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NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION NEWSLETTER



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GRID REFERENCE RELIABILITY

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Appearance of a problem

For every site recorded on an NZMS1 map, the Trust calculates an equivalent site number and grid reference for the metric NZMS260 map which will eventually replace it. A problem sometimes appears when sites replotted on the new maps plot on the wrong side of a road or river. In some cases, they may be displaced by several hundred metres. The largest errors clearly result from incorrectly entered NZMS1 grid references but other errors require further explanation. These and their effects are the subject of this paper.

The maps and their limitations

The NZMS1 maps are drawn on separate projections for the North and South Islands: the North and South Island Yard Grids. They are graduated in yards and are printed at a scale of one inch to one mile (1:63 360). The NZMS260 maps are drawn on a single projection, the New Zealand Map Grid. They are graduated in metres and are printed at the slightly larger scale of 1.27 inches to one mile (1:50 000).

It is impracticable to represent the true size of small features on maps of this scale. For example, the thick line representing a road 20 m wide, in fact, indicates a strip of country about 60 m wide. A site located with respect to the edge of that road would therefore be slightly displaced on the map. But this is only a small source of error.

Gross errors in map compilation

Maps are compiled in two stages. The positions of trig points are fixed on the grid and then the topographic detail is drawn around them. Because archaeological sites are usually located relative to topographical features rather than to trig points, problems can arise when there are not enough landmarks to fix the precise location of the site. But, even with abundant detail, the resulting grid references are still dependent on secondary information and it is here that the greatest sources of error can arise.

Some of the early NZMS1 maps, based on plane table mapping, which was carried out in great haste during the 2nd World War, are unreliable in parts of their detail. Some have

been revised in later editions but, on others, the earlier detail remains. Even without revision, most of the topography is accurately located to within 100 yd but, for reasons that are not always apparent, much larger errors can be encountered. The topographic detail on the Palliser sheet (N168-169) for example, is shifted up to 400 yd relative to the trig points when compared to the NZMS260 sheet. Fortunately such errors are rare, and are usually unimportant when only one map edition is used. But problems can occur when a grid reference derived from an early map is used on a later, corrected, edition or to calculate the equivalent position on another map projection.

What is a grid reference?

The convention for defining the position of a point on a map grid is to state its distance, along two axes, from the grid origin. These distances are expressed as the easting and northing, and together define the co-ordinates of the point on the grid. The co-ordinates of the corners of each map sheet are printed in full at the end of the grid lines and are continued, in abbreviated form, along its edges.

Contrary to popular belief, a grid reference actually defines a square on the map grid, not a point on the ground. The NZAA site recording scheme uses the most precise grid reference appropriate to its maps; defining a 100 yd square on NZMS1 maps or a 100 m square on maps of the NZMS260 series. Those squares, if drawn on the maps, would be of 1.6 mm and 2.0 mm sides respectively.

The normal convention for quoting a grid reference for NZMS1 and NZMS260 maps uses only the middle three digits of the easting and northing, as the following example shows.

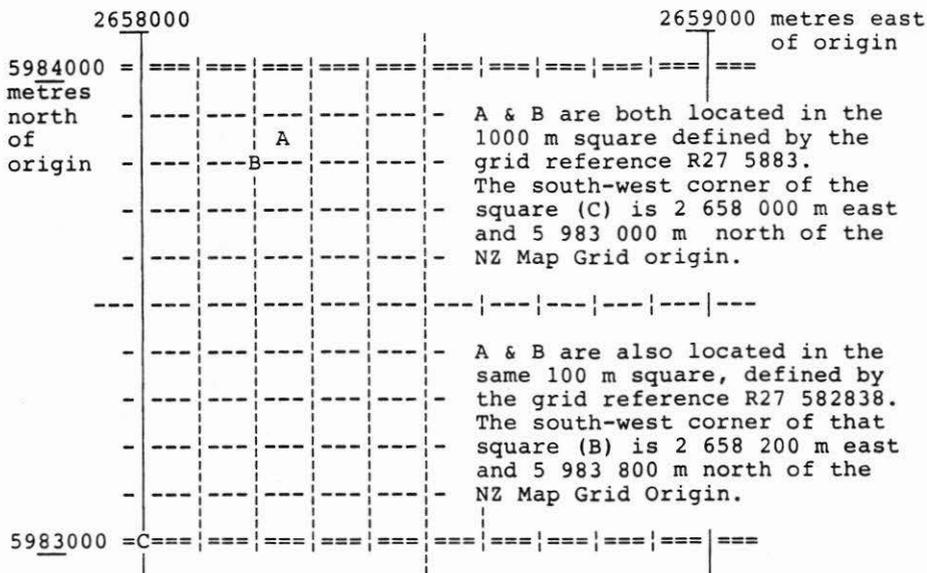
North Island Yard Grid co-ordinates	Map sheet	Grid reference
E <u>461200</u> N <u>513200</u>	N78	N78 612132
NZ Map Grid co-ordinates	Map sheet	Grid reference
E27 <u>48300</u> N64 <u>46500</u>	T12	T12 483465

In its abbreviated form, each easting and northing is repeated every 100 000 yd on NZMS1 maps and every 100 000 m on NZMS260 maps. For this reason it is essential to identify the map sheet.

The customary presentation of grid references by the Trust is to state the full easting and northing. This is done to simplify the computer retrieval of site records that might relate to any part of the Country.

Figure 1: The meaning of map grid references

(Example based on NZMS260 map R27)

Notes on Figure 1

- On actual NZMS260 maps,
 - the 100 m lines are not shown.
 - the full co-ordinates are shown only at the map corners.
 - the numbers printed by each grid line are those underlined in Figure 1.
- A similar example, graduated in yards applies to NZMS1 maps.
- From Figure 1, it can be seen that:
 - The last whole number in an easting and northing gives a position to the nearest metre, the next to the nearest 10 m and so on.
 - The grid reference defines the south-west corner of the smallest usable grid square in which the site lies. It does not indicate the co-ordinates of the centre of the site. The smallest usable square on a NZMS260 map has 100 m sides and is estimated from the 1000 m grid squares drawn on the map.
 - A site positioned on a vertical grid line is included in

the square to the east and a site positioned on a horizontal grid line, included in the square to the north. It therefore follows that, if the site is slightly west or south of a grid line but given a grid reference as if it were on the grid line itself, the reference will position the site in the square to the east or north of the correct square.

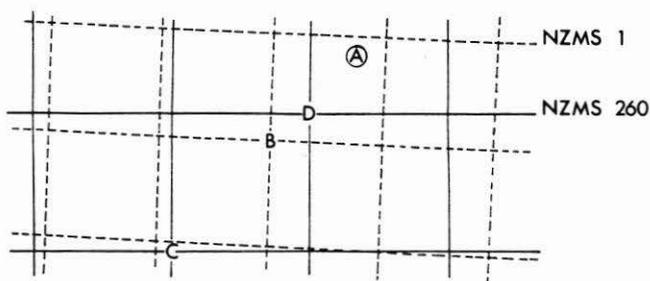
(d) An NZMS260 grid reference provides an adequate location on a 1:50 000 scale map but can cause problems on maps of larger scale. If, for instance, a site is to be marked on a cadastral map scaled at 1:10 000, its location should be indicated by drawing the 100 m square that the grid reference represents.

Accuracy of grid reference conversions

The Trust's computer programs convert NZMS1 (North or South Island Yard Grid) references to their NZMS260 (NZ Map Grid) equivalents and from NZMS260 to NZMS1. They have been tested with data selected by the Dept of Lands and Survey, to represent the central and extreme positions of each grid. With co-ordinates defined to the nearest yard or metre, the programs show an accuracy of +2 m in every case, with most examples providing a result within 1 m of the true equivalent. This provides a level of accuracy greatly exceeding that of the data being converted, and so has negligible effect on the accuracy of grid reference conversions.

To produce a result that more suitably reflects an equivalent to the grid reference being converted, the results are normally rounded down to the nearest 100 yards or metres.

Figure 2: Displacement of calculated grid references



Note Grid differences are exaggerated for clarity of illustration. The angular displacement results from the different projections on which the maps are based.

Because the NZMS1 and NZMS260 grid squares are of different size, there is a constantly changing overlap across the grids. Figure 2 shows a situation in which there is an extreme effect on the calculation of an equivalent NZMS260 (metric) grid reference to a site at A. The site is in the north-east corner of the 100 yd (NZMS1) square, defined by the co-ordinates of B. On the NZMS260 map, the square containing B is defined by the co-ordinates of C when, in fact, the site should be in the metric grid square defined by D. The calculated metric grid reference is 100 m west and 100 m south of the correct grid reference. A similar effect can occur when an NZMS260 grid reference is converted to NZMS1.

Conclusions

- (1) A grid reference determined from an NZMS1 or NZMS260 map will usually locate a site on the ground to within 100 yd or 100 m. Greater displacements can arise from errors in the topographic detail of NZMS1 sheets, but such errors are rare.
- (2) An NZMS260 grid reference calculated from an NZMS1 grid reference can be 100 m west and 100 m south of the true equivalent. This should locate a site on the ground to within 200 m and, in most cases, within 100 m depending on the overlap of the metric and yard grids in the vicinity of the site. The same level of confidence, expressed in yards, will also apply to an NZMS1 grid reference calculated from NZMS260 data.
- (3) The position of a site within a 100 yard or metre grid square is only important if it needs to be shown on a map of much larger scale. In this case, the area defined by the grid reference can be indicated by representing the 100 yard or metre square on the larger scale map.