

GOOD SURVEY PRACTICE

1. Surveying

1.1 A Definition

The art and science of surveying relates to the capture of measurements, and completion of computations to determine the configurations and positions of features on the earth's surface, and represent those features on maps, plans, and digital databases. [Mueller and Ramsayer abridged].

Surveyors also actively provide services in property location; construction and engineering surveys; control surveys; land planning; subdivisional design; mining, industrial, and hydrographic surveys [from Mueller and Buckner]. In more recent times, Surveyors can be involved with laser scanning surveys; global navigation satellite system (GNSS) positioning surveys; geographic information systems (GIS); and building information modelling (BIM) et al.

Cadastral surveying is the discipline of land surveying that relates to the laws of land ownership and rights, and the definition of property boundaries.

1.2 Good Survey Practice

With respect to cadastral surveying, **good survey practice** enables 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 principles, such as:

- the law
- working from the whole to the part
- using appropriate techniques and methods
- scientific honesty – accurate recording of observations
- evaluation of errors (understanding the error budget) in historic and current work
- incorporating checks – for verification of observations and redundancy
- leaving the cadastre in no worse state
- ensuring subsequent cadastral surveyors can readily utilise the information within the dataset of cadastral survey

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.

1.3 Duty of a Cadastral Surveyor

The Rules for Cadastral Survey (2010) and subsequently the Cadastral Survey Rules 2020 indicates that when defining a boundary by survey a cadastral surveyor must:

- gather all evidence relevant to the definition of the boundary and its boundary points;
- interpret that evidence in accordance with all relevant enactments and rules of law; and
- use that evidence to determine the correct position of the boundary and boundary points in relation to other boundaries and boundary points.

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, survey 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 and imagery, reports, other datasets, and GIS records.

2.4 Field Evidence

Sound definition also relies on field observations of existing occupation, structures, road alignments, infrastructure, and of course, old marks. These may have overriding authority in decisions about cadastral boundaries. No boundary decisions should be made without a serious evaluation of ground evidence.

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 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 Observation 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. Also, 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.

Guidance material is available for common conflict situations – where boundary definitions are impacted by factors such as:

- the effects of erosion and accretion
- the impact land movement due to earthquakes and slow slips
- limitations as to parcels
- claims of adverse possession

[A table including some example reference material for the above conflict situations is included within Appendix Section A.]

4.2 Definition

The determination and description of the spatial extent of interests is in relation to the adjoining parcels and is based on the observational and other information available, and the hierarchy of evidence.

The hierarchy of evidence can generally (although not always) be considered as follows:

- natural boundaries
- monuments
- occupation
- abuttals
- measurements

The priorities listed are not absolute but rather a guide, while particularly 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 should also 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 an important part of the dataset of cadastral survey and should always be lodged with the regulator. The observation record may present 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 landowner 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.

This document is a product of a 2018 ICS Project and has been published to the wider cadastral surveying community. Contributing parties were:

- *ICS Members*
- *NZIS – Cadastral Stream*
- *LINZ – Office of the Surveyor-General; Survey and Title Operations*
- *Otago University – School of Surveying*
- *Cadastral Surveyors Licensing Board*

Please provide any additional feedback or comments to: sec@ics.org.nz

Bibliography:

- Department of Surveying
Otago University
- Law for Surveyors
- Institute of Cadastral Surveying and
NZ Institute of Surveyors:
- Practice Guidelines for Cadastral Surveying in Areas Affected
by Ground Movement Caused by Earthquakes in Canterbury
(2016)
- Kelly E.M.:
- Summary of the Law Relating to Land Surveying in New
Zealand (4th Edition 1971) Hutcheson, Bowman &
Stewart Ltd, Wellington
- Land Information NZ:
- Rules for Cadastral Survey 2010 (LINZS65003) Amended
2012
Cadastral Survey Rules 2020
- Mueller I.I and Buckner R.B.:
- Paper presented at the General Assembly of the
International Federation of Surveyors (Washington
D.C) 1974
- Mueller I.I. and Ramsayer K.H.:
- Introduction to Surveying (1979) Frederick Ungar
Publishing Co. New York
- NZ Institute of Surveyors:
- The Surveyor and the Law (1984). Editor J.A. McRae
- NZ Institute of Surveyors:
- Land Title Surveys in New Zealand (1987) and also on-line
<https://landtitlesurveynz.org/>

Case Law:

- Edmonds v Lauder (CIV-2012-412-000926 [2013] NZHC 2770)
- application of Act to limited certificate of title
 - derogation from principle of indefeasibility
- Southern Agriculture Ltd v RGL & Anor (CIV-2008-485-1013) NZHC
- importance of clear boundaries to farms
 - limited as to parcels
 - practical resolution

Appendices:

Section A - General Notes Related to this Document:

a. Document Purpose

The intention of this document is that it should remain a high-level concept of “Good Survey Practice”, include reference to the basic survey principles, and be widely distributed and endorsed by the cadastral survey profession.

The inclusion of references to guidance material, explanatory notes, and feedback comments are retained so that the parties reviewing this current version are exposed to the consensus of views of all contributors.

b. Data Integration

While integration is outside the scope of good survey practice, the regulator (Land Information NZ) 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 alone do not form part of the hierarchy of evidence, although they may inform the hierarchy of evidence.

Integral to the regulator’s electronic cadastre management system is a pre-validation function. This is designed to be a quality assurance system for the purposes of the integration function of the regulators electronic cadastre management system and is not a substitute for a cadastral surveyor’s internal audit of the dataset of cadastral survey for good survey practice purposes.

c. Conflicts – Guidance Material

Reference to these publications and case law is not necessarily an endorsement of the information therein, nor an endorsement of a legal decision. Therefore, users should consider other information sources, and use discretion in interpreting these guidance documents.

<ul style="list-style-type: none"> • erosion and accretion 	<ul style="list-style-type: none"> - 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) - Land Title Surveys in New Zealand (NZIS)
<ul style="list-style-type: none"> • earthquake 	<ul style="list-style-type: none"> - Practice Guidelines for Cadastral Surveying in Areas Affected by

	<p>Ground Movement Caused by Earthquakes in Canterbury (ICS/NZIS)</p> <p>- Land Title Surveys in New Zealand (NZIS)</p>
<ul style="list-style-type: none"> • limited as to parcels 	<ul style="list-style-type: none"> - Land Title Surveys in New Zealand (NZIS) - Edmonds v Lauder (CIV-2012-412-000926 [2013] NZHC 2770) - Southern Agriculture Ltd v RGL & Anor (CIV-2018-485-1013) NZHC
<ul style="list-style-type: none"> • adverse possession 	<ul style="list-style-type: none"> - 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) - Land Title Surveys in New Zealand (NZIS)



Section B - Relevant Feedback Comments:

During the evolution of this document, relevant feedback has been provided which offers a more informal commentary on “Good Survey Practice”. The comments are reproduced as follows – without attribution – in order to present an insight into contributing survey practitioner thoughts and views:

- *Good Survey Practice is a critical component that will help maintain the integrity of the cadastral survey system in NZ, whilst introducing a benchmark for (perhaps) professional standards with respect to definition presentations. This, in the absence of robust young practitioner training and mentoring, in conjunction with a mechanical plan examination process that appears to rely solely on mathematical integration acceptance tests and rules.*
- *Good Survey Practice is largely about training, how to interpret records and experience. It is most likely that inexperienced LCS’s have differing views because they lack that experience. But I would suggest that as more training and experience is gained in NZ cadastral surveying, then views of experienced practitioners will generally converge. That does not mean there are not some very difficult definitions where there are multiple options, but generally most experienced surveyors would be able to eliminate some/most options.*
- *Good Survey Practice is also about Leadership in cadastral survey matters. This is about defending and promoting Good Survey Practice in the course of your work with others, and from other jurisdictions (eg Multi-disciplinary meetings, defending incorrect requisitions, Court appearances, Press releases). A lack of statutory recognition of Good Survey Practice (in the Rules), and lack of commitment to research and uphold Good Survey Practice by the Regulator, often in situations of conflict (between surveyors, in the plan approval function, or in the Courts) can lead to expensive and time-consuming outcomes, in compromised Court decisions or a lack of efficiency in the cadastre. In practice (and because of the Crown’s ongoing interests in the Guarantee of Title, and as Custodian of the Cadastre), verification of the Licensed Cadastral Surveyor’s boundary definition should be confirmed by experienced staff in LINZ.*
- *I have always considered “good survey practice” as being more than “good practice”. Good survey practice is how you leave your survey; the marks in the ground, the fieldwork, the definition and the plans; for the next surveyor who follows after you.*
- *I think there is a distinction between good survey practice (in its entirety) and what could be considered all the little things that make up good practice or best practice. Good survey practice ultimately leads to the best position for a boundary, for the client/s and public, and downstream users of the information.*
- *The survey profession will benefit from such an industry driven and published guide. Cadastral Surveyors should be able to use it to produce quality work that other surveyors, land tenure managers and users of cadastre can rely on. It should also reduce surveyors’ risk of failure to meet regulatory requirements (legislation, case law, common law, rules etc).*
- *Good Survey Practice can’t ‘align’ with regulatory requirements – it’s a higher level than that.*
- *Good Survey Practice in my view (although it has something also to do with good or best practice) is also something bigger. It is ultimately about taking all the vagaries of*

the NZ survey and titles system and coming to a determination of boundary, based on the hierarchy of evidence (having followed also good or best practice to evaluate options). I suspect there is no parallel in other professions, or perhaps other jurisdictions. Cadastral surveyors have an “individual” licence to practice (as it should be), and it would be inefficient and uneconomic to have a committee meeting to decide every boundary definition. That does not mean that surveyors do not discuss definition with peers or as part of their QA process.

- *Good Practice and Best Practice - Good practice and best practice are terms used frequently in New Zealand documentation, but are generally not defined. This may be because good practice and best practice vary depending on the context in which they are used.*

Good practice and best practice can be generally defined as follows:

- *Exercising good practice involves carrying out a function or activity using approved or recommended methods. Good practice is a ‘proper’, usual, or generally accepted way or ways of carrying out a function or activity within an industry or profession. Good practice is not necessarily the best method of carrying out a function or activity, but it is proven methods to obtain satisfactory results.*
- *Best practice is a method of carrying out a function or activity that produces results superior to those achieved with other means. Best practice is not necessarily utilised throughout an industry or profession; it can be developed by one organisation as a result of learning, analysis and experience, and can provide an organisation with a competitive advantage.*

Over time, if best practice becomes widely recognised it can become good practice.

- *Where Good Practice or Best Practice gives rise to ambiguity or a lack of clarity, Good Survey Practice will often give rise to practical solutions with least adverse consequences, or by minimising un-intended consequences, to all parties and the cadastre (including the Crown and other surveyors).*
- *With regard to the hierarchy of evidence, the courts (Chief Executive LINZ v Te Whanua o Rangiwahakaahu Hapu Charitable Trust [2013] NZCA 33) have noted:*
 - *“The hierarchy of evidence is a guide rather than a straitjacket. The hierarchy places the greatest weight on the points on which the parties were least likely to be mistaken at the time. If the circumstances make it clear that a piece of evidence further down the hierarchy is a more reliable indication of the parties’ intention, then it may take precedence”.*