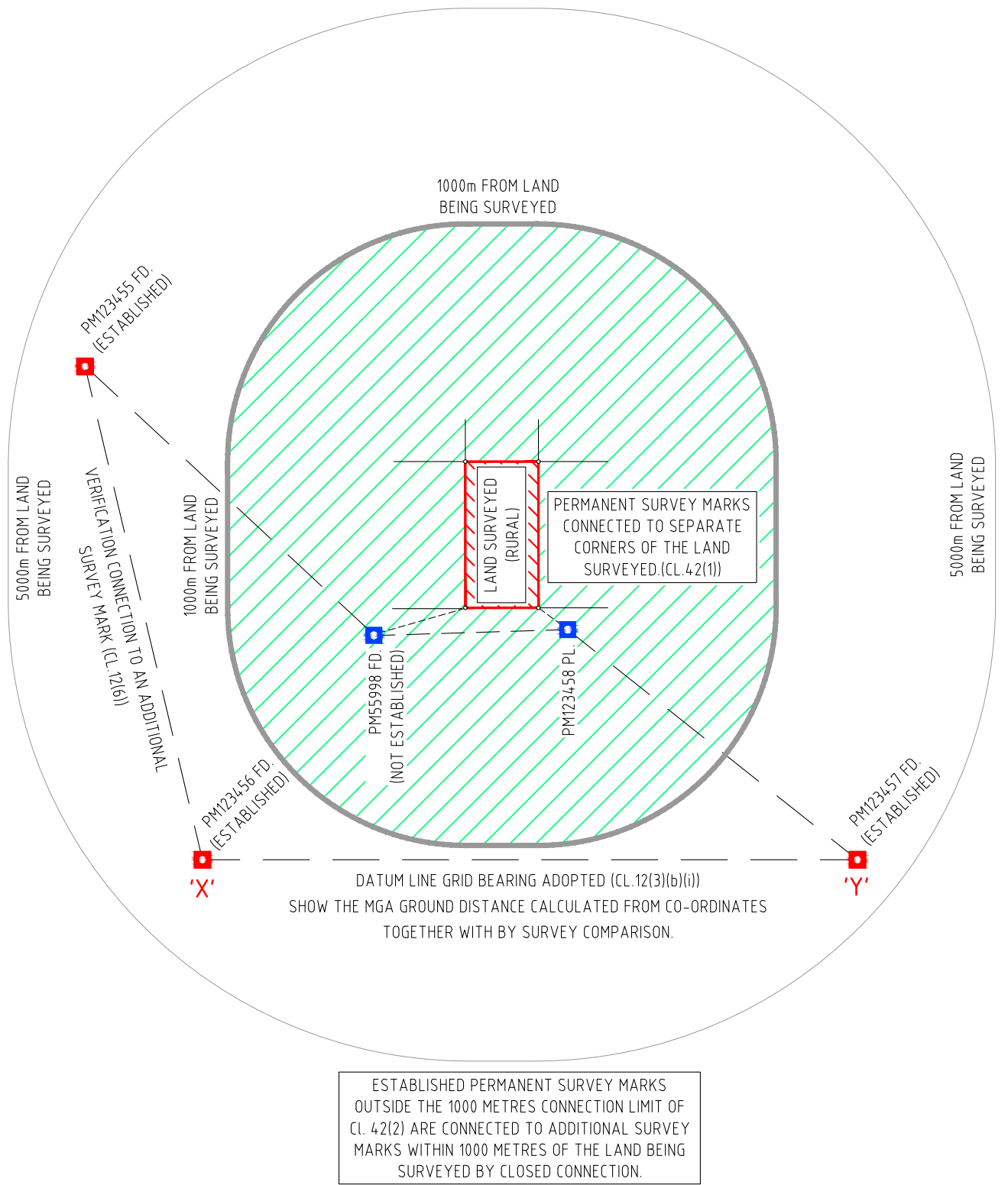


Diagram 7.30 - Rural Survey examples of compliance with Clause 42 and Clause 61 of the Regulation.

Clause 42(4) is a clarification that permanent survey marks used for the purpose of complying exclusively with Clause 13 do not need to be connected by closed survey to the land surveyed. That is, if the permanent survey mark in question is connected to the land surveyed by height difference only, then that permanent mark does not need to be connected horizontally by closed survey to the land surveyed. **All obligations under the Regulation for horizontal connections to the survey will still apply;** that is, the surveyor will still have to horizontally connect the same amount of permanent survey marks required by the Regulation.

3.23 Clause 43 – New permanent survey marks

Clause 43 emphasises that new permanent survey marks must be located in positions suitable for their stability and protection from disturbance, use by GNSS survey techniques, inclusion in the State control survey and be identified in a sketch plan. In order to achieve this, they must be placed at road junctions, intersections, angles or crests of hills as to be intervisible and also safe to use.

Clause 43(2) of the Regulation requires, for **urban surveys** only, the determination of AHD values for placed permanent survey marks only if any 2 permanent survey marks used by the survey for either:

- a SCIMS MGA orientation of the datum line, or
- connection to the land surveyed so as to comply with Clause 41(1), have “accurate AHD values”.

See section 3.2.1 “Accurate AHD value” for the definition of an “accurate AHD value”.

A flowchart (see [Diagram 7.43 - Flowchart to determine when a Height Schedule & Height Difference Schedule are required](#)) has been prepared to enable users to determine when a Height Schedule & Height Difference Schedule are required under the Regulation. A separate PDF version of the flowchart is available from the Surveyor-General's Directions area of the Spatial Services' website under “Direction No. 7”.

Note that surveyors cannot determine an “accurate AHD value” as part of the definition of “accurate AHD value” requires the value to be in SCIMS. Only the Surveyor-General can enter values into SCIMS.

The AHD values so determined by the surveyor under Clause 43(2) must:

- have an accuracy equal to or better than Class “B” or Class “LD”, and
- be verified by closed height difference between any 2 of the permanent survey marks used in the survey that have “accurate AHD values”.

The survey plan must show the AHD values in the **approved** height schedule and the height differences between survey marks in the **approved** height difference schedule. [3.31 Clauses 69, 70 & 71 – Height difference schedule, coordinate schedule & height schedule.](#)

There is no requirement (unless the survey falls under Clause 13) to propagate the AHD values for permanent survey marks placed in rural surveys. If the height can readily be propagated for a rural survey, then it would be prudent to do so.

Clause 43(3) & (4): Once a permanent survey mark is placed, the surveyor **must** forward the Locality Sketch Plan (LSP) within 2 months of placing the mark to SCIMS@customerservice.nsw.gov.au. The LSP must be prepared to an approved standard (see *Surveyor-General's Direction No. 2 – “Preparation of Locality Sketch Plans”*) and must include MGA coordinates of the mark to a positional uncertainty equal to or better than 3 metres.

3.24 Division 5 (Clauses 44 to 51 incl.) Boundaries formed by tidal and non-tidal waters and other natural features

For guidance in regard to clauses within this Division, refer to *Surveyor-General's Direction No. 6 - "Water as a boundary"*.

3.25 Clause 60 – Survey plan to indicate name of locality, street address and type of survey

Locality or Suburb: The Geographical Names Board (GNB) of NSW assign the name and extent of Localities or Suburbs within New South Wales. Usually, the assigned Suburb or Locality Name (i.e. Placename) is available using the "SIX Maps" identify tool available on the Spatial Services Portal. If a name is not provided, a Name Search can be undertaken via the [GNB web site](#).

Road Names: Roads are named by the relevant roads authority and the *Roads Regulation 2008* outlines the naming process. It is common for the relevant road authority to be Roads and Maritime Services (RMS) or the Local Council.

Street Address: An address describes a property's location and should include a house number, road name, road type and a locality. It is the local Council's legislative responsibility to allocate a new address for a lot when it is being created.

A table of new addresses must be provided on the administration sheet for each plan where titles will be created for the lots; for example subdivision, consolidation and strata.

For strata plans a site (Common Property) address must be included.

In situations where a lot will not have an address e.g. road widening, then the address number should have a "N/A" recorded.

For more detailed information regarding allocation of addresses see the "[NSW Address Policy and User Manual](#)".

Examples of the table to be included on the administration sheet are detailed below in [Table 5 - Street address schedule – Deposited Plan example](#) and [Table 6 - Street address schedule – Strata Plan example](#):

Lot Number	Sub-Address Number	Address Number	Road Name	Road Type	Locality Name
1		22	Linda	Street	Bathurst
2		24	Linda	Street	Bathurst
3		2	John	Road	Bathurst
4		6	John	Road	Bathurst
5	1	8	John	Road	Bathurst
6	2	8	John	Road	Bathurst
7		10	John	Road	Bathurst
8		N/A	John	Road	Bathurst

Table 5 - Street address schedule – Deposited Plan example

Lot Number	Sub-Address Number	Address Number	Road Name	Road Type	Locality Name
CP		22A	Linda	Street	Bathurst
1	101	22A	Linda	Street	Bathurst
2	102	22A	Linda	Street	Bathurst
3	103	2	John	Road	Bathurst
4	104	2	John	Road	Bathurst

Table 6 - Street address schedule – Strata Plan example

Urban/Rural: Clause 60(d) requires the type of survey, “Urban” or “Rural”, to be shown on the survey plan. The zoning of the land surveyed determines whether the survey is “Urban” or “Rural” as per the definitions in Clause 5 of the Regulation.

The purpose of showing “Rural” or “Urban” is to enable the correct assessment of compliance with the Regulation. To help simplify the intent of this clause, surveyors are required to show “Urban” or “Rural” on the plan of survey rather than state the zoning of the land according to the environmental planning

instrument so as to facilitate a more efficient assessment of compliance with the Regulation.

Terrain: In the case where a plan includes a partially compiled residue Lot, the nature of the terrain of the land contained within the Lot is required. The terrain needs to be classified as Level/Undulating or Steep/Mountainous. Paragraph 68 of the *NSW Department of Lands Regulations for the Employment of Licensed Surveyors 1914* stated the following respective classes of country:

- “Level,” where the slope does not exceed 3 degrees;
- “Undulating,” where the slope ranges from 3 degrees to 10 degrees;
- “Mountainous,” where the slope exceeds 10 degrees.

Therefore, Level/Undulating terrain has slopes less than 10 degrees, and Steep/Mountainous terrain has slopes greater than 10 degrees.

3.26 Clause 61 – Method of recording datum line

The recording of the datum line of orientation of a survey on the survey plan is of fundamental importance. It is the basis from which all bearings shown on the survey plan have been derived; it also, for the majority of survey plans, describes the basis of alignment with the Map Grid of Australia, a most important consideration as much of the data shown on a survey plan will be ingested into spatial information databases for the benefit of the public of NSW.

The datum line of orientation is also the first consideration for future surveyors wanting to accurately place their survey on the horizontal datum of the subject survey; this is the case for the Surveyor-General when carrying out an audit survey.

It is therefore paramount that a quality statement of the datum line be included on the survey plan so that future users can assess the veracity of the orientation adopted. This is referred to as the “validation” of the datum line.

To correctly assess the datum adopted and its veracity, Clause 61 has several requirements covering the variety of orientations that may be adopted by a surveyor.

It should be noted that the term “if practicable” in Clause 61 (and Clause 12(6)) refers to verification of a SCIMS MGA datum line orientation by bearing and distance, (see section [3.6.5.2 Verification of SCIMS MGA orientation by “bearing only”](#)).

In the case where an exemption has been granted by the Surveyor-General for adoption of a “bearing only” datum line, a distance comparison and closed connection cannot be shown for the datum line.

Clause 61(1) is a requirement to identify the marks comprising the terminals of the datum line adopted. Where those marks are recorded in the State control survey, the identification of the marks given by the State control survey (usually sourced from SCIMS) are sufficient as unique identifiers. Where the marks are not State control survey marks (e.g. a reference mark galvanised iron pipe), then the terminal must be given an identifier unique within the subject survey plan.

Clause 61(2) requires the surveyor to state the horizontal datum adopted on the survey plan. The horizontal datum adopted and its source should be placed immediately adjacent to the north point of the plan, in accordance with the common usage of survey plans. See below for selected examples of north points.

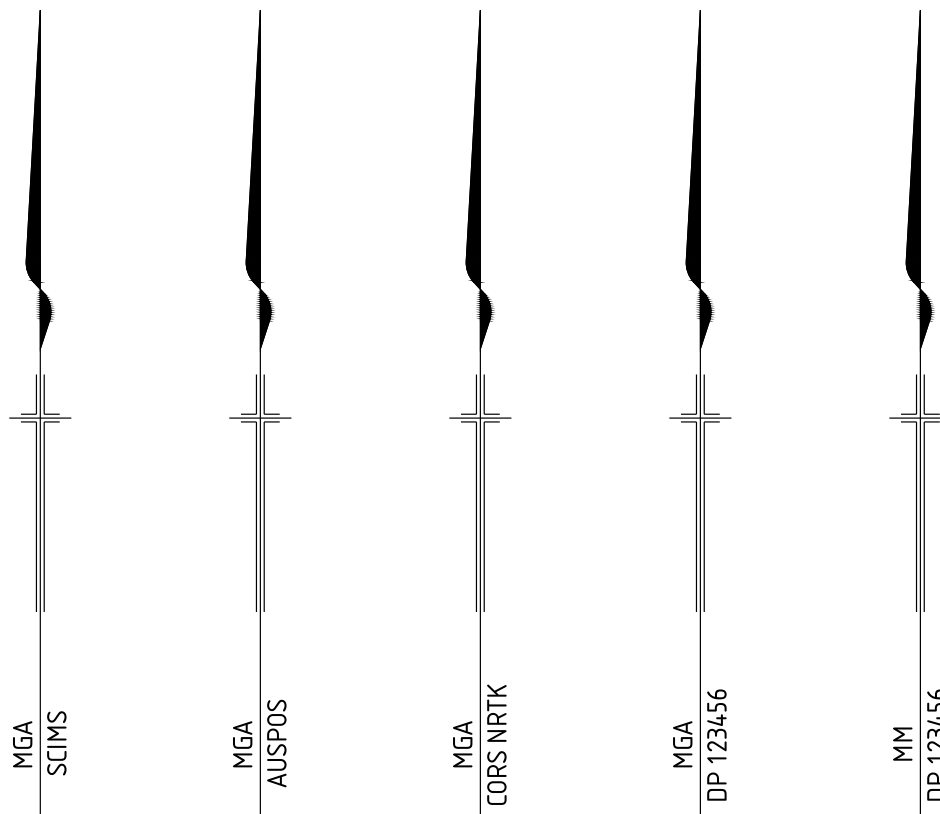


Diagram 7.32 - Example north points

Clause 61(3) requires that the datum line and any verifying line must (if practicable) be related to the survey by closed connection. This means that ALL datum lines and verifying lines must be in a closed horizontal loop. The only exceptions are “bearing only” verification lines.

Clause 61(4) requires, for a survey plan adopting a SCIMS MGA orientation, comparisons to be shown on the survey plan, for the datum line and any verifying line, of the measured bearings and distances with those calculated from the SCIMS MGA coordinates. “Bearing only” verification lines can only show a bearing comparison.

Note that the bearings calculated from the SCIMS MGA coordinates for adoption of the datum line orientation and comparison on the verifying lines should be MGA grid bearings, not plane bearings. Grid bearing = Plane bearing - (Arc-to-chord correction).

Clause 61(5) refers to the case where the orientation of the survey is adopted from a grid bearing derived from MGA coordinates, determined using an approved GNSS method, of 2 permanent survey marks or reference marks.

In such a case, the survey plan must show the grid bearing adopted AND must show details of the GNSS validation in an approved schedule as per Clause 66. See section [3.29 Clause 66 – Survey plan to show GNSS validation](#). The distance comparison may also be shown on the datum line itself.

Clause 61(6) requires, where the orientation of the datum line is adopted from a plan filed or recorded by the Registrar-General or a public authority, the survey plan must show a comparison for the datum line of the measured bearing and distance (if practicable) with those calculated from or shown on the plan being adopted.

The only exceptions are those to which the term “if practicable” refers; that is, in the case where an exemption has been granted by the Surveyor-General for adoption of a “bearing only” datum line.

3.27 Clause 63 – Method of showing boundaries generally

It is paramount that the survey plan contains complete dimensions and the facts and evidence relating to occupations and structures that are on a boundary, near a boundary or relevant to a boundary. In this regard it is important to correctly and completely describe the age, nature, construction material and relationship of fencing and structures to the boundary.

3.27.1 Complete dimensions

Greater attention to detail is required to ensure E-plan can deliver and assess whether information is complete, accurate, current and included within the survey plan.

In this regard, Clauses 63 (f) & (g) require that the surveyor must include complete dimensions on the survey plan, that is, complete dimensions of every parcel surveyed or partially compiled. This ensures complete dimensions are transferred from the current title to the proposed title. **This is a fundamental outcome of a survey plan.** The complete dimensions must also “close” within specified limits; see section [3.14 Clause 26 - Checking accuracy of measurements and calculations](#).

3.27.2 Clearing and blazing of boundary lines

Clause 63(h) requires a surveyor to record on the survey plan if clearing and blazing of boundaries has not been undertaken in accordance with clause 28(5)(d). That is, for a rural survey, if the clearing and blazing of unfenced boundaries would have been unlawful or environmental considerations dictated that clearing and blazing could not be carried out, then the surveyor must place a note on the survey plan to that effect.

Such a note should be to the effect of:

“Clearing and blazing of unfenced boundary lines has not been undertaken”

This ensures that a future user of a plan (whether that user is a surveyor, landowner or interested party) is aware whether or not the boundary line has been cleared and blazed; this provides greater certainty of the survey marking outcomes when investigating boundaries for any purpose.

3.27.3 Description of occupations on survey plans

It is important for the surveyor to accurately describe the nature and/or construction material of fencing on or near boundaries. Do NOT describe fencing as “P & W” or “Post & Wire” as almost all fencing is comprised of posts and wire, rendering this description useless for subsequent users. The surveyor must describe what type of wire and how many of each, i.e. plain wire, barbed, nett etc. The guidelines shown below in [Table 7 - Fence types](#) should be used:




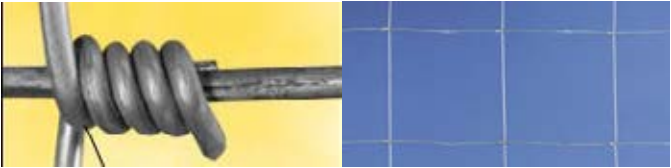


Full Description of Fencing	Abbreviation	Example
Plain Wire	P	
Barbed Wire	B	
Netting	Nett	
Hinge Joint	H/J	
Ring Lock	R/L	
Chain Link	C/L.	

Table 7 - Fence types

An example abbreviated description of a 3 Plain wire, 2 Barbed wire and Hinge Joint fence about 25 years old would be “3P 2B H/J (25 yrs)”, however, the format of the description is at the discretion of the surveyor.

Clause 9(1)(c) of the *Survey Practice Regulation 1990* was amended in October 1994 to emphasise the location of substantial structures near boundaries. Substantial structures in this context are fences, walls, buildings etc. Eaves and gutters are generally not considered to be substantial structures. However, if they encroach over a boundary, then the plan **must** be noted accordingly.

Clause 9(3) of the *Survey Practice Regulation 1990* was amended in October 1994 to emphasise that walls must not be called “Party Walls” unless there are easements for support already existing, as referred to in the Conveyancing Act 1919, or there is an intention to create such easements.

If there are no easements and there is no intention to create easements, then the wall must not be referred to as a “party wall”. In this case it may be called centre of wall or face of wall etc. as the case may be.

3.27.4 Historical classifications – age of fencing

To aid surveyors in interpreting older survey plans, the classifications for describing the age of fencing as shown in the *NSW Dept of Lands – Survey Directions 1963* are reproduced below in Table 8:

Age Description	Abbreviation
New - 1 - 10 Years	N
Fairly New - 11 - 20 Years	FN
Fairly Old - 21 - 30 Years	FO
Old - 31 - 40 Years	O
Very Old - Over - 40 Years	VO

Table 8 – Historical classifications - age of fencing

Surveyors should NOT use the above table of abbreviations as notations on current survey plans to be lodged with the Registrar-General or a public authority. It is reproduced here only as an aid for interpretation of older survey plans.

3.27.5 Aligned Roads and the showing of Kerb As Laid (K.As.L)

Where land being surveyed abuts an aligned road, the original road boundary alignment must be reinstated by either:

- The location of original monuments such as alignment posts, pins or stones as shown on the original alignment plans or,
- The adoption of original kerb as laid to define the Kerb Line from the alignment survey or,
- The use of connections from structures contained in original alignment field books or,
- From the adoption of other monuments and occupations shown on plans on public record.

Under Clause 63(1)(b) and 63(1)(e)(ii) if existing kerbs are adopted as part of the road alignment definition they must be shown on the plan of survey as they show the nature of the boundaries at the time of survey and they are to be considered relevant to the boundary definition being shown.

Any survey which has a frontage to an aligned road must, at the extremities of the surveyed land, show the relationship of the existing constructed kerb as laid in relation to the Kerb Line as determined by survey.

Where existing kerbs are adopted to define the Kerb Line, existing kerb as laid must be shown at the following locations:

- Where the kerb is being adopted to define the Kerb Line for the road,
- At any point on the kerb which has been used to support the definition of the Kerb Line,
- at the extremities of the land being surveyed abutting the aligned road,

Kerb as laid may also be shown at any point on the Kerb Line at the discretion of the surveyor undertaking the survey where it supports the definition being shown.

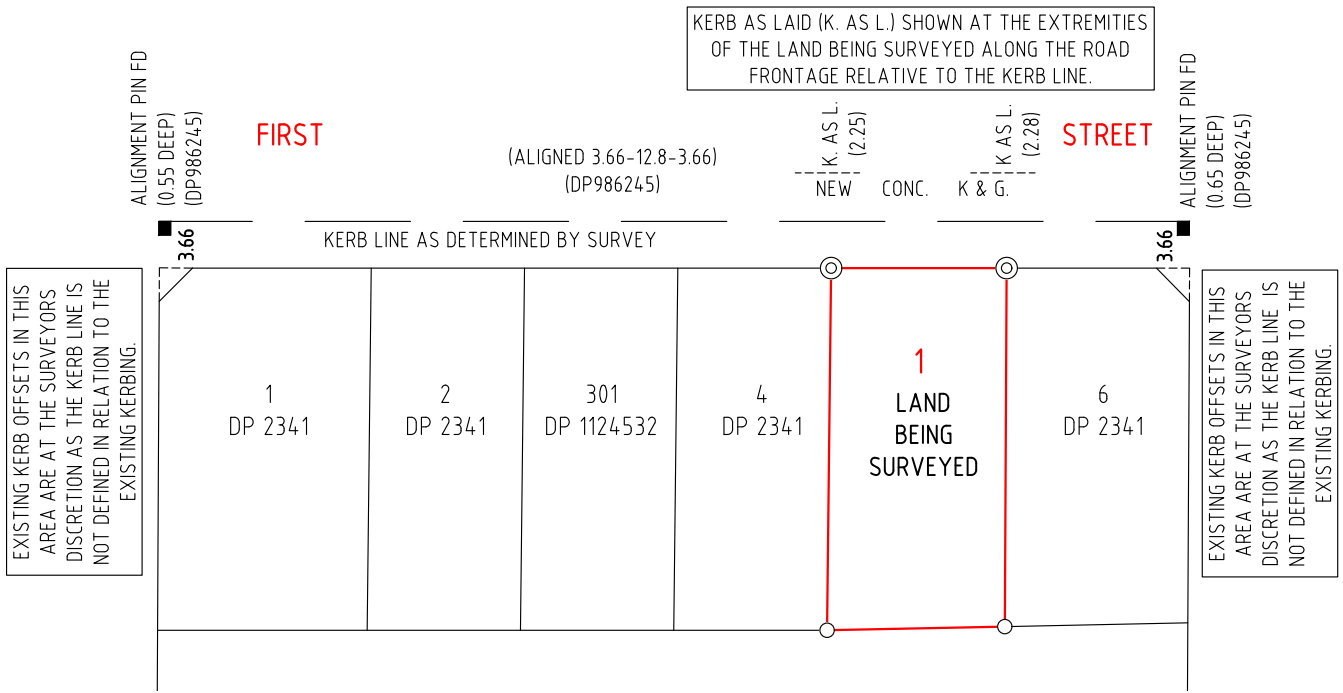


Diagram 7.33 - Aligned Road definition from Alignment Marks and showing Kerb As Laid (K. As L.)

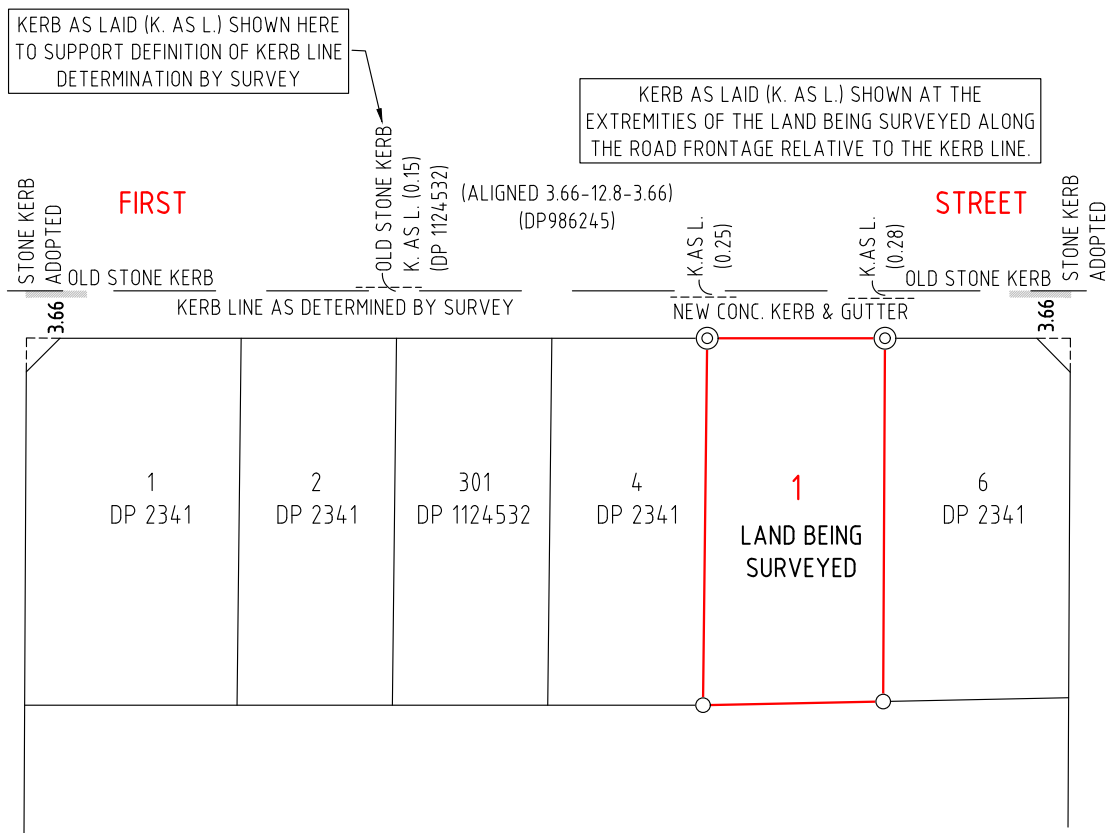


Diagram 7.34 - Aligned Road definition from Original Kerb as Laid and showing existing Kerb As Laid (K. As L.)

3.28 Clause 64 – Method of showing natural feature boundaries

All natural features that form boundaries must be described on the survey plan as follows:

- A description of the type of natural feature must be shown on the survey plan; this should be done by the addition of a notation immediately adjacent to the natural feature. Examples of such a notation are “MHWM”, “Left bank is boundary”, “Centre of river is boundary” etc. Where the notation is “Left bank is boundary” or “Right bank is boundary”, the plan must also show the direction of flow of the stream or river, and
- The natural feature is to be graphically represented on the survey plan by a spline curve (i.e. a “smooth wiggly line”), and
- The position of the natural feature at the time of survey (i.e. the “snapshot” of its position) is to be shown as a table of sequential bearings and distances that accurately locate each change in direction of the natural feature, and
- For each lot (or part lot) that abuts the natural feature, a direct connection must be shown between the terminals of the natural feature as pertain to the subject lot (or part lot). That is, each subject lot (or part lot) that abuts the natural feature will have two terminals of the natural feature within that lot (or part lot); the surveyor is required to show a direct connection between those two terminals.

Consultation with the geospatial industry indicates that the term “spline” is considered the geometric entity best suited for the graphical representation of a natural feature boundary. An acknowledged usage of the word is “spline curve”. See section 3.2.7 “Spline” for the definition of “spline”. See section 3.28.1 Spline curve – example diagrams below for examples of a spline curve.

Note that the use of a spline refers to the graphical representation of the natural feature only (i.e. the plan drafting of the natural feature), not its legal definition. The definition of a natural feature boundary has not changed and remains the feature itself, subject to the doctrine of accretion and erosion and other provisions within the Regulation and Directions.

Advice from the Office of the Registrar-General indicates the requirement to represent natural feature boundaries as a spline or “smooth wiggly line” is to avoid the repeat of past cases where natural feature boundaries have been confused with right-line boundaries where the natural feature boundaries were depicted as straight line chords.

3.28.1 Spline curve – example diagrams

The diagrams below show examples of a spline curve. The spline curve given in the definition is an “interpolating cubic” spline; that is, a spline of degree 3.

When drafting the spline curve to graphically represent the spline curve on the plan of survey, the spline curve must pass through the surveyed points that define the position of the natural feature at the date of survey. The fixed points of a spline (in this case, the surveyed points of the natural feature) are mathematically termed “knots”. See [Diagram 7.35 - Surveyed points on natural feature](#), [Diagram 7.36 - Spline passing through surveyed points](#) and [Diagram 7.37 - Natural feature boundary - required plan elements - concept](#) over.

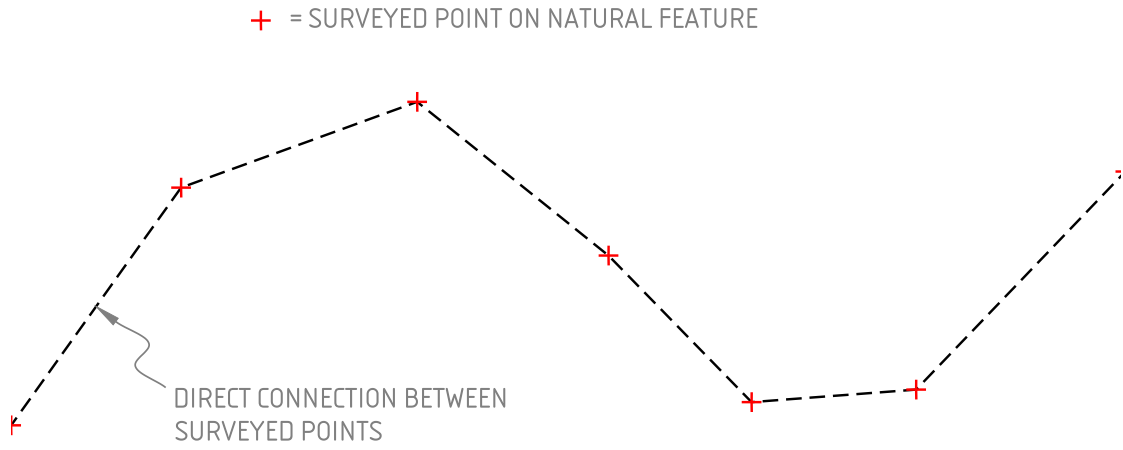


Diagram 7.35 - Surveyed points on natural feature

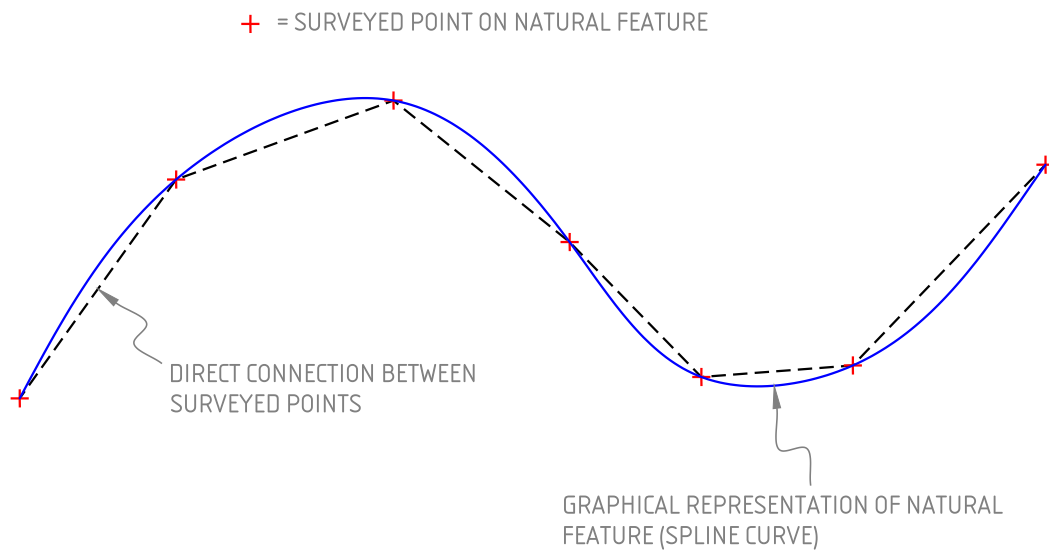


Diagram 7.36 - Spline passing through surveyed points

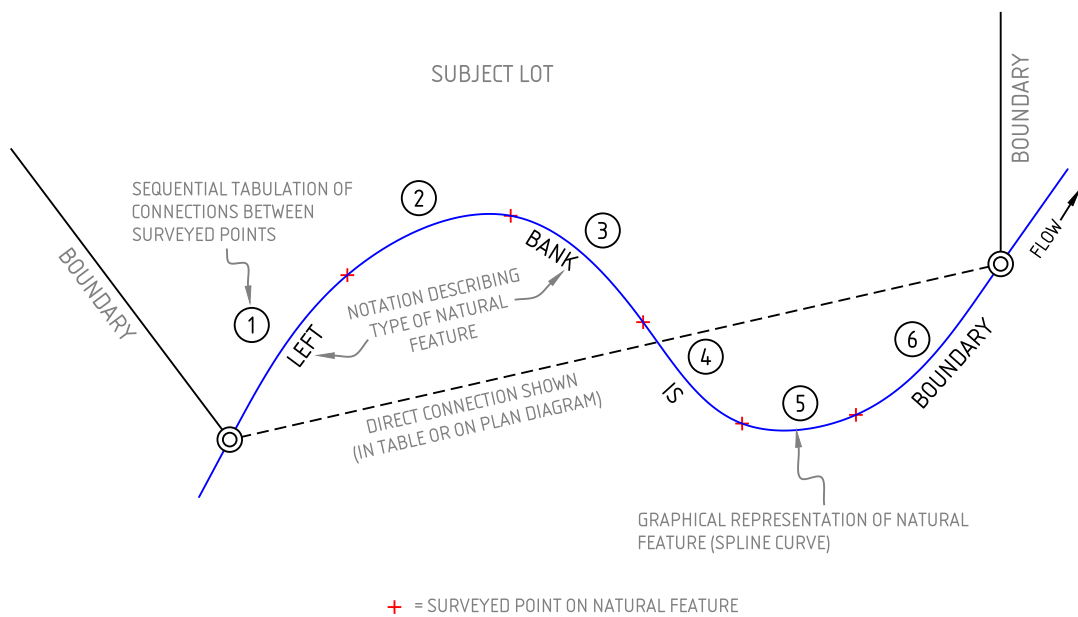


Diagram 7.37 - Natural feature boundary - required plan elements - concept

As can be seen from [Diagram 7.35 - Surveyed points on natural feature](#), [Diagram 7.36 - Spline passing through surveyed points](#) & [Diagram 7.37 - Natural feature boundary - required plan elements - concept](#), it is most important for a surveyor to measure sufficient points to describe the changes in direction of the natural feature as per Clause 64(c).

Some CAD packages will allow the user to select the direction of the start and end tangents of the spline; the user must select the direction of the start and end tangents so that the spline best depicts the natural feature.

Note that [Diagram 7.37 - Natural feature boundary - required plan elements - concept](#), showing a conceptual diagram of elements required to be shown on the plan for a natural feature boundary, shows the natural feature boundary as a spline curve, does NOT show the direct connections between the surveyed points as straight lines, yet shows sequential index numbers relating to the direct connections between surveyed points. The surveyed points on the natural feature, shown as a red cross in [Diagram 7.37 - Natural feature boundary - required plan elements - concept](#), need not be shown on the survey plan.

Clause 64(c) requires that the tabulated bearings and distances accurately locating each change in direction of the natural feature boundary must be sequential. If the bearings and distances are not sequential, the following undesirable situations occur:

- If the bearings and distances are not numbered or indexed and out of sequence, the table does not correctly and completely describe the boundary and computed areas will be erroneous or,
- If the bearings and distances are numbered or indexed and out of sequence, the table is extremely difficult to interpret, giving increased scope to errors in interpretation.

3.28.2 Practical examples of showing a natural feature boundary.

The following diagrams provide examples of how to show a natural feature boundary on a plan of survey in compliance with Clause 64 of the Regulation. Diagrams 7.38-7.40 are based on a survey where the left bank of a non-tidal creek is the Title boundary being surveyed; these can easily be adapted for survey plans which have other types of natural feature boundaries such as a Mean High Water Mark (M.H.W.M) or cliff face boundaries. Example 4 uses a combination of methods 2 and 3 to correctly represent an *ad medium filum aqua* centre of creek natural boundary on a survey plan.

TABLE OF SEQUENTIAL BEARINGS AND DISTANCES
Cl. 64(c)

SCHEDULE OF CREEK BOUNDARY LINES

Number	Bearing	Distance
1	42°50'00"	33.200
2	67°50'00"	26.800
3	113°10'00"	33.500
4	164°00'00"	19.400
5	132°40'00"	15.500
6	114°30'00"	10.600
7	74°20'00"	21.000
8	28°00'00"	25.950
9	359°10'00"	24.500
10	38°30'00"	20.050
11	58°47'00"	69.800
12	41°41'00"	20.900
13	3°18'00"	17.500
14	316°15'00"	15.500
15	284°33'00"	27.500
16	267°44'00"	20.700
17	299°10'00"	24.100
18	261°44'00"	13.800
19	257°22'00"	31.100
20	308°20'00"	11.800
21	9°00'00"	7.110
22	16°35'00"	26.460
23	30°33'00"	42.70
24	357°05'00"	40.200
25	33°30'00"	21.700
26	355°20'00"	16.400
27	307°08'00"	21.700
28	284°03'00"	44.200
29	347°33'00"	31.750
30	332°40'00"	19.100
31	301°54'00"	56.400
32	41°08'00"	42.800

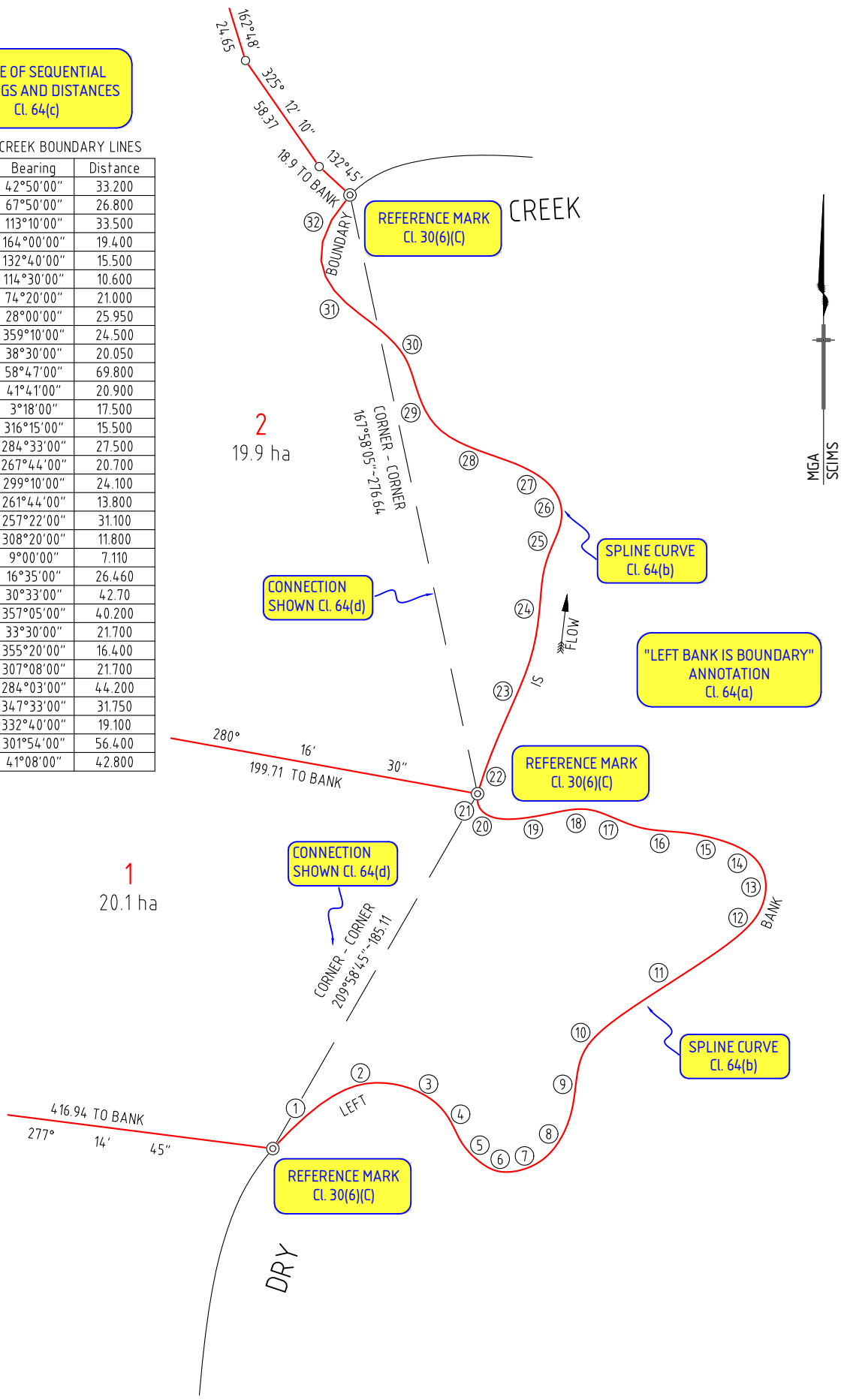


Diagram 7.38 - Natural Feature Practical Example 1

TABLE OF SEQUENTIAL BEARINGS AND DISTANCES Cl. 64(c)

SCHEDULE OF CREEK BOUNDARY LINES

Number	Bearing	Distance
1	42°50'00"	33.200
2	67°50'00"	26.800
3	113°10'00"	33.500
4	164°00'00"	19.400
5	132°40'00"	15.500
6	114°30'00"	10.600
7	74°20'00"	21.000
8	28°00'00"	25.950
9	359°10'00"	24.500
10	38°30'00"	20.050
11	58°47'00"	69.800
12	41°41'00"	20.900
13	3°18'00"	17.500
14	316°15'00"	15.500
15	284°33'00"	27.500
16	267°44'00"	20.700
17	299°10'00"	24.100
18	261°44'00"	13.800
19	257°22'00"	31.100
20	308°20'00"	11.800
21	9°00'00"	7.110
22	16°35'00"	26.460
23	30°33'00"	42.70
24	357°05'00"	40.200
25	33°30'00"	21.700
26	355°20'00"	16.400
27	307°08'00"	21.700
28	284°03'00"	44.200
29	347°33'00"	31.750
30	332°40'00"	19.100
31	301°54'00"	56.400
32	41°08'00"	42.800

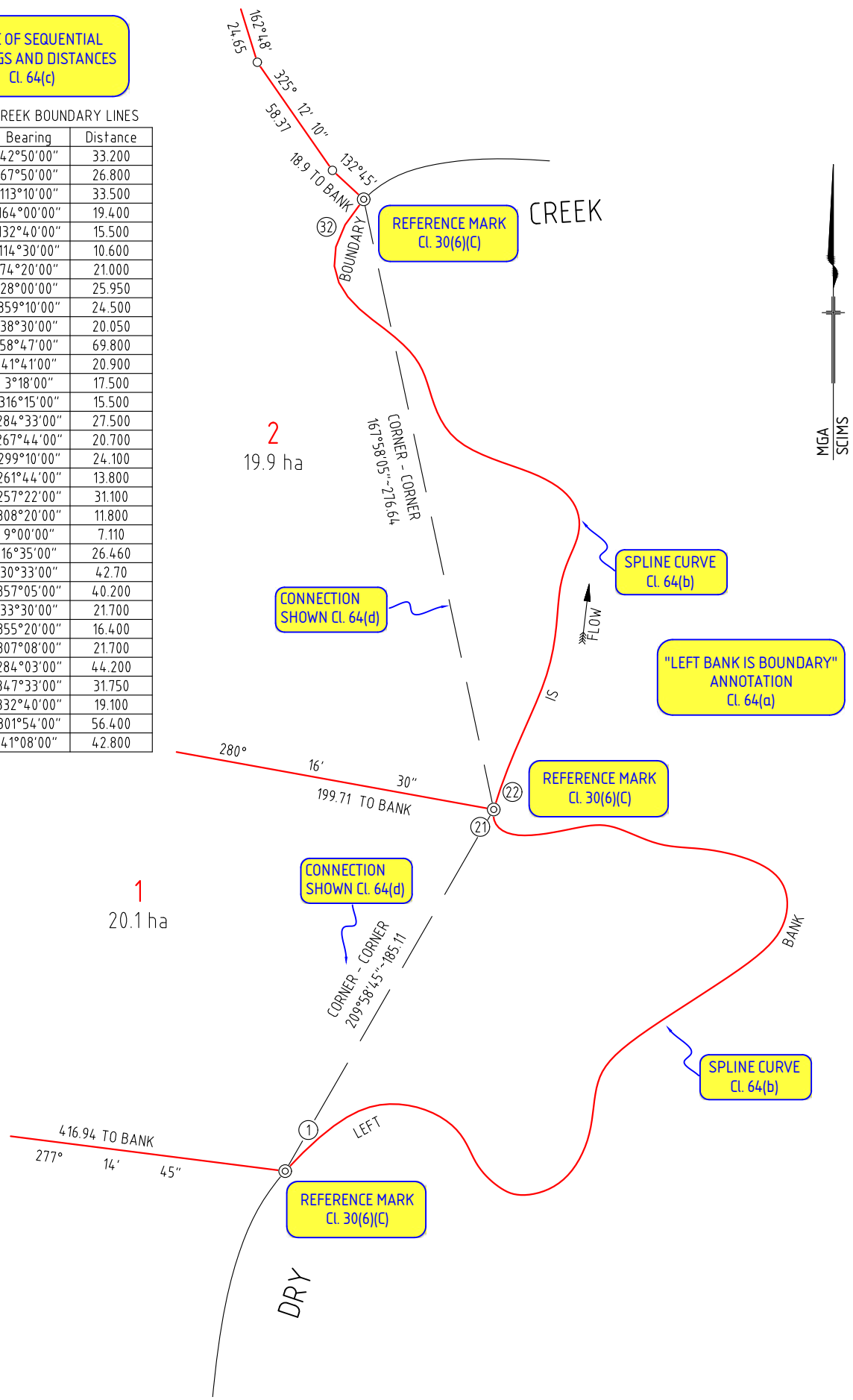


Diagram 7.39 - Natural Feature Practical Example 2

**TABLE OF SEQUENTIAL BEARINGS AND DISTANCES
CL. 64(c)**

SCHEDULE OF CREEK BOUNDARY LINES

Number	Bearing	Distance
1	42°50'00"	33.200
2	67°50'00"	26.800
3	113°10'00"	33.500
4	164°00'00"	19.400
5	132°40'00"	15.500
6	114°30'00"	10.600
7	74°20'00"	21.000
8	28°00'00"	25.950
9	359°10'00"	24.500
10	38°30'00"	20.050
11	58°47'00"	69.800
12	41°41'00"	20.900
13	3°18'00"	17.500
14	316°15'00"	15.500
15	284°33'00"	27.500
16	267°44'00"	20.700
17	299°10'00"	24.100
18	261°44'00"	13.800
19	257°22'00"	31.100
20	308°20'00"	11.800
21	9°00'00"	7.110
22	16°35'00"	26.460
23	30°33'00"	4.270
24	357°05'00"	40.200
25	33°30'00"	21.700
26	355°20'00"	16.400
27	307°08'00"	21.700
28	284°03'00"	44.200
29	347°33'00"	31.750
30	332°40'00"	19.100
31	301°54'00"	56.400
32	41°08'00"	42.800

DRY CREEK BOUNDARY LINES FOR LOT 1 AND LOT 2 ARE SHOWN IN THE SCHEDULE OF CREEK BOUNDARY LINES.
LOT 1 CREEK FRONTAGE CORNERS 'A'-'B' LINE NUMBERS 1 TO 21
LOT 2 CREEK FRONTAGE CORNERS 'B'-'C' LINE NUMBERS 22 TO 32

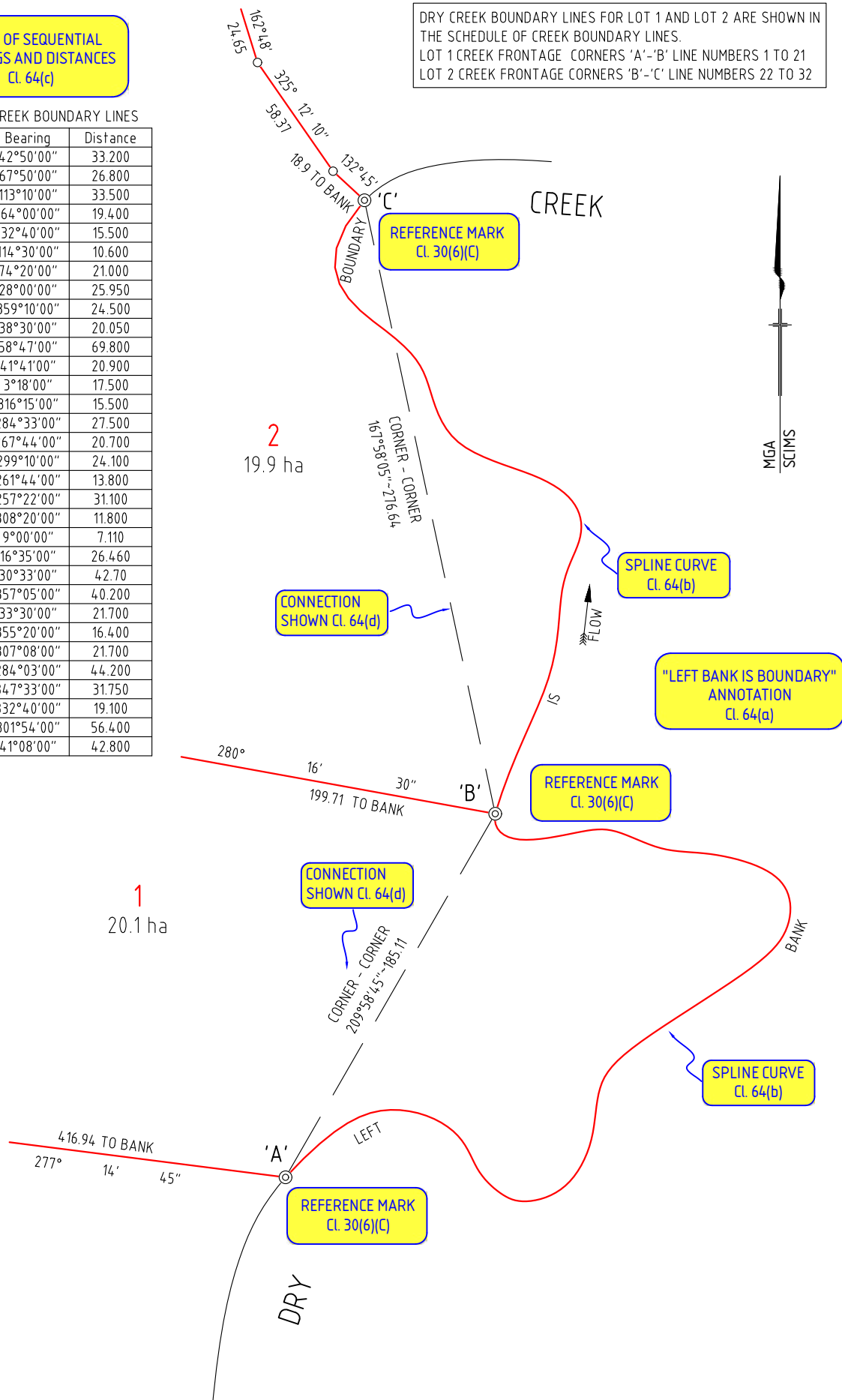
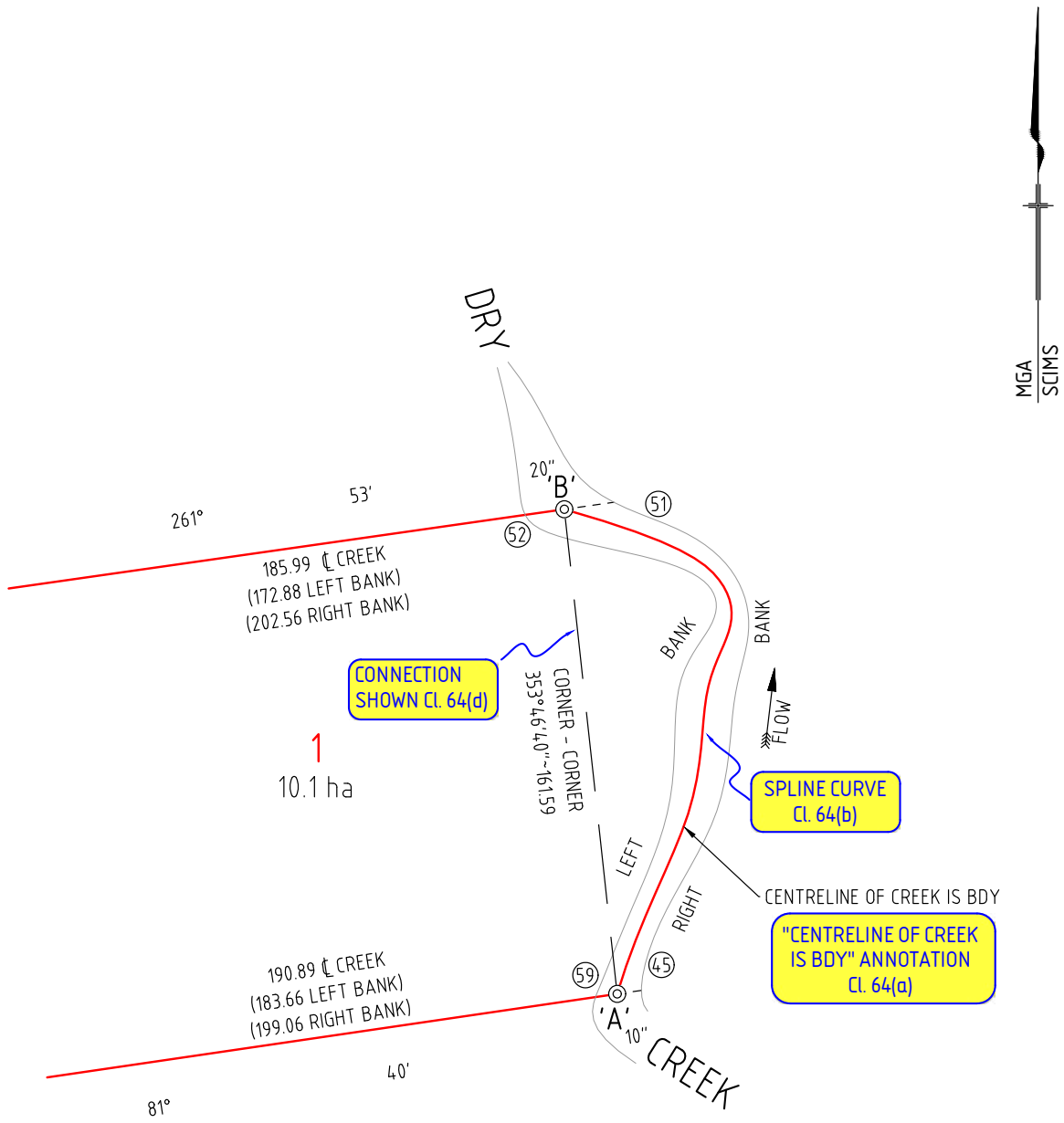


Diagram 7.40 - Natural Feature Practical Example 3



CONNECTION SHOWN Cl. 64(d)

SPLINE CURVE Cl. 64(b)

"CENTRELINE OF CREEK IS BDY" ANNOTATION Cl. 64(a)

TABLES OF SEQUENTIAL BEARINGS AND DISTANCES Cl. 64(c)

SCHEDULE OF LEFT BANK SHORT LINES

52	353°41'40"	11.530
53	279°24'00"	49.325
54	301°01'30"	18.790
55	4°24'00"	12.695
56	43°24'10"	23.260
57	354°17'50"	41.135
58	24°57'00"	40.980
59	20°48'50"	27.695

SCHEDULE OF CREEK BOUNDARY SHORT LINES FROM CORNER 'A' - CORNER 'B'

16°35'00"	26.460
30°33'00"	42.700
357°05'00"	40.200
33°30'00"	21.700
355°20'00"	16.400
307°08'00"	21.700
284°03'00"	44.200

SCHEDULE OF RIGHT BANK SHORT LINES

45	192°06'40"	25.650
46	215°40'20"	44.795
47	179°59'40"	39.365
48	202°27'10"	20.875
49	169°41'50"	20.365
50	131°45'40"	24.795
51	109°52'20"	39.440

Diagram 7.41 - Natural Feature Practical Example 4

3.29 Clause 66 – Survey plan to show GNSS validation

All GNSS are operated by international parties. Most GNSS augmentation systems (e.g. CORSnet-NSW, GPSnet) are operated by Government or commercial third parties and are not under the surveyor's direct control. As such, any GNSS equipment and methods used must be confirmed ("validated") against an independent external source of known accuracy for each survey where an approved GNSS technique is used.

GNSS equipment is not a tool which can be "calibrated" in the strict sense of the word and therefore the proper use of the equipment in accordance to the *Surveyor-General's Directions* is important.

Clause 66 requires details of GNSS validation to be shown in an approved schedule (see [Table 9 - Approved GNSS validation schedule](#)) on the survey plan when approved GNSS techniques have been used to measure any part of the survey. Use of a GNSS validation schedule that is not in the same form as those that are approved will attract a requisition upon lodgement of the survey plan; elements of the approved schedule that must be adhered to are:

- Heading of the schedule
- Number of columns, the column designation and the column order
- The split row layout for the validation measurements

Reasons for the use of approved schedules are outlined in section [3.31 Clauses 69, 70 & 71 – Height difference schedule, coordinate schedule & height schedule](#).

A drawing template for the approved GNSS Validation Schedule is available from the Spatial Services – Surveyor General's Directions webpage.

https://www.spatial.nsw.gov.au/surveying/publications/surveyor_generals_directions

Clause 66 has a conditional requirement whereby if the orientation of the survey is adopted from a grid bearing derived from MGA coordinates, determined using an approved GNSS method, of 2 permanent survey marks or reference marks, the validation must be performed and shown on the plan of survey for the datum line of orientation.

The extra requirement of validating the datum line for the case above described is to affirm the MGA orientation and MGA position, as taken solely from MGA coordinates determined by the surveyor using an approved GNSS method. This can be considered analogous to showing comparisons on the datum line with established MGA coordinates or with prior plans filed or recorded by a public authority.

Surveyors requiring more details regarding GNSS validation should refer to section 4 of *Surveyor-General's Direction No. 9 – "GNSS for Cadastral Surveys"*.

GNSS VALIDATION SCHEDULE				
FROM	TO	GRID BEARING	DISTANCE	METHOD
SSM 66367	SSM 19764	289°09'34"	1092.340	EDM TRAVERSE
		289°09'34"	1092.332	CORS NRTK
SSM 172630	SSM 19087	12°44'44"	453.283	EDM TRAVERSE
		12°44'44"	453.290	AUSPOS
PM 169843	PM 169844	161°01'05"	1783.171	GNSS STATIC
		161°01'05"	1783.182	AUSPOS

Table 9 - Approved GNSS validation schedule

GNSS VALIDATION SCHEDULE				
FROM	TO	GRID BEARING	DISTANCE	METHOD
PM#1	TS "EXAMPLE"	44°56'04"	220.796	CORS-NRTK
		44°56'04"	220.794	SCIMS

Diagram 7.42 - GNSS validation table - standard example

3.30 Clause 68 - Surveyor to report on doubts, discrepancies and difficulties

To help facilitate the assessment of discrepancies shown on a survey plan, a threshold tolerance of 40mm + 200ppm has been set. It is four times the rejection criteria of the current length tolerance and two to three times that of older surveys. If a surveyor discloses differences of more than 40mm + 200ppm then a report must be supplied with the survey plan upon lodgement with the Registrar-General.

3.31 Clauses 69, 70 & 71 – Height difference schedule, coordinate schedule & height schedule.

Surveyors are required to show height differences, MGA coordinates and heights in **approved** schedules. Use of schedules that are not in the same form as those that are approved will attract a requisition upon lodgement of the survey plan; elements of the approved schedules that must be adhered to are:

- Heading of the schedule
- Number of columns, the column designation and the column order
- Information regarding the date of SCIMS coordinates, the MGA zone, MGA datum, Combined Scale Factor (CSF) and height datum which must be shown at the bottom of the schedules.

The Height Schedule, Height Difference Schedule and Coordinate Schedule must appear as separate schedules on the survey plan (i.e. they cannot be merged into one schedule). This is to facilitate digital capture and manual examination of the survey plan.

The requirement for the height difference, coordinate and height schedules as per clauses 69, 70 & 71 to be “approved schedules” (i.e. of the form specified by the Surveyor-General) has been introduced for several reasons:

- Data in a standardised form means that the information is always given in a specific format, thus enabling LandXML digital lodgment automated checking procedures and ingestion
- Surveyors should be the subject of fewer requisitions regarding the form of the schedule required if a standardised form is specified and adhered to.
- Reduces clutter on the plan and specifies a particular place where certain information is contained, thus making manual examination and interpretation easier.

The definition of ‘approved’ is that shown in Clause 5 of the *Surveying and Spatial Information Regulation 2017* which states:

Approved means approved by the Surveyor-General.

A drawing template for the approved schedules required under clauses 66, 69, 70 & 71 in Autocad .dwg and .dxf formats is available from the Spatial Services – Surveyor General's Directions webpage.

https://www.spatial.nsw.gov.au/surveying/publications/surveyor_generals_directions

3.31.1 Height difference schedule and height schedule

The height datum needs to be propagated for infrastructure management and development; survey control is essential public infrastructure, in just the same way as sewer, stormwater drainage, electricity, communication and data services. Height is an important component of survey control.

The survey plan is being used as the delivery mechanism for height from the surveying industry for several reasons:

- Previous information delivery mechanism for height was through Locality Sketch Plans. The Surveyor-General has received less than 65% of Locality Sketch Plans for marks issued in 2016, so this delivery mechanism has demonstrably failed.
- All necessary survey information is contained in one location, allowing for the easier integration with E-Plan validation and the Surveyor-General's collation and ingestion of the information.
- In specifying both height differences and height values to be shown, the survey plan becomes self-describing and self-checking. This can be considered analogous to showing MGA coordinates and horizontal bearings and distances. One can be used to check the other.
- Avoids duplication of effort by different surveyors having to propagate height from a remote origin for differing stages of the same development, resulting in a net benefit to industry and community.

It is emphasised that the requirement to determine AHD heights has not changed since its introduction in the *Survey Practice Regulation 1990*; it is the delivery mechanism of the height information that changes.

A flowchart (see [Diagram 7.43 - Flowchart to determine when a Height Schedule & Height Difference Schedule are required](#)) has been prepared to enable users to determine when a Height Schedule & Height Difference Schedule are required under the Regulation. A separate PDF version of the flowchart is available from the Surveyor-General's Directions area of the Spatial Services' website under "Direction No. 7".

In the instance that the Regulation does not require a Height Difference Schedule and a Height Schedule to be shown on the survey plan, a surveyor may, if they so choose, show the Height Difference Schedule only on the survey plan, or both schedules where AHD heights are available. The Height Schedule cannot be shown without the Height Difference Schedule.

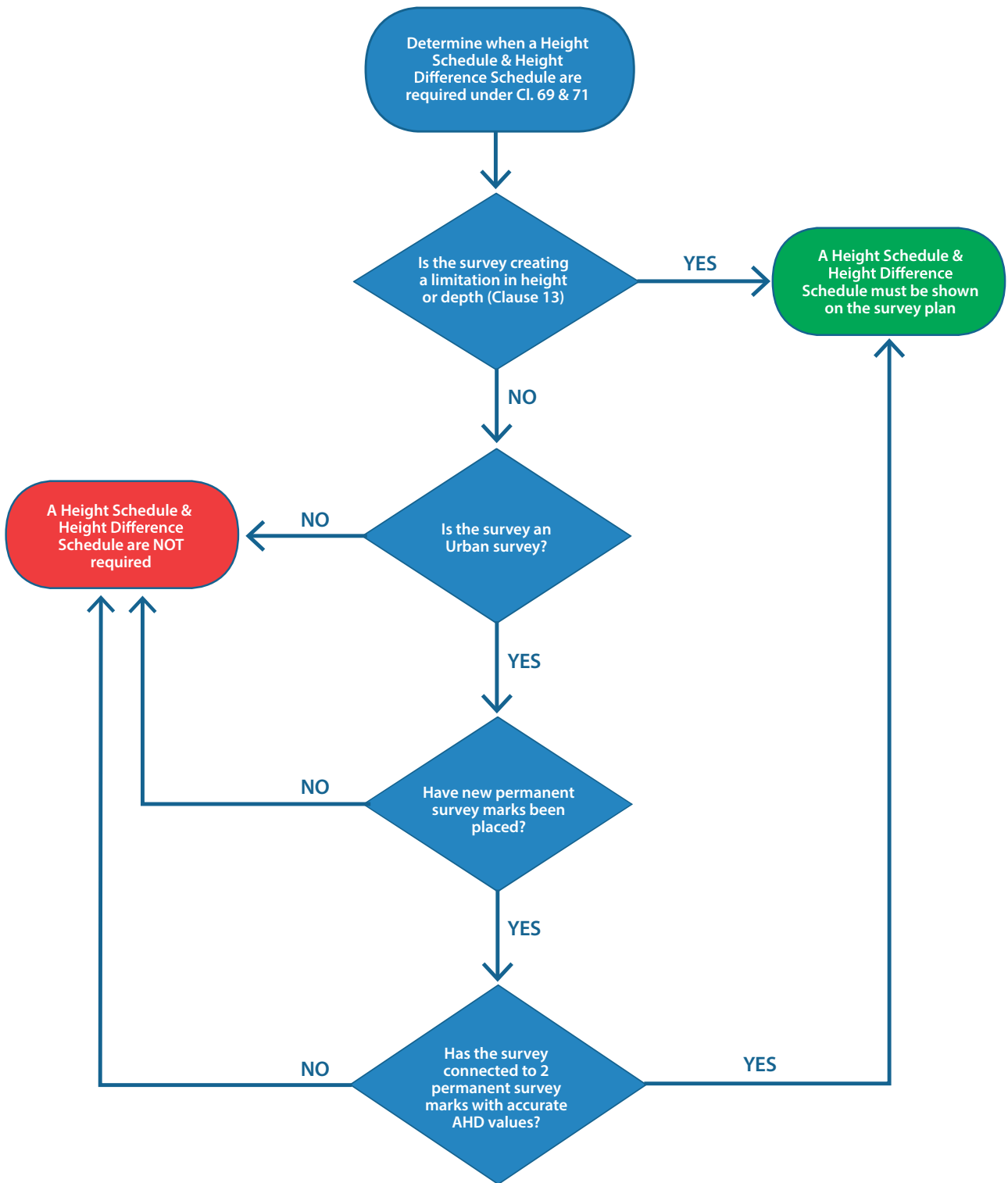


Diagram 7.43 - Flowchart to determine when a Height Schedule & Height Difference Schedule are required

3.31.1.1 Height difference schedule requirements

Clause 69 requires that an approved height difference schedule must show height differences between pairs of marks for which heights have been determined under Clause 13 (see section [3.7 Clause 13 – Bench marks](#)) or Clause 43(2) (see section [3.23 Clause 43 – New permanent survey marks](#)).

The height differences must be shown as a closed sequence (that is, a closed “loop” or “loops”). There must not be any height difference shown that is not part of a closed sequence (i.e. a “hanging” height difference). See [Diagram 7.44 - Height difference - closed sequence](#) below.

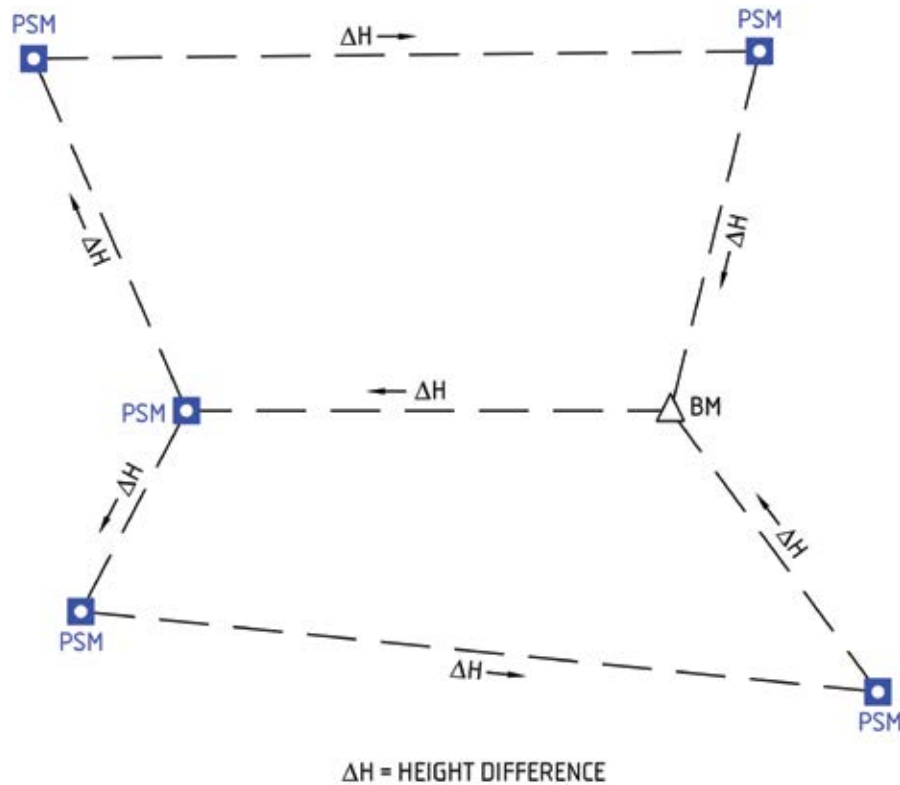


Diagram 7.44 - Height difference - closed sequence

The marks between which height differences must be shown will be either permanent survey marks or bench marks unless as otherwise approved.

If a mark defining the terminal of a height difference has an identification designated by the State control survey (in most cases this will be recorded in SCIMS), then that identification must be shown on the survey plan. Otherwise, identification unique to the subject survey plan must be used.

The method used to determine height differences shown on the plan must be stated in the appropriate column of the approved schedule; the height differences must attain a Class “B” or Class “LD” accuracy or better, regardless of the method used.

The height differences shown in the height difference schedule should be taken from the adjusted height difference components of the survey adjustment output; they should NOT be calculated directly from the height schedule drafted on the survey plan. This method provides an independent check of the drafted plan height difference values when comparing both the height difference and height schedules.

All height differences should be relative to the same datum. That is, a surveyor cannot state gravimetric height differences relative to AHD and non-gravimetric height differences (e.g. ellipsoidal height differences) relative to an approved datum within the same survey plan.

Table 11 - Approved height difference schedule below shows the approved height difference schedule; the clauses in the Regulation that apply to the different elements of the schedule are colour coded.

HEIGHT DIFFERENCE SCHEDULE			
FROM	TO	HEIGHT DIFFERENCE	METHOD
PM 3570	PM 3571	+11.107	DIFFERENTIAL LEVELLING
PM 3571	PM 1653	+1.726	TRIGONOMETRIC HEIGHTING
PM 1653	PM 3570	-12.833	TRIGONOMETRIC HEIGHTING
PM 3570	TS 5517	+51.279	STATIC GNSS
TS 5517	GB 2465	-17.273	DIFFERENTIAL LEVELLING
GB 2465	BM 2	+3.791	DIFFERENTIAL LEVELLING
BM 2	BM 1	-3.436	DIFFERENTIAL LEVELLING
BM 1	PM 43390	-5.717	DIFFERENTIAL LEVELLING
PM 43390	PM 3570	-28.644	TRIGONOMETRIC HEIGHTING
HEIGHT DATUM: AHD71			

**Clause 69
(2)(b)**

**Clause 69
(2)(a)**

**Clause 69
(1)**

**Clause 69
(2)(c)**

Table 11 - Approved height difference schedule

HEIGHT DIFFERENCE SCHEDULE			
FROM	TO	HEIGHT DIFFERENCE	METHOD
PM 3571	PM 3570	-11.107	DIFFERENTIAL LEVELLING
PM 3570	SS 57633	+2.019	DIFFERENTIAL LEVELLING
SS 57633	BM 3	-2.073	DIFFERENTIAL LEVELLING
BM 3	PM 3571	+11.161	DIFFERENTIAL LEVELLING
HEIGHT DATUM: AHD71			

Diagram 7.45 - Height difference schedule – standard example

A drawing template for the approved height difference schedule in Autocad .dwg and .dxf formats is available from the Spatial Services – Surveyor General’s Directions webpage.

https://www.spatial.nsw.gov.au/surveying/publications/surveyor_generals_directions

3.31.1.2 Height schedule requirements

Clause 71 requires that an approved height schedule must show heights that have been determined under Clause 13 (see section [3.7 Clause 13 – Bench marks](#)) or Clause 43(2) (see section [3.23 Clause 43 – New permanent survey marks](#)).

The marks for which heights must be shown will be either permanent survey marks or bench marks, unless as otherwise approved.

If a mark for which a height is shown has an identification designated by the State control survey (in most cases this will be recorded in SCIMS), then that identification must be shown on the survey plan. Otherwise, identification unique to the subject survey plan must be used.

For the height schedule, the survey technique used to derive the AHD value is not needed as it will be a derivative of the method shown in the height difference schedule.

The heights shown in the height schedule should be taken from the adjusted heights of the survey adjustment output; they should NOT be calculated directly from the height difference schedule drafted on the survey plan. This method provides an independent check of the drafted plan height values of marks when comparing both the height difference and height schedules.

The accuracy of the AHD values must be shown (see section [3.31.3 Determination of Class and Positional Uncertainty](#)).

The height datum validation is required to be shown for all marks in the height schedule that have an “accurate AHD value” (see section [3.2.1 “Accurate AHD value”](#)).

The height datum validation comprises:

- The SCIMS AHD value adopted to derive the AHD values for marks not having an “accurate AHD value”. This AHD value must be designated “SCIMS adopted” in the height datum validation column of the approved height schedule. Only one AHD value in the height schedule can be given the designation “SCIMS adopted”.
- The marks used to validate the “accurate AHD value” of the single mark adopted. There must be at least one such mark; the marks used for height datum validation must be given the designation “from SCIMS – datum validation” and the height as recorded by SCIMS must be shown in the height schedule. It is expected that this will usually mean a minor disparity, within the specified tolerance, when the measured height differences within the height difference schedule are used to check the SCIMS heights shown in the height schedule.

Marks that do not have “accurate AHD values”:

- cannot be designated as “SCIMS adopted” or “From SCIMS – datum validation”
- if shown in the Height Schedule, must be shown with the height value as determined by the surveyor to Class B or LD or better

The height datum validation is critical information describing what the height values determined by the surveyor are based on and what was used to validate that basis.

The state of the marks must be shown which can only be shown as either “found”, “placed” or “disturbed” (disturbed marks with a height shown must be stable and have an unambiguous measurement point).

The date of the SCIMS AHD values must be shown; all SCIMS AHD values must have been obtained or verified from SCIMS at the same date.

All heights should be relative to the same datum. That is, a surveyor cannot state gravimetric heights relative to AHD and non-gravimetric heights (e.g. ellipsoidal heights) relative to an approved datum within the same survey plan.

Table 13 - Approved height schedule below shows the approved height schedule; the clauses in the Regulation that apply to the different elements of the schedule are colour coded.

HEIGHT SCHEDULE					
MARK	AHD VALUE	CLASS	PU	HEIGHT DATUM VALIDATION	STATE
PM 3570	680.182	LA	0.01	SCIMS ADOPTED	FOUND
PM 3571	691.290	LA	0.01	FROM SCIMS - DATUM VALIDATION	FOUND
TS 5517 "MULLEY"	731.465	LC	N/A	FROM SCIMS - DATUM VALIDATION	FOUND
PM 1653	693.015	B	0.03		DISTURBED
PM 43390	708.830	LB	N/A	FROM SCIMS - DATUM VALIDATION	FOUND
GB 2465	714.190	LC	N/A	FROM SCIMS - DATUM VALIDATION	FOUND
BM 1	714.543	LD	N/A		PLACED
BM 2	717.979	LD	N/A		PLACED
DATE OF SCIMS AHD VALUES: 1-1-2020			HEIGHT DATUM: AHD71		

Table 13 - Approved height schedule

HEIGHT SCHEDULE					
MARK	AHD VALUE	CLASS	PU	HEIGHT DATUM VALIDATION	STATE
PM 3570	680.182	LA	0.01	SCIMS ADOPTED	FOUND
PM 3571	691.290	LA	0.01	FROM SCIMS - DATUM VALIDATION	FOUND
SS 57633	682.201	LD	N/A		FOUND
BM 3	680.128	LD	N/A		PLACED
DATE OF SCIMS AHD VALUES: 1-1-2020			HEIGHT DATUM: AHD71		

Diagram 7.46 - Height schedule - standard example

A drawing template for the approved height schedule in Autocad .dwg and .dxf formats is available from the Spatial Services – Surveyor General’s Directions webpage.

https://www.spatial.nsw.gov.au/surveying/publications/surveyor_generals_directions

3.31.2 Coordinate schedule

The combination of Clause 41 and Clause 70 requires that an approved coordinate schedule be shown on all survey plans.

The coordinate schedule must show for:

- Any mark used to define an “accurate MGA orientation” (see section 3.2.2), or
- Any permanent survey mark found or placed, or
- Any bench mark found or placed

the MGA coordinates of any such mark.

Additionally particulars of the mark and its MGA coordinates must also be shown as per Clause 70(2), specifically,

- The identity of the mark,
- The accuracy of the mark (see section [3.31.3 Determination of Class and Positional Uncertainty](#))
- The survey method used to determine the MGA coordinates; where the mark is an established survey mark, the method should be shown as “from SCIMS”
- The state of the mark, which can only be shown as either:
 - Found
 - Placed
 - Disturbed (disturbed marks with a coordinate shown must be stable and have an unambiguous measurement point)
- The date of the SCIMS MGA coordinates; all SCIMS MGA coordinates must have been obtained or verified from SCIMS at the same date.
- The Combined Scale Factor.

Clause 70(1) requires that MGA coordinates shown on the survey plan must be within the same MGA zone and be derived from the same datum. This prevents surveyors from using coordinates from different coordinate systems (different datums and map projection zones) on the same plan (e.g. GDA94 and GDA2020) which may result in incorrect spatial positioning and incorrect datum line orientation.

If a mark for which coordinates are shown has an identification designated by the State control survey (in most cases this will be recorded in SCIMS), then that identification must be shown on the survey plan. Otherwise, identification unique to the subject survey plan must be used.

Regarding the accuracy of the MGA coordinates required to be shown in the coordinate schedule:

1. If the mark is an established survey mark, then the MGA coordinates that must be shown are those recorded in SCIMS.
2. If the mark is not an established survey mark and has been used for complying exclusively with Clause 13 (that is, is connected to the survey by height difference only), then the MGA coordinates need only be determined to a positional uncertainty of 3 metres or better.

3. If the survey has adopted an “accurate MGA orientation” (see section 3.2.2 “Accurate MGA orientation”) and the mark is not an established survey mark (excepting those marks in (2) above), then the surveyor must show the MGA coordinates of the mark to an accuracy of Class “D” or better.
4. For all other marks not under cases (1)-(3) above, the surveyor must show the MGA coordinates of the mark to a positional uncertainty of 3 metres or better.

A flowchart (see [Diagram 7.47 - Flowchart to determine MGA coordinate accuracy requirements](#)) has been prepared to enable users to determine the MGA coordinate accuracy requirements of the Regulation that apply to their survey. A [separate PDF version](#) of the flowchart is available from the [Surveyor-General's Directions](#) area of the Spatial Services website under “Direction No. 7”.

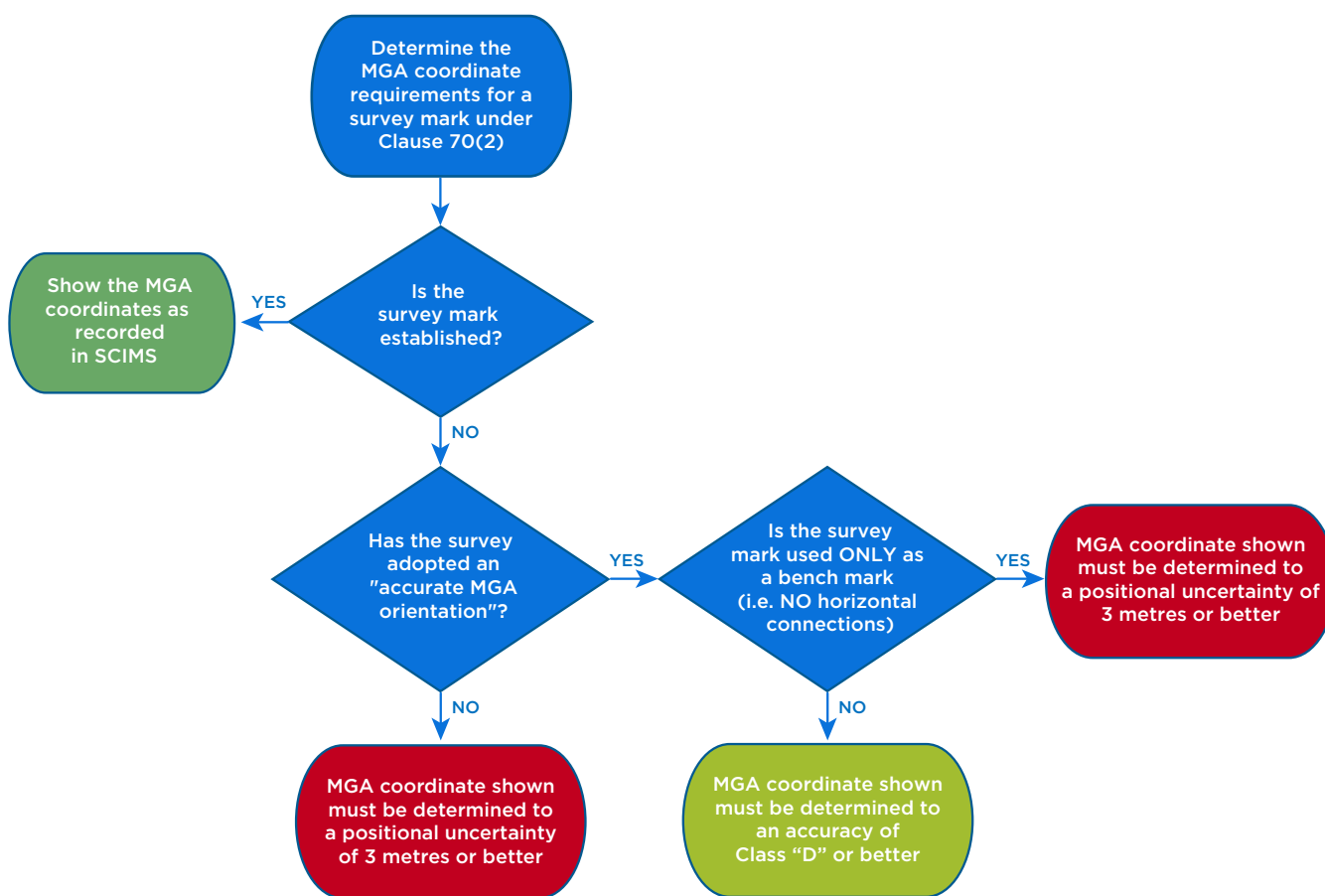


Diagram 7.47 - Flowchart to determine MGA coordinate accuracy requirements

Table 14 - Approved coordinate schedule below shows the approved coordinate schedule; the clauses in the Regulation that apply to the different elements of the schedule are colour coded.

Diagram 7.74 - Approved coordinate schedule shows the clauses in the Regulation that apply to the different elements of the schedule are colour coded. It should be noted on this diagram the Clause number references which have been shown are to illustrate how the approved schedule illustrates the requirements of Clause 70 of the Regulation. At no time should any Regulation Clause number references be shown within or associated with the coordinate schedule.

COORDINATE SCHEDULE						
MARK	MGA COORDINATES		CLASS	PU	METHOD	STATE
	EASTING	NORTHING				
TS 5517 "MULLEY"	738 668.404	6 298 132.250	2A	0.02	SCIMS	FOUND
GB 2465	738 705.138	6 298 195.369	D	0.02	SCIMS	FOUND
PM 1653	738 520.845	6 299 164.103	D	0.05	CADASTRAL TRAVERSE	DISTURBED
PM 3570	738 727.326	6 299 302.728	B	0.02	SCIMS	FOUND
PM 3571	738 544.177	6 299 161.049	A	0.02	SCIMS	FOUND
PM 43390	738 606.451	6 298 196.270	B	N/A	SCIMS	FOUND
GI PIPE A	738 598.524	6 298 083.327	D	N/A	CORS NRTK GNSS	PLACED
DH&W B	738 591.617	6 298 061.751	D	0.03	AUSPOS	PLACED
STAR PICKET C	738 600.552	6 298 091.414	D	0.05	AUSPOS	PLACED
DH&W D	738 572.753	6 298 038.178	D	0.03	CORS STATIC GNSS	FOUND
BM 1	738 627.439	6 297 977.148	C	N/A	CADASTRAL TRAVERSE	PLACED
BM 2	738 672	6 298 059	U	3	HAND HELD GNSS	PLACED
DATE OF SCIMS COORDINATES: 1-1-2020 MGA ZONE: 55 MGA DATUM: GDA2020 COMBINED SCALE FACTOR: 1.000187						

Table 14 - Approved coordinate schedule

A drawing template for the approved coordinate schedule in Autocad .dwg and .dxf formats is available from the Spatial Services – Surveyor General's Directions webpage.

https://www.spatial.nsw.gov.au/surveying/publications/surveyor_generals_directions

The requirement to show a coordinate schedule is considered necessary and beneficial for the following reasons:

- The coordinate schedule spatially enables the survey plan without reference to any external databases, spatial information systems or plans. This enables the end user of the plan to determine the position of the survey without recourse to any of the aforementioned resources.
- In the case where an “accurate MGA orientation” has been adopted, the coordinate schedule will describe the fundamental information that forms the basis of the horizontal datum adopted. This is a fundamental outcome of a survey plan and will be increasingly important in future when horizontal coordinate datums are updated and many such former datums will exist. Should the coordinate schedule not be placed on the survey plan, the end user will have to make assumptions as to what fundamental information was used. As a survey plan is a condensed statement of observed and compiled facts, the end user of the plan should not be required to make assumptions.
- The above two points emphasise that the survey plan is self-describing and self-checking. This is an important attribute as it requires access to far fewer, if any, external information sources to use the survey plan.

Practical working examples of the approved coordinate schedule can be seen in [Diagram 7.48 – Approved Coordinate schedule – practical examples](#);

COORDINATE SCHEDULE						
MARK	MGA COORDINATES		CLASS	PU	METHOD	STATE
	EASTING	NORTHING				
TS 5112	744 967.495	6 298 524.697	2A	0.02	SCIMS	FOUND
SS 29508	745 309.567	6 299 025.436	C	N/A	SCIMS	FOUND
PM 78165	744 323.423	6 298 970.037	B	N/A	SCIMS	FOUND
SS 205652	744 084.045	6 299 017.814	C	N/A	CAD. TRAV	PLACED
SS 195799	744 061.715	6 298 879.024	C	N/A	CAD. TRAV	FOUND
DATE OF SCIMS COORDINATES: 1-1-2020			MGA ZONE: 55		MGA DATUM: GDA2020	
COMBINED SCALE FACTOR: 1.000223						

EXAMPLE 1 - SCIMS ORIENTATION WITH TWO UNESTABLISHED SURVEY MARKS COORDINATED BY CADASTRAL TRAVERSE.

COORDINATE SCHEDULE						
MARK	MGA COORDINATES		CLASS	PU	METHOD	STATE
	EASTING	NORTHING				
PM 78276	547 305.696	6 856 543.526	D	N/A	CORS NRTK	FOUND
PM 78277	547 480.881	6 856 879.003	D	N/A	CORS NRTK	FOUND
DATE OF CORS NRTK COORDINATES: 1-1-2020			MGA ZONE: 56		MGA DATUM: GDA2020	
COMBINED SCALE FACTOR: 0.999594						

EXAMPLE 2 - USE OF AN APPROVED GNSS METHOD - CORSNET SURVEY PLAN ORIENTATION.

COORDINATE SCHEDULE						
MARK	MGA COORDINATES		CLASS	PU	METHOD	STATE
	EASTING	NORTHING				
PM 78276	547 305.696	6 856 543.526	D	0.03	AUSPOS	FOUND
PM 78277	547 480.881	6 856 879.003	D	0.03	AUSPOS	FOUND
DATE OF AUSPOS COORDINATES: 1-1-2020			MGA ZONE: 56		MGA DATUM: GDA2020	
COMBINED SCALE FACTOR: 0.999594						

EXAMPLE 3 - USE OF AN APPROVED GNSS METHOD - AUSPOS SURVEY PLAN ORIENTATION

COORDINATE SCHEDULE						
MARK	MGA COORDINATES		CLASS	PU	METHOD	STATE
	EASTING	NORTHING				
GIP 'X'	546 863.192	6 856 740.276	D	N/A	CORS NRTK	PLACED
GIP 'Y'	547 045.174	6 856 549.591	D	N/A	CORS NRTK	PLACED
PM 78276	547 305.696	6 856 543.526	D	N/A	CAD. TRAV	FOUND
PM 78277	547 480.881	6 856 879.003	D	N/A	CAD. TRAV	FOUND
DATE OF CORS NRTK COORDINATES: 1-1-2020			MGA ZONE: 56		MGA DATUM: GDA2020	
COMBINED SCALE FACTOR: 0.999585						

EXAMPLE 4 - USE OF AN APPROVED GNSS METHOD - CORSNET SURVEY PLAN ORIENTATION AND UNESTABLISHED SURVEY MARKS COORDINATED FROM CADASTRAL TRAVERSE.

COORDINATE SCHEDULE						
MARK	MGA COORDINATES		CLASS	PU	METHOD	STATE
	EASTING	NORTHING				
GIP 'X'	546 863.192	6 856 740.276	D	0.03	AUSPOS	PLACED
GIP 'Y'	547 045.174	6 856 549.591	D	0.03	AUSPOS	PLACED
PM 78276	547 305.696	6 856 543.526	D	0.04	CAD. TRAV	FOUND
PM 78277	547 480.881	6 856 879.003	D	0.04	CAD. TRAV	FOUND
DATE OF AUSPOS COORDINATES: 1-1-2020			MGA ZONE: 56		MGA DATUM: GDA2020	
COMBINED SCALE FACTOR: 0.999585						

USE OF AN APPROVED GNSS METHOD - AUSPOS SURVEY PLAN ORIENTATION AND UNESTABLISHED SURVEY MARKS COORDINATED FROM CADASTRAL TRAVERSE.

Diagram 7.48 - Approved Coordinate schedule - practical examples

3.31.3 Determination of Class and Positional Uncertainty

Generally speaking, “Class” is the quality of the survey and “Positional Uncertainty” (PU) is the quality of a coordinate or height with respect to the fundamental reference frame (e.g. GDA2020); see Section 3.2.4 “Positional uncertainty” for a definition of PU.

Requirements for accuracies to be shown in the Coordinate and Height schedule on a survey plan are:

- For established survey marks, the Class and PU as shown in SCIMS is required to be shown; if the PU is reported in SCIMS as null (empty), “N/A” should be shown for PU.
- For survey marks with MGA coordinates or heights determined by the surveyor (excluding established survey marks), Class is required to be shown and **PU is optional**. If the surveyor does not wish to show PU in this case, “N/A” should be placed in the PU column. For surveyors wishing to show PU, advice regarding determination of PU is given below.

Surveyor-General's Direction No. 12 and SP1 Version 1.7, published by ICSM have comprehensive details regarding the determination of the Class and PU of a survey. See [Table 1 - Class derived from station density and point error ellipse size \(at one sigma\)](#).

Should a surveyor wish to determine a PU to place in the Coordinate Schedule or Height Schedule on a survey plan, the following examples provide advice for determination of PU however **other more comprehensive sources should be referenced**. In this regard, SP1 Version 1.7, published by ICSM is recommended as an initial source.

AUSPOS MGA coordinates: The AUSPOS report gives a PU for the respective coordinate and height solutions. The PU for MGA coordinates should be that shown as the “Horizontal” PU for the applicable datum within the AUSPOS report.

CORS NRTK MGA coordinates: Determining PU for individual CORS NRTK solutions is the subject of ongoing research; this research has not yet concluded, therefore, it is recommended that a PU of “N/A” be shown.

Static GNSS and terrestrial methods: PU for coordinates and/or heights within networks measured by static GNSS and/or terrestrial methods should be determined by a constrained least-squares adjustment, appropriately connected to survey marks having a reported PU in SCIMS; coordinate and/or height constraints should be derived using the PUs as shown in SCIMS.

3.32 Part 3 - Clauses 75 to 86 – Administration

For further direction on the clauses under Part 3 “Administration” of the Regulation, please refer to the “Determinations and policies” section within the website of the [Board of Surveying and Spatial Information](#).

3.33 Clause 90 - Applications to remove survey marks under section 24 of the Act

Applications under this clause to remove survey marks, being permanent survey marks, reference marks and bench marks should be made in writing with appropriate documentation via DCS Spatial Services’ webpage under “[Application for Surveyor General approval – Survey Mark\(s\) Removal](#)”.

Refer to *Surveyor-General's Direction No. 11* - “Preservation of survey infrastructure” for instructions detailing the requirements of such an application.

3.34 Clause 91 - Exemption by Surveyor-General

Clause 91 allows a surveyor to apply to the Surveyor-General to seek an exemption from the requirements of the Regulation.

If the Surveyor-General is of the opinion it is not practicable or necessary to comply with a requirement of the Regulation, an exemption in writing will be provided, applying only to the conduct of the relevant survey.

Further, an exemption may only partly exempt the surveyor from compliance with a clause of the Regulation (i.e. it may only apply to a part of the subject survey); an exemption may also be granted subject to conditions. If the surveyor does not comply with those conditions, then, as per Clause 91(2), the exemption granted does not take effect and the surveyor must comply with the entirety of the Regulation.

Each survey plan subject to an exemption should have its own unique exemption number; Clause 91(3) requires that number to be shown on the survey plan; this notation is usually placed adjacent to the surveyor's reference. Only the exemption number is to be shown on the survey plan; the requirements of previous Regulations no longer apply whereby the surveyor had to show the clause or clauses to which the exemption applies as well as the exemption number.

Where a survey plan to which an exemption applies is lodged with the Registrar-General or a public authority, the Registrar-General or that public authority must be furnished, at the time of lodgement, with a copy of the exemption. As above, exemptions are often issued referring to only part of the survey and subject to one or more conditions. When a survey plan subject to an exemption is lodged with the Registrar-General or a public authority, it is considered critical for the examination process that the surveyor lodges a copy of the exemption so that a plan examiner can:

- Be aware of which part or parts of the survey plan the exemption applies to, and
- Determine whether the conditions, if any, which apply to the exemption have been met.

The majority of exemptions relate to the adoption or verification of datum (MGA or AHD) or to marking requirements to accommodate unique site conditions or constraints.

Exemptions are only given for the **field component** required for each survey. It is assumed that the field component is accurately reflected in the survey plan.

3.34.1 Applying for an exemption

Surveyors wanting to apply for an exemption should do so through the online application form: [Application for Surveyor-General's Approvals and Exemptions – S&SI Regs.](#)

3.34.2 Exemption policy history

The original exemption powers (from 1990 to 2001) of the Surveyor-General only related to easements, datum lines, use of ISG orientation and the placing permanent survey marks. The implementation of the Survey Control Network into the *Survey Practice Regulation 1990* was somewhat inflexible and did not cater well for the size of the survey and existing marks in the network. As exemptions were common in three areas, "Exemption Policies" were developed in 1992/93. The three Exemption Policies published were:

Exemption Policy No.1	Placement of marks - staged subdivisions.
Exemption Policy No.2	Placement of marks - more than 5 lots.
Exemption Policy No.3	Adoption of map grid orientation - minor surveys.

Exemption Policy No.'s 1 & 2 are no longer valid due to amendments of the *Survey Practice Regulation 1990 (as Amended 1994)*.

3.34.3 Exemption Policy No.3 - Adoption of MGA orientation - minor surveys.

This exemption policy is still current and can apply to minor surveys using an MGA orientation from a registered Deposited Plan.

The survey plan wishing to adopt a Policy 3 exemption must satisfy the following criteria:

- The dominant registered Deposited Plan (DP) must be on an MGA orientation derived from the connection to established survey marks.
- The subject survey must be of a minor nature and must be an interpolation of the existing cadastre within the dominant DP (eg dual occupancy or boundary adjustments).

If the above two points apply, it is sufficient to connect to at least 3 suitably located unestablished permanent survey marks connected in the dominant DP. The datum line and verifying lines must comply with the following:

- The orientation of the datum line must be adopted from a bearing as shown on (not calculated from) the dominant DP.
- The datum line must show the distance comparison with the dominant DP for the datum line adopted.
- The verifying line must show a comparison of the measured bearing and distance with the bearing and distance as shown on (not calculated from) dominant DP.

The surveyor should show the notation “MGA” and the Deposited Plan number of the dominant Deposited Plan adjacent to the north point (see [Diagram 7.32 - Example north points](#))

In order to streamline procedures for exemptions under this policy, surveyors need not apply for an exemption number. The notation “**Exemption Policy 3**” should be placed after the Surveyor’s Reference.

If the plan is lodged with the Registrar-General and the examining officer considers that the survey does not comply with the “Exemption Policy 3” criteria above, then the surveyor will be required to connect the survey to established permanent survey marks.

3.34.4 Exemption Policy No.4 – “Project” SCIMS MGA orientation – staged subdivisions.

A Policy 4 Exemption is aimed primarily at large projects being staged subdivisions that propose to adopt, for all stages, a longer datum line more appropriate to the survey project as a whole, without incurring a requisition to comply with Clause 12(2)(a).

This exemption policy applies only to surveys that are required to comply with Clause 12(2)(a); that is, an urban survey that is within 300 metres of 2 established survey marks.

A survey plan proposing to adopt a Policy 4 Exemption must meet the following criteria:

- The survey must initially be required by the Regulation to comply with Clause 12(2)(a)
- The survey must be part of a multi-stage subdivision

If the above criteria are met, then the bearing used for orientation of the survey may be adopted from the grid bearing derived from the SCIMS MGA coordinates of 2 established survey marks **within 1500 metres** of the overall project extents **subject to the following conditions:**

- 2 established survey marks within 300 metres of the land surveyed are connected by direct lines to separate corners of the land surveyed and those connections shown on the survey plan; and
- A direct connection between the 2 established survey marks within 300 metres of the land surveyed is shown by closed connection on the survey plan; and
- Clause 61(4) is complied with; that is, comparisons of measured bearings and distances with those calculated from the SCIMS MGA coordinates for the datum line and **all** verifying lines must be shown. The line between the 2 established marks within 300 metres of the land surveyed is considered a verifying line and as such a comparison for this line must be shown on the survey plan; and
- The same datum line and datum line orientation is adopted for all stages of the survey project.

A Policy 4 Exemption is an exemption from Clause 12(2)(a) only; all other requirements of the Regulation must be complied with.

In order to streamline procedures for exemptions under this policy, surveyors need not apply for an exemption number. The notation “**Exemption Policy 4**” should be placed after the Surveyor’s Reference.

If the plan is lodged with the Registrar-General and the examining officer considers that the survey does not comply with the “Exemption Policy 4” criteria above, then the surveyor will be required to adopt a datum line in compliance with the Regulation.

See [Diagram 7.49 Exemption Policy No.4 - concept diagram](#) below for a conceptual representation of a Policy 4 exemption.

A Policy 4 Exemption is an exemption that stipulates adoption of a SCIMS MGA orientation derived from SCIMS MGA coordinates of 2 established survey marks; when a change in the approved horizontal datum for NSW occurs e.g. GDA94 to GDA2020, the SCIMS MGA coordinate values for all established survey marks will change.

For a large project still to be completed under a Policy 4 Exemption during a datum change, though the SCIMS MGA coordinates of the established survey marks comprising the datum line will change with a new approved horizontal datum, the change in the calculated grid bearing of the datum line between the old and new horizontal datum should be negligible in most cases. Where there is a significant difference in the grid bearing used for datum line orientation when transitioning from the old datum to the new datum, the grid bearing derived from the new datum’s coordinates must be adopted and the Policy 4 exemption for the large project will then continue on the new datum, unless a separate

exemption applies (e.g. a Policy 2020-94 exemption), in which case both exemptions (e.g. “Exemption Policy 4” & “Exemption Policy 2020-94”) must be shown adjacent to the Surveyor’s Reference. All other Clauses of the Regulation must be complied with.

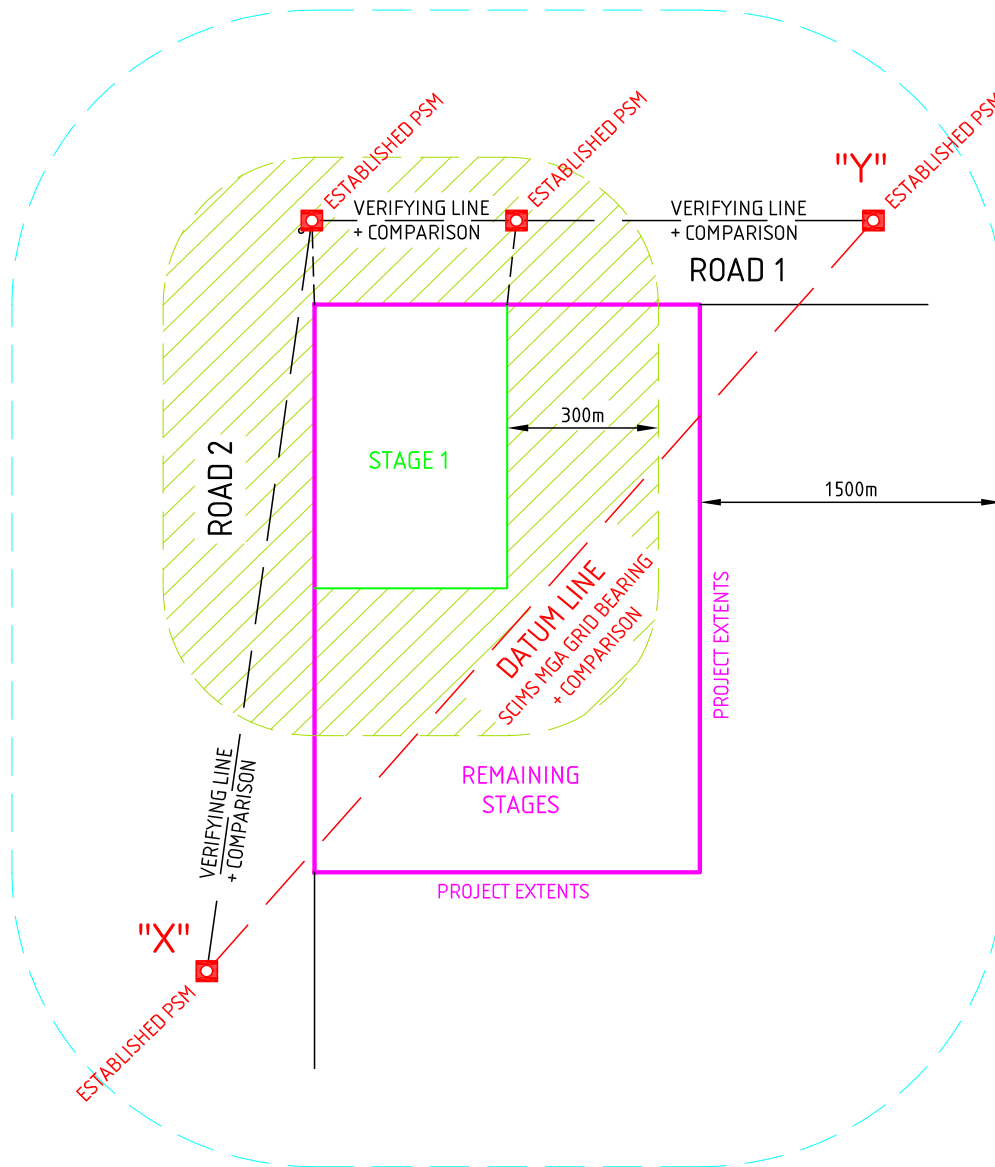


Diagram 7.49 – Exemption Policy No.4 – concept diagram

3.34.5 Exemption Policy No.5 – Land Acquisition Surveys under the Roads Act 1993.

All lots surveyed under the Regulation must be marked in accordance with the Regulation. This includes the placement of boundary marks, reference marks and permanent survey marks where required (see Division 4, Subdivision 1 of the Regulation).

Exemption Policy No. 5 exempts surveyors from placing **boundary marks only** on the existing road frontage boundaries of surveyed lot(s) that define areas of land required for road purposes pursuant to the Roads Act 1993. Exemption Policy No.5 replaces the previous “LASRA” exemption policy. Note that the Exemption Policy No.5 applies **only** to those lots intended to be acquired for road purposes under the Roads Act 1993.

A survey plan proposing to adopt a Policy 5 Exemption must meet the following criteria:

- The survey plan must intend to acquire land for road purposes under the Roads Act 1993
- Any lot intended for road purposes to which the Policy 5 exemption is to apply must be a proposed widening of an existing road.

If the above criteria are met, then Exemption Policy No.5 may be applied, **subject to the following conditions:**

- All boundaries other than those to which the Policy 5 exemption applies must be marked in compliance with the Regulation; and
- For each lot to which the Policy 5 exemption applies, the reference marks required to be either connected to, or placed and connected to, by Clauses 29, 30 and 31 of the Regulation must refer to corners of the proposed road boundary, not to corners of the existing road boundary intended to become defunct.

This is required as, in the majority of instances, existing reference marks referring to those corners of the existing road boundary proposed to become defunct are within the area of proposed road works and thus likely to be disturbed or destroyed.

See [Diagram 7.51 – Exemption Policy No.5 – urban concept diagram](#) and [Diagram 7.50 – Exemption Policy No.5 – rural concept diagram](#) for concept examples of a road widening with a Policy 5 exemption applied; and

- Pursuant to Clause 36 and Clause 43(1)(b) of the Regulation, reference marks and permanent survey marks must be placed in safe, stable locations which will be free from disturbance during any known proposed road-works.

In order to streamline procedures for exemptions under this policy, surveyors need not apply for an exemption number. The notation “**Exemption Policy 5**” should be placed after the Surveyor’s Reference.

If the plan is lodged with the Registrar-General and the examining officer considers that the survey does not comply with the “Exemption Policy 5” criteria above, then the surveyor will be required to mark all boundaries in compliance with the Regulation.

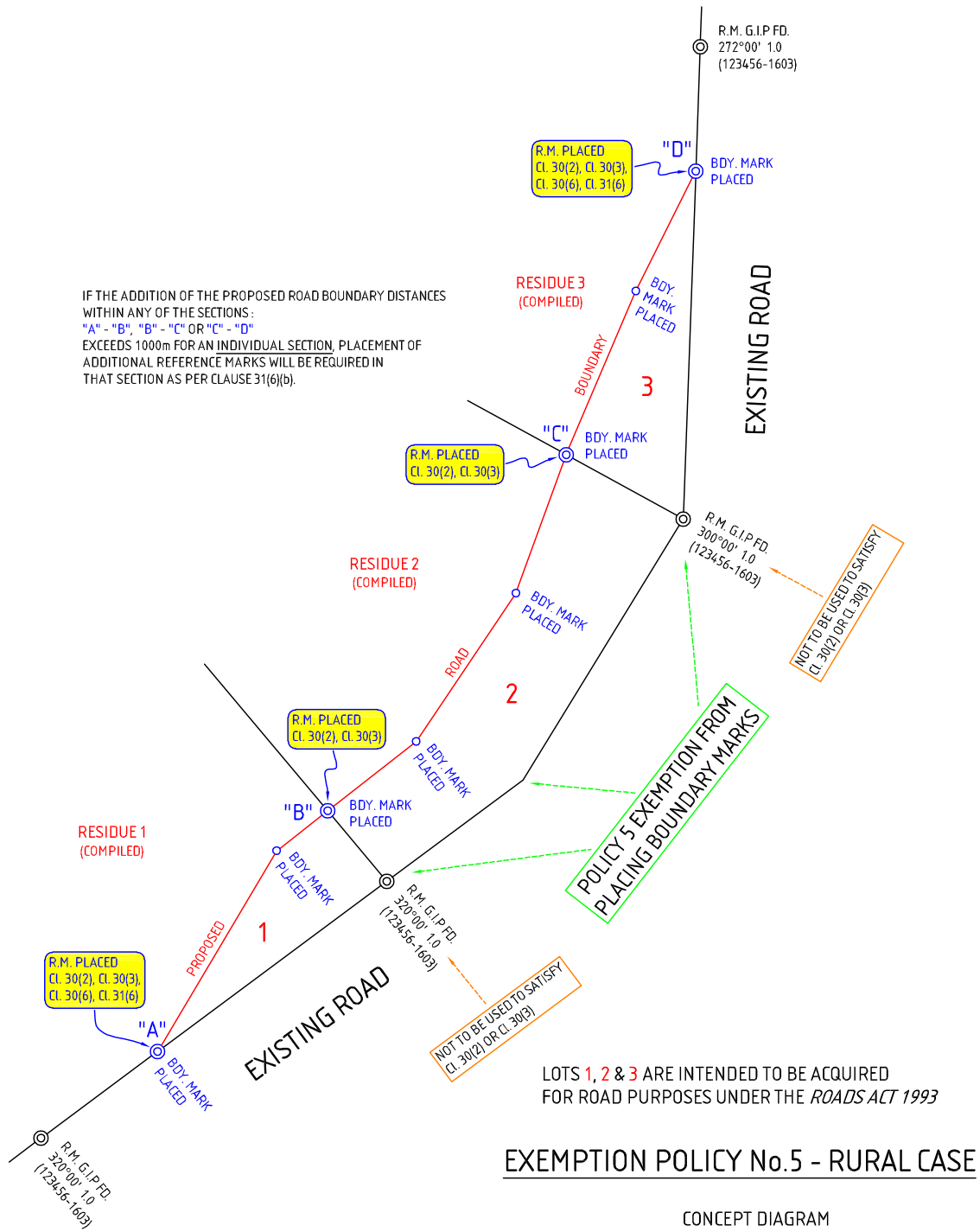


Diagram 7.50 – Exemption Policy No.5 – rural concept diagram

3.34.6 Exemption Policy No. 2020-94 – Adoption of an MGA94 datum line orientation

A Policy 2020-94 Exemption allows a survey plan with a date of survey between 01 January 2020 and 30 June 2020 (inclusive) to adopt, as orientation of the datum line, the grid bearing derived from the MGA94 coordinates of two survey marks.

A survey plan proposing to apply a Policy 2020-94 Exemption must meet the following criteria:

- An “accurate MGA orientation” must be adopted (see section [3.2.2 “Accurate MGA orientation”](#))
- **The date of survey must be between 01 January 2020 and 30 June 2020 (inclusive).**

If the above criteria are met, then the survey plan applying a Policy 2020-94 Exemption is exempt from compliance with the definition of the term “MGA” within Clause 5(1) and **must** adopt the following alternate definition of the term “MGA” for use in the applicable clauses of the Regulation:

MGA means Map Grid of Australia, that is, a rectangular coordinate system using a Universal Transverse Mercator projection with zones 6 degrees wide and based on The Geocentric Datum of Australia 1994 (GDA94), being a datum surface described in a notice published by the Surveyor-General in Gazette No 88 of 8 August 1997, at pages 6127 and 6128, and designated in that notice as “The Geocentric Datum of Australia (GDA)”.

Note that the above formal definition of the term “MGA” refers to MGA94 coordinates.

The coordinate schedule to be shown on a survey plan applying a Policy 2020-94 Exemption **must** be of the form shown in [4.6 Appendix F – MGA94 coordinate schedule for Exemption Policy No. 2020-94](#) instead of that shown in section 3.31.2; to comply with Clause 70(1)(b), all MGA coordinates shown on such a survey plan must be MGA94 coordinates and must show the datum statement in the coordinate schedule as “GDA94”. Where applicable, the height schedule to be used in conjunction with a survey plan applying a Policy 2020-94 Exemption can be that shown in [Table 13 – Approved height schedule](#) (showing Class & PU), or that shown in Version 3.1 of the Direction (showing Class & Order).

Where a Certificate of Currency (Plan Form 6CC) is furnished for a survey plan that is proposing to apply a Policy 2020-94 Exemption with a date of survey within the above stipulated period (1-1-2020 to 30-6-2020 incl.), the Policy 2020-94 Exemption will still apply if 2 or more of the permanent survey marks used in the survey remain in place. If 2 or more of the permanent survey marks used in the survey **do not** remain in place, the Policy 2020-94 Exemption **does not** apply and the survey plan must be updated as per the Certificate of Currency requirements on Plan Form 6CC; such an update would require the survey plan, where required by the Regulation, to adopt an orientation derived from MGA2020 coordinates.

Note that a Policy 2020-94 Exemption is an exemption only from the definition of the term “MGA” within Clause 5(1); **all other clauses of the Regulation must be complied with.**

In order to streamline procedures for exemptions under this policy, surveyors need not apply for an exemption number. The notation **“Exemption Policy 2020-94”** should be placed after the Surveyor’s Reference.

If the plan is lodged with the Registrar-General and the examining officer considers that the survey does not comply with the “Exemption Policy 2020-94” criteria above, then the surveyor will be required to adopt MGA2020 coordinates as specified by the Regulation.

3.35 Schedule 1 - Bench Marks

The form and style of the non-corrodible nail state the minimum diameter of the nail to be 6mm; this does NOT include the diameter of the collar or washer of the so-called “hilti” nail or “mickey pin”. The 6mm minimum diameter must be the diameter of the shaft of the nail itself.

3.36 Schedule 2 – Boundary marks

The steel fence post specified as a boundary mark may include a steel fence post with or without a cap. It does NOT include star pickets used as a fence post or otherwise not complying with the requirements for a star picket boundary mark specified in Schedule 2.

Any other post type other than a steel fence post described above must be marked with a boundary mark if so required by the Regulation.

The form and style of the non-corrodible nail state the minimum diameter of the nail to be 6mm; this does NOT include the diameter of the collar or washer of the so-called “hilti” nail or “mickey pin”. The 6mm minimum diameter must be the diameter of the shaft of the nail itself.

3.37 Schedule 3 – Reference marks

The broad arrow type reference mark states as part of the requirements for placement and use of mark that the point of the broad arrow is the reference point. The “point” of the broad arrow is the intersection of the three axes of the broad arrow, that is, the tip of all three wings at their intersection point.

The form and style of the non-corrodible nail state the minimum diameter of the nail to be 6mm; this does NOT include the diameter of the collar or washer of the so-called “hilti” nail or “mickey pin”. The 6mm minimum diameter must be the diameter of the shaft of the nail itself.

3.38 Schedule 6 – Forms

3.38.1 Form 1 – Survey certificate

Where appropriate, a completed survey certificate or certificate as to survey not requiring strict accuracy must be shown on the survey plan as per Clause 72.

The survey certificate completed for either a full or partial plan of survey requires the surveyor to record the survey marks adopted for the datum line adopted for the survey. Clause 61(1) of the Regulation requires that the datum line for the survey must be shown on the survey plan by distinguishing characters placed at the terminals of the datum line. These distinguishing characters should be recorded in the Datum Line field of the survey certificate and should be shown in the order adopted for calculating the datum line grid bearing.

It should be remembered that under Clause 12 of the Regulation where an MGA orientation is adopted from SCIMS MGA coordinates or from MGA coordinates derived from an approved GNSS method, the surveyor must adopt the **grid bearing** calculated from one survey mark to another survey mark. Grid bearings can calculate differently depending on the direction calculated in certain circumstances in NSW therefore there is an obligation for the surveyor preparing a plan of survey for registration to show the grid bearing in the direction that has been adopted to orientate the plan. Generally the difference between the two is negligible in a cadastral sense due to the small distances between adopted marks but in rural NSW the difference can be considerable..

Also if the survey plan includes a partially compiled lot, then the terrain type must be filled out as per Clause 60(e). If the survey plan does not show a partially compiled lot (i.e. ALL lots are fully surveyed), then the entirety of the line of the survey certificate specifying terrain type should be ruled through.

The terrain type is ONLY used to determine the misclose tolerance that applies to the partially compiled lot as per Clause 26(3). See section [3.14.2 Checking closes of partially surveyed lots on the survey plan](#).

The terrain type of the land should be determined by reference to the following categories:

- “Level,” where the slope does not exceed 3 degrees;
- “Undulating,” where the slope ranges from 3 degrees to 10 degrees;
- “Mountainous,” where the slope exceeds 10 degrees.

4. Appendices

4.1 Appendix A - Deferment of survey marks - application

I wish to apply for the deferment of _____ survey (including boundary/reference/permanent) marks under Clause 38 of the *Surveying and Spatial Information Regulation 2017*.

Attached is the security deposit of \$_____ (\$308/survey mark)(minimum \$929).

I understand the Surveyor-General will hold the security for a period until the deferred marks have been placed and when the marks are satisfactorily placed, 85% of the original security will be returned. No payment will be released for partial completion of the survey.

Final approval will not be given until the security has been received by the Surveyor-General.

Details of my application are as follows:

Surveyor's Name/Organisation:

Address:

Phone/Fax No:

Surveyor's Reference:

Lot:

DP:

LGA:

Locality:

Development Name/Stage:

Name of Road/Roads:

_____/_____/_____
Signature

Office Use Only:

Deferred Mark Number: DM ____ / ____

Received From: _____

Receipt Number: _____ Amount: \$ _____

Date Received: _____

DM Approval: _____ / ____ / ____

4.2 Appendix B – Deferment of Survey Mark - Placement

I , (Surveyor registered under the
insert name *Surveying & Spatial Information Act 2002*)

of

.....
organisation/address

hereby certify that the deferred survey marks under Clause 38 have been placed in accordance with the *Surveying & Spatial Information Regulation 2017* and the conditions of Approval Number DM____/_____.

Details of the Deferred Mark approval are as follows:

1. DP Number
2. Deferred Mark number
3. Name of Road/Roads
4. Locality
5. LGA
6. Surveyor's Reference
7. No. of Deferred Marks placed

I request the 85% refund of the \$_____ security deposit lodged with your office.

Signature

Date ____ / ____ / ____

4.3 Appendix C – Forestry right surveys

4.3.1 Plans of survey

Any plan of survey or plan of limited survey lodged for the purpose of creating a Forestry right must follow the guidelines as specified by the [Registrar-General's Guidelines for Forestry rights](#).

Further to the requirements specified by the Registrar-General's Guidelines:

4.3.1.1 Orientation

The orientation of the survey is to be determined from the coordinates of two established permanent survey marks if both marks are suitably located with respect to the area to be surveyed for the Forestry Right.

If established permanent survey marks are not available, the orientation can be obtained from an approved GNSS method as outlined in [3.6.6 Use of approved GNSS methods to determine datum line orientation](#), or from a previous survey filed or recorded by the Registrar-General or a public authority. The horizontal datum adopted as orientation must be stated on the survey plan (see section [3.26 Clause 61 – Method of recording datum line](#)).

4.3.1.2 Aerial imagery

Where aerial imagery is used, there shall be **5 ground control points** recorded on the survey. Two (2) of these will preferably be the permanent survey marks referred to above, otherwise use is to be made of existing durable cultural (man-made) features wherever possible. The relative location of these ground control points will be determined by survey so as to enable location of the Forestry Right boundary by aerial imagery.

4.4 Appendix D – Derivation of formulae

4.4.1 Derivation of the formula for the required angular accuracy

FORMULA FOR THE ANGULAR ACCURACY TOLERANCE

$$\alpha \text{ (seconds of arc)} = 206265 \left(\frac{0.01 + \left(\frac{d}{20000} \right)}{d} \right)$$

$d = \text{DISTANCE (m)}$

NOTE: (d) IS THE LENGTH OF THE SHORTEST LINE REFERRED TO IN CLAUSE 23(5) OF THE REGULATION

FROM DIAGRAM D-1:

$$d \alpha = \text{ARC}_{\text{max}}$$

$$\alpha = \frac{\text{ARC}_{\text{max}}}{d} \quad \dots \text{(Equation ED-1)}$$

(where α is in radians)

IF ARC_{max} IS REQUIRED TO BE 10mm + 50ppm OF THE DISTANCE (d), THEN:

$$\begin{aligned} \text{ARC}_{\text{max}} \text{ (m)} &= 0.01 + d \left(\frac{50}{1,000,000} \right) \\ &= 0.01 + d \left(\frac{1}{20000} \right) \\ &= 0.01 + \left(\frac{d}{20000} \right) \quad \dots \text{(Equation ED-2)} \end{aligned}$$

THEREFORE, FOR AN ARC_{max} OF 10mm + 50ppm OF THE DISTANCE (d), FROM Equations ED-1 & ED-2 ABOVE:

$$\alpha \text{ (radians)} = \frac{0.01 + \left(\frac{d}{20000} \right)}{d} \quad \dots \text{(Equation ED-3)}$$

TO CONVERT FROM RADIANS TO SECONDS OF ARC, MULTIPLICATION BY A CONSTANT IS REQUIRED:

$$\begin{aligned} \pi \text{ radians} &= 180^\circ \\ &= (180 \times 3600) \text{ seconds of arc} \\ &= 648000 \text{ seconds of arc} \end{aligned}$$

THEREFORE:

$$\begin{aligned} 1 \text{ radian} &= \frac{648000}{\pi} \text{ seconds of arc} \\ &= 206264.8 \text{ seconds of arc} \\ &= 206265 \text{ seconds of arc (rounded to zero decimal places)} \end{aligned}$$

SO CONVERSION FROM RADIANS TO SECONDS OF ARC WILL REQUIRE MULTIPLICATION BY THE CONSTANT 206265.

TO EXPRESS α IN Equation ED-3 AS SECONDS OF ARC, Equation ED-3 THEN BECOMES:

$$\alpha \text{ (seconds of arc)} = 206265 \left(\frac{0.01 + \left(\frac{d}{20000} \right)}{d} \right)$$

where:
 $d = \text{DISTANCE (m)}$

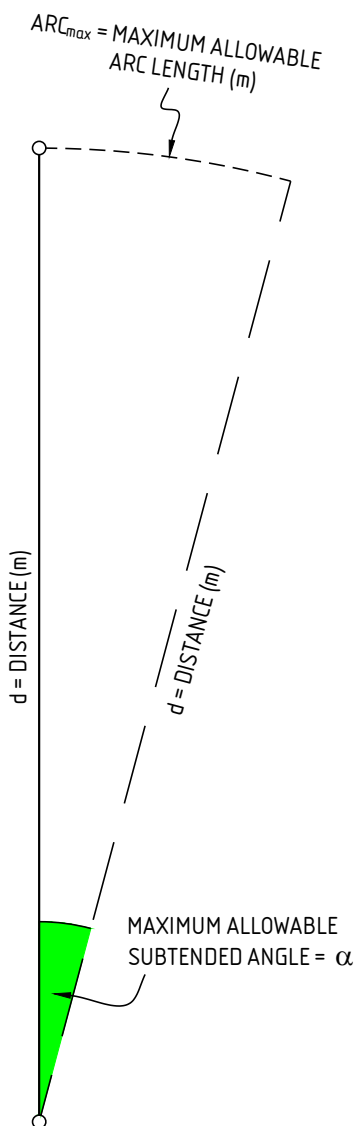


DIAGRAM D-1.
SHOWING THE ELEMENTS USED TO DERIVE THE FORMULA FOR THE ANGULAR ACCURACY TOLERANCE

4.4.2 Derivation of the formula for the required accuracy of relative position

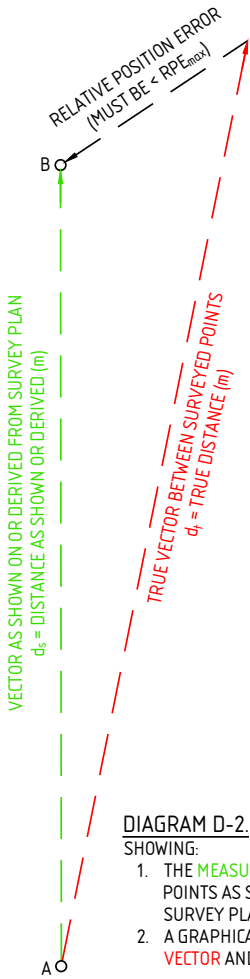


DIAGRAM D-2.
SHOWING:
1. THE MEASURED VECTOR BETWEEN TWO SURVEYED POINTS AS SHOWN ON OR DERIVED FROM A SURVEY PLAN.
2. A GRAPHICAL REPRESENTATION OF THE TRUE VECTOR AND ERROR IN RELATIVE POSITION.

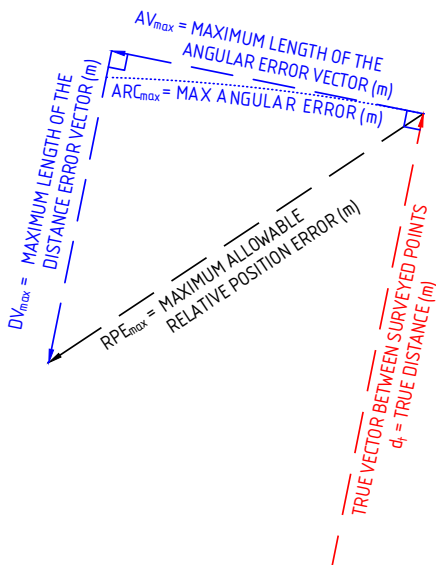


DIAGRAM D-3.
SHOWING THE ELEMENTS USED TO DERIVE THE MAXIMUM ALLOWABLE RELATIVE POSITION ERROR BETWEEN TWO SURVEYED POINTS AS DERIVED FROM A SURVEY PLAN

FORMULA FOR THE RELATIVE POSITION ACCURACY TOLERANCE

$$RPE_{max} = \sqrt{2 \left(0.01 + \frac{d}{20000} \right)^2}$$

d = DISTANCE BETWEEN TWO SURVEYED POINTS (m)

FROM DIAGRAMS D-2 & D-3:

TERMS USED:

d_s = LENGTH OF THE VECTOR BETWEEN TWO SURVEYED POINTS AS SHOWN OR DERIVED FROM THE SURVEY PLAN (m) (DISTANCE AS SHOWN OR DERIVED)

d_t = LENGTH OF THE TRUE VECTOR BETWEEN TWO SURVEYED POINTS (m) (TRUE DISTANCE)

ARC_{max} = MAXIMUM LENGTH OF THE ANGULAR ERROR ARC (m)

AV_{max} = MAXIMUM LENGTH OF THE ANGULAR ERROR VECTOR (m)

DV_{max} = MAXIMUM LENGTH OF THE DISTANCE ERROR VECTOR (m)

RPE_{max} = LENGTH OF THE MAXIMUM ALLOWABLE RELATIVE POSITION ERROR (m)

IF ARC_{max} IS REQUIRED TO BE 10mm + 50ppm OF d_t , THEN:

$$ARC_{max} = 0.01 + d_t \left(\frac{50}{1,000,000} \right)$$

$$= 0.01 + \left(\frac{d_t}{20000} \right) \quad \dots \text{(Equation ED-4)}$$

FROM Equation ED-4, FOR PRACTICAL VALUES OF d_t (>0.014m), $ARC_{max} - AV_{max} < 1mm$ AND AV_{max} CAN EFFECTIVELY BE SUBSTITUTED FOR ARC_{max} :

$$ARC_{max} = AV_{max} = 0.01 + \left(\frac{d_t}{20000} \right) \quad \dots \text{(Equation ED-5)}$$

IF DV_{max} IS REQUIRED TO BE 10mm + 50ppm OF d_t , THEN:

$$DV_{max} = 0.01 + \left(\frac{d_t}{20000} \right) \quad \dots \text{(Equation ED-6)}$$

FROM DIAGRAM D-3:

$$RPE_{max}^2 = DV_{max}^2 + AV_{max}^2$$

SUBSTITUTING FROM Equations ED-5 & ED-6:

$$RPE_{max}^2 = \left(0.01 + \frac{d_t}{20000} \right)^2 + \left(0.01 + \frac{d_t}{20000} \right)^2$$

$$RPE_{max} = \sqrt{\left(0.01 + \frac{d_t}{20000} \right)^2 + \left(0.01 + \frac{d_t}{20000} \right)^2}$$

$$RPE_{max} = \sqrt{2 \left(0.01 + \frac{d_t}{20000} \right)^2} \quad \dots \text{(Equation ED-7)}$$

IF THE DIFFERENCE BETWEEN d_t AND d_s IS LESS THAN 14 metres, THEN THE EFFECT OF THE DIFFERENCE ON RPE_{max} IS LESS THAN 1mm AND d_s CAN BE EFFECTIVELY SUBSTITUTED FOR d_t IN EQUATION ED-7.

SO, FOR $|d_t - d_s| < 14$ metres:

$$RPE_{max} = \sqrt{2 \left(0.01 + \frac{d_s}{20000} \right)^2}$$

4.5 Appendix E Surveyor-General's Approvals

Where a Surveyor-General's Approval is required under any applicable Clause of the Regulation (e.g. the use of an approved photogrammetric technique) an application should be made to the Office of the Surveyor-General via the Spatial Services' Cadastral Management Unit in Bathurst. Applications should be made using the online Application for Surveyor-General Approval – S&SI Regs Exemption Request form which can be found on the Surveyor General's Directions webpage under Direction No.7.

https://www.spatial.nsw.gov.au/surveying/publications/surveyor_generals_directions

Once an approval is issued, which will include a Surveyor General Approval (SGA) reference number the surveyor should add the approval reference number to the surveyor's reference on the final plan of survey as is shown below in [Diagram 7.52 - Use of a Surveyor-General approval number](#).

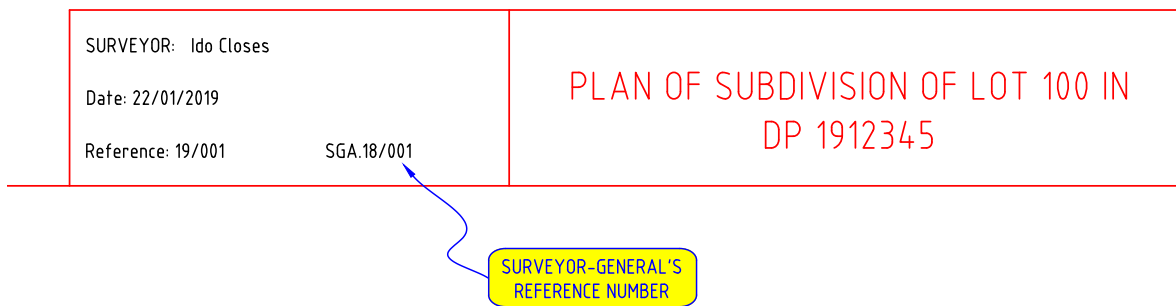


Diagram 7.52 - Use of a Surveyor-General approval number

4.6 Appendix F – MGA94 coordinate schedule for Exemption Policy No. 2020-94

A survey plan with a date of survey between 1-1-2020 and 30-6-2020 (inclusive) can use the below coordinate schedule as the approved coordinate schedule if, and only if, the Policy 2020-94 Exemption is applied.

COORDINATE SCHEDULE						
MARK	MGA COORDINATES		CLASS	ORDER	METHOD	STATE
	EASTING	NORTHING				
PM 622	341 418.711	6 259 416.278	B	2	FROM SCIMS	FOUND
PM 623	341 417.817	6 259 711.967	C	3	FROM SCIMS	FOUND
PM 632	341 362.507	6 259 428.731	B	2	FROM SCIMS	FOUND
PM 791	341 232.567	6 259 432.971	C	N/A	CADASTRAL TRAVERSE	DISTURBED
PM 50520	340 415.400	6 259 009.385	C	N/A	CADASTRAL TRAVERSE	FOUND
SS 51647	341 227	6 259 043	U	N/A	HAND HELD GNSS	PLACED
SS 67065	341 471.490	6 258 704.067	C	N/A	RTK GNSS	PLACED
SS 61260	341 287.160	6 258 707.785	C	N/A	CADASTRAL TRAVERSE	PLACED
SS 95190	340 828.656	6 258 970.832	D	N/A	CADASTRAL TRAVERSE	FOUND
GI PIPE A	340 701.748	6 259 150.568	D	N/A	AUSPOS	PLACED
DH&W B	341 220.823	6 259 054.046	D	N/A	AUSPOS	PLACED
STAR PICKET C	341 176.185	6 259 075.004	D	N/A	CORS NRTK GNSS	PLACED
DH&W D	341 077.010	6 259 184.774	D	N/A	CORS STATIC GNSS	FOUND
BM 1	341408.803	6259489.927	D	N/A	CADASTRAL TRAVERSE	PLACED
BM 2	341 374	6 259 492	U	N/A	HAND HELD GNSS	PLACED
DATE OF SCIMS COORDINATES: 22-9-2016 MGA ZONE: 56 MGA DATUM: GDA94						
COMBINED SCALE FACTOR: 0.999906						

4.7 Appendix G – Contact information

DCS Spatial Services

Head office

346 Panorama Avenue
Bathurst NSW 2795
+ 61 02 6332 8287

Visit us

Office hours - 8:30 am to 4:30 pm business days.

Postal address

346 Panorama Avenue
Bathurst NSW 2795

Application for exemption

Surveyors wanting to apply for an exemption should do so through the online application form:

[Application for Surveyor-General's Approvals and Exemptions – S&SI Regs.](#)

Application for survey mark removal

Person/s wanting to apply for approval to remove survey mark/s should do so through the online application form: [Application for Surveyor-General approval – survey mark removal.](#)

Office of the Surveyor-General – Spatial Services Cadastral Management Unit

Postal address is as per DCS Spatial Services' head office above.

E-mail: CMU@customerservice.nsw.gov.au

The current Surveyor-General's Directions are available through the Spatial Services online portal.

https://www.spatial.nsw.gov.au/surveying/publications/surveyor_generals_directions

Office of the Registrar-General (ORG)

The Office of the Registrar General is responsible for maintaining NSW land title legislation and policy.

Office of the Registrar General
McKell Building
2-24 Rawson Place
Sydney NSW 2000

T: 1300 318 998

+61 2 9219 3600 - international

E: ORG-Admin@customerservice.nsw.gov.au

End of Direction