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GOOD SURVEY PRACTICE

1. Forward

With respect to cadastral surveying, **good survey practice** allows cadastral surveyors to utilise their skill and experience to define boundaries and other interests in land by attributing the correct weight to all of the elements in the hierarchy of evidence.

In establishing positions for boundaries and other interests, the cadastral surveyor must have regard to, but not be restricted by, accepted survey and other principles, such as:

- the law
- working from the whole to the part
- consideration and evaluation of errors in historic and current work
- minimising gaps and overlaps in the cadastre

The test of **good survey practice** will always be that when faced with the same evidence to define a boundary or boundary point, most experienced cadastral surveyors will define the same, or very nearly the same, position for a boundary or boundary point.

2. Evidence Gathered

2.1 Cadastral Record

Sound definition of existing parcels relies on the researching of plans and diagrams, hardcopy field notes or electronic field files and reports, traverse and calculation sheets, electronic databases, and GIS records of the cadastre.

2.2 Legal Record

Similarly, sound definition also relies on the researching of title records, documents associated with the title, and court records.

2.3 Non-Cadastre Records

Particularly in situations of conflict, it may be necessary to assess non-cadastre evidence such as (but not limited to) the oral narrative, affidavits, photography & imagery, reports, other datasets, GIS records.

3. Observations

3.1 Origin

An origin of survey is a test for conflict of scale and rotation and consists of the vector observations between a minimum of three old marks, located as close as possible to the area of survey, and that should ideally extend across the area of survey.

3.2 Old Marks

As old boundary and non-boundary marks are the most common basis of redefining the boundaries of underlying and adjoining parcels, it is necessary to search for those in close proximity to the area of survey.

3.3 Reliability

While it is common to assess mark reliability in terms of the mathematical accuracy standards in force at the time of old mark placement, it is more accurate to define reliable as:

- a survey mark or evidence of a survey mark that remains in its original relative position to the ground in which it was emplaced.

3.4 Record

Hardcopy field notes and electronic field files need to reference the equipment used, the date of observation, information relevant to derived or reduced values, be an accurate, clear and unambiguous record of observations undertaken, including a graphical representation of survey marks used, allotment boundaries and references, and occupation adjacent to new boundary marks and their radiating boundaries. Any derived or reduced values included in the record need to be clearly identifiable as such.

3.5 New Marks

To minimise observation and calculation errors, new marks should be emplaced as close to vertical as possible. Non-boundary marks have been shown to have higher survival rates over time when buried.

3.6 Vectors

The survey component of the cadastre is largely based on vectors comprised of a bearing and a distance, and the equipment and techniques utilised need to match the accuracies to be achieved.

3.7 Time

All surveys are a snapshot of the physical situation at a single point in time. In many cases that physical situation will change over time (particularly with regard to water boundaries), while it is also possible for some actions to be time dependant (eg: adverse possession).

3.8 Reduced Levels

After about 1970 it became more common for cadastral surveys to also include a height dimension to reflect the vertical extent of the cadastre. These are of course subject to similar monumentation, origin, and recordings of observation as applicable to the vector component of the survey, and the equipment and techniques utilised need to match the accuracies to be achieved.

4. Spatial Extent

4.1 Conflicts

The identification and resolution of conflict is an important aspect of definition and identified conflicts must be resolved before definition can be finalised.

The most common conflicts are adopted bearing adjustments resolved using the ray trace method, and scale adjustments resolved using pro-rata or Bowditch techniques.

There are several other reasonably common conflict situations for which guidance material is available:

• erosion and accretion	- Summary of the Law Relating to Land Surveying in New Zealand (Kelly) - The Surveyor and the Law (NZIS) - Law for Surveyors (Dept of Surveying - University of Otago/NZIS)
• earthquake	- Practice Guidelines for Cadastral Surveying in Areas Affected by Ground Movement Caused by Earthquakes in Canterbury (ICS/NZIS)
• limited as to parcels	- Edmonds v Lauder (CIV-2012-412-000926 [2013] NZHC 2770)
• adverse possession	- Summary of the Law Relating to Land Surveying in New Zealand (Kelly) - The Surveyor and the Law (NZIS) - Law for Surveyors (Dept of Surveying - University of Otago/NZIS)

4.2 Definition

The determination and description of the spatial extent of interests is in relation to the adjoining parcels, based on the evidence available and the hierarchy of evidence. The hierarchy of evidence can generally be considered as follows:

- natural boundaries
- monumented lines (original marks)
    - old original reliable boundary marks
    - old original reliable non-boundary marks
- occupation – old and undisputed (including on abuttals)
- abuttals
- measurements – mathematical evidence of position

with consideration also to:

- historic observation records (plan information and field notes)
- historic calculations and graphics records (file information if available)

The priorities given are not absolute but provide a guide where two or more types of conflicting evidence is available. In some instances of conflict, the value of occupation may increase in importance.

It should be noted that where dataset requisitions by the regulator may offer guidance on the resolution of the requisition, an assessment as to whether that guidance provides new definition evidence also needs to be made.

5. Dataset of Cadastral Survey

5.1 Survey Report

The survey report needs to be comprehensive, explaining how the various elements of the dataset of cadastral survey were undertaken and combined.

5.2 Observation Record

The observation record forms a vital part of the dataset of cadastral survey and should always be lodged with the regulator. The observation record has the highest ranking of documentary records in the hierarchy of evidence, and in many instances, reference to the observation record is the only way to resolve a conflict.

5.3 Calculations

To avoid incorporating prior adjustment errors into calculations, it is advisable to undertake all calculations within the dataset using a single originating coordinate.

Calculations for definition purposes should embrace the concept of working from the whole to the part and use closed circuits of observed vectors wherever possible. All other calculations in a dataset should have a clear and obvious purpose.

5.4 Diagram of Survey

The diagram of survey is a graphical representation of how a cadastral survey was undertaken, and effectively replaces the Survey Plan under the 1972, 1998 and 2002 survey regulations.

As far as practicable, diagrams should be clear and consistent, while where it is necessary for multiple diagrams, these should be presented in a logical sequence and not unnecessarily fragmented causing a loss of context of the information presented.

5.5 Diagram of Parcels

The diagram of parcels is a graphical representation of why a cadastral survey was undertaken, and effectively replaces the Title Plan under the 1972, 1998 and 2002 survey regulations.

As far as practicable, diagrams should be clear and consistent, while where it is necessary for multiple diagrams, these should be presented in a logical sequence and not unnecessarily fragmented causing a loss of context of the information presented.

Further, the diagram of parcels should be drawn with consideration towards a non-survey audience, such as Council officers, the land owner and their legal representative.

5.6 Other Diagrams

Other diagrams required for a dataset of cadastral survey should be fit for purpose, should be clear and consistent, while where it is necessary for multiple diagrams, these should be presented in a logical sequence and not unnecessarily fragmented causing a loss of context of the information presented.

6. Quality Assurance

6.1 General

Good quality assurance starts in the field with redundant observation and clear observation records, continues in the office with a comprehensive report, clearly recorded calculations, and clear graphical records.

All datasets of cadastral survey should undergo internal audit by the cadastral surveyor using a documented quality assurance process before lodgement with the regulator. Such auditing should be recorded in suitable formats and be made available to the regulator on request.

General Notes:
While integration is outside the scope of good survey practice, the regulator introduced mandatory lodgement for the dataset of cadastral survey for approval as to survey using the electronic *Landonline* system in mid-2007. This had the effect of transferring much of the integration of the cadastral survey into the cadastre from the regulator to the cadastral surveyor.

Concurrent with the regulator's introduction of electronic methods of managing the cadastre, the concept of the coordinate cadastre was developed to provide unique electronic spatial locations for individual pieces of data captured. It should be remembered that this electronic spatial location may not reflect the actual physical spatial location of the referenced data, and such coordinates do not form part of the hierarchy of evidence.

The coordinate cadastre utilised by the regulator's electronic cadastre management system has the effect of requiring datasets of cadastral survey to conform to the bearing orientation used in the cadastre management model. This orientation should not be confused with a cadastral survey origin requirement, which are a test for ground movement or dataset of cadastral survey conflicts.

Integral to the regulator's electronic cadastre management system is the pre-validation function. While this offers some assistance across the dataset of cadastral survey and integration functions, this should only be utilised as one component of a cadastral surveyor's internal audit for good survey practice purposes.

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This document is an output from an ICS Project and is published to the wider cadastral surveying community. Please provide any feedback or comments to: sec@ics.org.nz
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