



Standard for the New Zealand survey control system

LINZS25003

21 September 2009

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Terms and definitions

For the purposes of this standard, the following terms and definitions apply.

| Term/abbreviation | Definition |
|--------------------------|--|
| BGN | basic geospatial network |
| cadastral survey dataset | as defined in the Cadastral Survey Act 2002 and submitted in terms of the rules for cadastral survey |
| CHN | cadastral horizontal control network |
| class | a categorisation of a coordinate's local accuracy; as defined in <i>LINZS25005: Standard for the geospatial accuracy framework</i> |
| CVN | cadastral vertical control network |
| datum | a particular type of reference system in which coordinates are defined in relation to a particular reference surface by means of distances or angles, or both |
| deformation | the change in shape, scale, or position of an area of land |
| DMN | deformation monitoring network |
| geodetic datum | a datum used to depict coordinates in relation to a model of the surface of the Earth. It is often implemented by the definition of a coordinate reference system and a reference ellipsoid. |
| Landonline order | a combined categorisation of a coordinate's local and network accuracy used to describe the accuracy of coordinates in the Landonline application. Landonline orders are specified in <i>LINZS25006: Standard for tiers, classes, and orders of LINZ data, section 5</i> . |
| local accuracy | a value that represents the uncertainty of a coordinate relative to other nearby coordinates; as defined in <i>LINZS25005: Standard for the geospatial accuracy framework</i> |
| major deformation event | a sudden or short-term deformation event resulting in significant surface deformation |

| Term/abbreviation | Definition |
|--------------------------------|---|
| national survey control system | a system used to determine the position of points, features, and boundaries in cadastral surveys, other surveys, and land information systems; as defined in s 4 of the Cadastral Survey Act 2002 |
| network accuracy | a value that represents the uncertainty of a coordinate relative to a datum; as defined in <i>LINZS25005: Standard for the geospatial accuracy framework</i> |
| NHN | national height network |
| NRF | national reference frame |
| official datum | a geodetic or vertical datum declared as official by the Surveyor-General |
| permanent reference mark | a mark used as a permanent reference for a cadastral survey in accordance with the rules for cadastral survey |
| rules for cadastral survey | rules made by the Surveyor-General under s 49 of the Cadastral Survey Act 2002, or any alternative requirements specified under s 47(5) of the Cadastral Survey Act 2002 |
| tier | a categorisation of a coordinate's network accuracy, as defined in <i>LINZS25005: Standard for the geospatial accuracy framework</i> |
| vertical datum | a curved or level surface taken as a surface of reference from which to determine elevations |
| witness mark | a mark used to witness a boundary point in accordance with the rules for cadastral survey |

Foreword

Introduction

- (a) A national geodetic system and its associated national survey control system are fundamental components of a nation's infrastructure. The unique property of a geodetic system is its ability to allow the integration of multiple geographically dependent data sources into a single geographic reference frame.
- (b) A survey control system comprises physical control marks and information about those marks that enables the coordinates of other points to be determined.
- (c) Sections 7(1)(a) and (b) of the Cadastral Survey Act 2002 make it a function and a duty of the Surveyor-General to maintain a national geodetic system and a national survey control system.
- (d) This standard sets requirements to ensure that control marks are established and maintained across New Zealand, its offshore islands and the Ross Sea Region of Antarctica to enable users to determine positions, orientation, and scale in terms of the official datums.

Purpose of standard

The purpose of this standard is to specify the Surveyor-General's requirements for the provision and maintenance of the national survey control system in accordance with section 7(1)(b) of the Cadastral Survey Act 2002.

Brief history of standard

This standard supersedes the following document:

LINZ 2003, *SG Standard 1, version 1.1: Accuracy Standards for Geodetic Surveys*, Office of the Surveyor-General, LINZ, Wellington

References

The following documents are necessary for the application of this standard.

LINZ 2009, *LINZS25005: Standard for the geospatial accuracy framework*, Office of the Surveyor-General, LINZ, Wellington

LINZ 2009, *LINZS25006: Standard for tiers, classes, and orders of LINZ data*, Office of the Surveyor-General, LINZ, Wellington

1 Scope

This standard prescribes the Surveyor-General's requirements for:

- (a) the location, accuracy, construction, and access to control marks within survey control networks,
- (b) the provision of information about control networks and control marks, and
- (c) monitoring official datums for the effects of surface deformation.

2 Intended use of standard

Land Information New Zealand (LINZ) must comply with this standard when providing and maintaining the national survey control system in accordance with s 7(1)(b) of the Cadastral Survey Act 2002.

3 Survey control networks

3.1 National reference frame

Each control mark in the national reference frame (NRF) must be placed in a location that enables the determination and monitoring of the spatial relationship between:

- (a) official geodetic datums and international reference systems,
- (b) official vertical datums and international height systems, and
- (c) official geodetic datums and official vertical datums.

3.2 Deformation monitoring network

Each control mark in the deformation monitoring network (DMN) must be placed in a location to enable the determination and monitoring of:

- (a) national-scale deformation caused by tectonic plate movements, and
- (b) regional- and local-scale deformation for:
 - (i) the maintenance of the deformation model used in the official geodetic datum,
 - (ii) the maintenance of the cadastral horizontal control, cadastral vertical control, and basic geospatial networks to account for gradual deformation, and
 - (iii) the re-establishment of the cadastral horizontal control, cadastral vertical control, and basic geospatial networks following a major deformation event.

3.3 Cadastral horizontal control network

Control marks in the cadastral horizontal control network (CHN) must be placed in locations to ensure that 98 % of cadastral survey datasets that include a witness mark and are submitted to LINZ, have one or more witness or permanent reference marks that achieve Landonline order 6 or better.

3.4 Cadastral vertical control network

Each control mark in the cadastral vertical control network (CVN) must be placed in a location that enables heightened permanent reference marks in cadastral survey datasets submitted to LINZ to be efficiently and accurately referenced to official vertical datums.

3.5 Basic geospatial network

Each control mark in the basic geospatial network (BGN) must be placed in a location that enables data from government-directed geospatial activities to be efficiently and accurately referenced to official geodetic datums.

3.6 National height network

Each control mark in the national height network (NHN) must be placed in a location that enables data from government-directed geospatial activities to be efficiently and accurately referenced to official vertical datums.

4 Control marks

Every control mark must:

- (a) belong to at least one survey control network, and
- (b) comply with all criteria in this standard for every survey control network to which it belongs.¹

¹ This requirement may cause some networks to be mutually exclusive.

5 Accuracy

5.1 Network accuracy

- (a) A control mark coordinate must achieve the horizontal and vertical tiers specified in Table 1 for every survey control network to which it belongs.
- (b) Local-deformation DMN control mark coordinates are only required to comply with (a) at the time the mark is surveyed by or for LINZ. Where the tier of a local-deformation DMN control mark coordinate at the time of survey differs from the current tier, the current tier must be recorded in accordance with 9(a)(ii).
- (c) The network accuracy of a coordinate must be assessed at the 95 % confidence level, as defined in *LINZS25005: Standard for the geospatial accuracy framework*, using the tier parameters defined in *LINZS25006: Standard for tiers, classes, and orders of LINZ data*.

Table 1: Survey control network tiers

| Network | Horizontal tier | Vertical tier |
|--------------------------|-----------------|---------------|
| NRF | A | A |
| national-deformation DMN | A | B |
| regional-deformation DMN | B | E |
| local-deformation DMN | C | F |
| CHN | C | n/a |
| CVN | n/a | F |
| BGN | C | F |
| NHN | n/a | E |

5.2 Local accuracy

- (a) A control mark coordinate must achieve the horizontal and vertical coordinate classes specified in Table 2 to all control marks within the specified evaluation radius for every survey control network to which it belongs.
- (b) Local-deformation DMN control mark coordinates are only required to comply with (a) at the time the mark is surveyed by or for LINZ. Where the class of a local-deformation DMN control mark coordinate at the time of survey differs from the current class, the current class must be recorded in accordance with 9(a)(ii).
- (c) The local accuracy of a coordinate must be assessed in accordance with *LINZS25005: Standard for the geospatial accuracy framework*, using the class parameters defined in *LINZS25006: Standard for tiers, classes, and orders of LINZ data*.

Table 2: Survey control network classes

| Network | Horizontal class | Vertical class | Evaluation radius (km) |
|--------------------------|---|----------------|--------------------------------|
| NRF | II | II | evaluate against all NRF marks |
| national-deformation DMN | III | IV | 300 |
| regional-deformation DMN | V | VI | 50 |
| local-deformation DMN | VII | VIII | 6 for urban areas |
| | | | 20 for rural areas |
| CHN | VIII | n/a | 0.3 for urban areas |
| | | | 1 for rural areas |
| CVN | n/a | IX | 0.3 for urban areas |
| | | | 1 for rural areas |
| BGN | VIII | IX | 0.3 for urban areas |
| | | | 1 for rural areas |
| NHN | n/a | VI | 2 |
| NOTE 1 | 'urban area' means an area where the cadastre comprises primarily class A cadastral surveys, as specified in the Rules for Cadastral Survey 2010 | | |
| NOTE 2 | 'rural area' means an area where the cadastre comprises primarily class B or class C cadastral surveys, as specified in the Rules for Cadastral Survey 2010 | | |

6 Control mark characteristics

6.1 Identification

Control marks must be easily identifiable as official monuments.

6.2 Location

Each control mark must be positioned to enable survey observations to be safely and easily collected.

6.3 Permanence

Every control mark must be:

- (a) made of sufficiently durable material,
- (b) set in sufficiently stable material, and
- (c) located in a suitable position,

so that it can reasonably be expected to survive and remain useable for at least 50 years.

6.4 Stability

Every control mark must be sufficiently stable to meet the accuracy requirements of the survey control networks to which it belongs.

6.5 Reference point

Every control mark must have a reference point that is clearly defined both horizontally and vertically.

7 Mark names

- (a) A control mark name must be unique.
- (b) If an existing survey mark is used as a control mark, that mark must retain its name.
- (c) The name of a control mark must not be misleading.

8 Network accessibility

- (a) Users must be able to easily access control marks using appropriate technology and techniques for the survey control networks to which a mark belongs.
- (b) If a control mark is below ground level, it must be accessible without causing unreasonable damage to the surface of the ground around it.
- (c) Where a beacon is installed above a control mark, the beacon must:
 - (i) be easily identifiable as an official structure, and
 - (ii) provide reference points with a known relationship to the control mark, including vertical offsets and horizontal eccentricity.

9 Survey control system information

- (a) The following information about control marks must be recorded:
 - (i) physical mark information,
 - (ii) coordinates and information about the coordinates,
 - (iii) location information,
 - (iv) beacon information, and
 - (v) protection structure information.
- (b) The information specified in (a) must be provided to users in an open format as soon as practical following the receipt of a request.
- (c) Information acquired by LINZ under 3.1 and 3.2 must be provided as soon as practical following the receipt of a request to enable other parties to:
 - (i) verify the spatial relationships and deformation rates determined by LINZ, or
 - (ii) make use of the information for other purposes.

10 Review of survey control networks

- (a) Every NRF and national-deformation DMN mark must be reviewed annually for compliance with this standard.
- (b) Every DMN mark not included in (a) must be reviewed for compliance with this standard whenever it is surveyed by or for LINZ.
- (c) Every BGN mark in the North Island, South Island, Stewart Island/Rakiura, and all islands within their contiguous territorial sea must be reviewed for compliance with this standard at least every seven years.
- (d) Every BGN mark not included in (c) must be reviewed for compliance with this standard whenever:
 - (i) it is surveyed by or for LINZ, or
 - (ii) there is reason to suspect that the provided information is no longer accurate, such as a major deformation event in the mark's vicinity.
- (e) Every CHN and CVN mark must be reviewed for compliance with this standard whenever it is surveyed by or for LINZ.
- (f) Every NHN mark must be reviewed for compliance with this standard whenever it is surveyed by or for LINZ.