Coordinate accuracy

LINZG25706

This fact sheet describes the tier, class and order classification systems that LINZ introduced on 24 May 2010 to describe the accuracy of cadastral and control mark coordinates.

Before geospatial data can be used appropriately, it is essential to understand its accuracy. To ensure that quality information about coordinates is provided in a way that is helpful to a range of users, accuracy is described using two methods: network accuracy and local accuracy. The implementation of these methods in LINZ coordinate data is formally defined in *LINZS25005: Standard for the geospatial accuracy framework* and *LINZS25006: Standard for tiers, classes and orders of LINZ data*.

Network accuracy

Network accuracy represents the uncertainty of a coordinate in relation to a datum. For coordinates in terms of NZGD2000, network accuracy is measured in relation to the geo-centre of the Earth. For NZGD2000 heights network accuracy refers to the GRS80 ellipsoid and for NZVD2009 heights the NZGeoid2009 surface.

Network accuracy can be thought of as the standalone accuracy of a coordinate or height. It provides a method of indicating the accuracy of a coordinate by a single value. Network accuracy is defined as a circular error for coordinates (latitude and longitude or northing and easting) and a linear error for heights.

The maximum horizontal error (HE) and maximum vertical error (VE) for a coordinate (at the 95% confidence level) is computed by the following equations (σ is the standard deviation of the coordinate component that is normally determined as part of a least-squares adjustment):

$$HE_{95} = \frac{2.45}{\sqrt{2}} \sqrt{\sigma_X^2 + \sigma_Y^2}$$

$$VE_{95} = 1.96\sigma_X$$

Network accuracy is described by classifications called tiers. A coordinate or height can be assigned to a tier if its horizontal or vertical error is less than the threshold for that tier.

Local accuracy

Local accuracy represents the uncertainty of a coordinate in relation to other nearby coordinates. This measure of coordinate accuracy is of most benefit to users who are interested in the relative accuracy between coordinates (for example, surveyors wanting to know the accuracy of a calculated vector between two cadastral marks).

Local accuracy is described by classifications called classes. Each class has a maximum local accuracy value that is defined by the combination of a constant term (c) and a distance-dependent term (p). The maximum error for a class (at the 95% confidence level) is given by the following equation (where D is the distance between the coordinates):

$$\sqrt{c^2 + (D\,p)^2}$$

Before a coordinate can be assigned to a class, the local accuracy must be assessed in relation to all surrounding coordinates that are of the same or higher class. Because local accuracy is most relevant to coordinates that are close together, it is normal to define a maximum radius to limit which adjacent coordinates need to be assessed. In the surveying context, this means that the relationship is tested between all marks within the radius, regardless of whether there are direct observations between them or not.

Orders

Orders are classifications used in Landonline to provide a single descriptor of coordinate accuracy. Each order has a minimum tier and class requirement that must be achieved before a coordinate can be assigned to it. Landonline orders have been established to satisfy a particular purpose (for example order 7 is for class A cadastral boundary marks). As such, the specific tier and class used for each order have been set in relation to this purpose.

Geometric coordinates, such as NZGD2000 latitude and longitude or northing and easting together with an optional ellipsoidal height, are described by orders 0 to 12. Normal-orthometric heights, such as NZVD2009, are described by orders 1V to 6V.

The orders used in Landonline, together with their composite tiers and classes, are listed in the tables at the end of this factsheet.

What has changed?

Prior to the introduction of the geospatial accuracy framework and the standard for tiers, classes and orders, the accuracy of different coordinate orders was described inconsistently by LINZ. The new classification system ensures that all coordinates and heights published by LINZ have their accuracy described in a uniform way.

The survey control mark orders (0 to 5) have not undergone major change. Under the previous classification scheme the network accuracy tolerances were specified at the millimetre level. These have now been rounded to more meaningful 5 centimetre bands. Minor changes have been made to some of the local accuracy tolerances.

The cadastral mark orders (6 to 12) have been revised to reflect the new accuracy and survey class requirements of the *Rules for Cadastral Survey 2010*. This has resulted in order 7(i) being renumbered to 7, orders 7(ii) and 7(iii) being merged to order 8, and the lower orders similarly renumbered. Horizontal tier and class requirements have now been defined for all cadastral mark orders. Previously the lower orders had no local accuracy criteria associated with them.

The height orders (1V to 6V) have undergone the largest change. They no longer indicate the method of survey to determine the height. Instead the height orders now provide an indication of the accuracy of the height they relate to.

FURTHER INFORMATION

LINZ standards, fact sheets, and up-to-date information are available on the LINZ website:
www.linz.govt.nz

Further information is available from:
Surveyor-General
Land Information New Zealand
PO Box 5501
Wellington 6145
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LINZ coordinate tiers, classes and orders

Order	Purpose	Network Accuracy				Local Accuracy					
		Horizontal Tier	Constant (m)	Vertical Tier	Constant (m)	Horizontal Class	Constant (m)	Proportional (m/m)	Vertical Class	Constant (m)	Proportional (m/m)
0	National Reference Frame	A	0.05	A	0.05	II	0.003	0.000 000 03	II	0.003	0.000 000 03
1	National Deformation Monitoring	A	0.05	B	0.10	III	0.003	0.000 000 1	IV	0.003	0.000 000 3
2	Regional Deformation Monitoring	B	0.10	E	0.25	V	0.003	0.000 001	VI	0.01	0.000 03
3	–	B	0.10	F	0.35	VI	0.01	0.000 003	VII	0.01	0.000 01
4	Local Deformation Monitoring	C	0.15	F	0.35	VII	0.01	0.000 01	VIII	0.01	0.000 05
5	Cadastral Horizontal Control; Basic Geospatial	C	0.15	F	0.35	VIII	0.01	0.000 05	IX	0.02	0.000 1
6	Cadastral permanent reference and witness marks	C	0.15	–	–	X	0.03	0.000 15	–	–	–
7	Class A Boundary Marks	D	0.20	–	–	XI	0.06	0.000 15	–	–	–
8	Class B Boundary Marks	G	0.50	–	–	XII	0.30	0.000 6	–	–	–
9	Class C Boundary Marks	K	5	–	–	XIV	1	0.003	–	–	–
10	–	N	20	–	–	XV	3	0.01	–	–	–
11	–	P	50	–	–	XVI	10	0.03	–	–	–
12 [a]	–	–	–	–	–	–	–	–	–	–	–

[a] Order 12 includes all coordinates that do not achieve the order 11 requirements

LINZ height tiers, classes and orders

Order	Purpose	Network Accuracy		Local Accuracy		
		Vertical Tier	Constant (m)	Vertical Class	Constant (m)	Proportional (m/m)
1V	National Height Network	E	0.25	VI	0.01	0.000 003
2V	–	F	0.35	VII	0.01	0.000 01
3V	Cadastral Vertical Control	F	0.35	IX	0.02	0.000 1
4V	–	G	0.50	X	0.03	0.000 15
5V	–	H	1	XII	0.30	0.000 6
6V[b]	–	–	–	–	–	–

[b] Order 6V includes all heights that do not achieve the order 5V requirements