PROTECTING THE INTEGRITY OF VICTORIA'S CADASTRE – MANAGING THE RISKS

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KEYWORDS

Land Surveying, Integrity of Cadastre, Regulation of land surveying

ABSTRACT

Land Surveying is not an exact science. Establishing title boundaries, or re-establishing them, is at least as much about the law, its interpretation and the gathering of evidence as it is about measurement and position fixing. It is often said that land surveying is more an art that requires competence, experience and judgement.

Whilst government guarantees title, it does not guarantee boundaries. Underpinning the legal registration of land is the spatial framework provided by land surveyors. It is largely through this spatial framework that the land registration system has been able to minimise land boundary disputes.

There are various levels of protection built into the systems that regulate the management of the cadastre and changes to it. Cadastral systems ensure that the title boundaries are correct, that the fundamental database is robust and that the parcels fit together (rather like a completed jigsaw).

Since the 1860s, Victoria has regulated land surveyors and licensed them to undertake cadastral surveys. Victoria continues to examine all survey plans submitted to its Land Registry (Land Titles Office). In recent years, the level of examination has been reduced. The reduction in the level of examination has resulted in the Surveyor General's audit program.

The Reform of Land Surveying in Victoria project has focussed on both the regulation of surveying and surveyors. An underlying principal of this project has been the protection of the integrity of Victoria's cadastre. In addition, Victoria is pursuing a reform agenda that will see land surveyors be held more accountable for their outputs.

This paper examines Victoria's approach to the quality assurance and risk management of its cadastre. Changes to the regulatory system arising from the new Land Surveying Bill will also be addressed.

INTRODUCTION

To the broader community, the cadastre is largely either unknown or not understood. In mid-2001, a number of prominent Australian and Victorian politicians were asked by a journalist on public affairs radio to discuss the cadastre. Not surprisingly, their respective knowledge was limited to the definitions to be found in dictionaries.

Surveyors and land registration professionals consider the cadastre as the public register or collections of registers that hold information about land, including tenure, ownership, spatial relationships, interests (rights and restrictions) and valuation. The spatial component of the cadastre is provided by land surveyors, whose surveys provide the reliable spatial framework defining all land parcels. It is the spatial component of the cadastre that describes the size and extent of a land parcel and its spatial relationship with other parcels of land, roads and natural features, including rivers. Also included are relevant interests such as some easements and covenants. This spatial component includes the physical infrastructure (that is, the survey marks and monuments) as well as the records of the survey. Government registers this information, and has overall responsibility for maintaining a comprehensive and accessible information management system for the spatial cadastre. In addition government has responsibility for the regulatory framework for all land surveys.

Land surveying is not an exact science. Rather, establishing title boundaries, or re-establishing them, is at least as much as about the law, its interpretation and the gathering of evidence as it is about measurement and position fixing. It is often said that land surveying is more an art that requires competence, experience and judgement.

Community and investor confidence in the cadastre is essential for a robust land market throughout Australia. The Victorian economy is underpinned by the property market, which depends on the cadastre for its successful operation. The Victorian land property market, currently valued at almost $500 billion with an annual turnover of $25 billion, is worth more than three times the Victorian gross domestic product (GDP). Much of our social interaction, cultural values, cohesion and community development is also underpinned by the cadastre.

Whilst government guarantees title, it does not guarantee boundaries. Underpinning the legal registration of land is the spatial framework provided by land surveyors. It is largely through the regulation of the spatial framework of the cadastre that government has been able to effectively manage the risks to the cadastre, thereby minimising property disputes.

INTEGRITY OF THE CADASTRE

The spatial cadastre supports Government policy for land tenure and land taxation, and provides security of title in land by maintaining an accurate record of lodged interests in land which underpins Government's guarantee of title. It maximises the ability to identify a land parcel with certainty by providing a technical surveying framework and minimum technical standards for cadastral surveys and enabling a mechanism to determine boundaries and resolve boundary disputes. The current cadastral systems are driven by a societal dependence and need for sound and secure information on land.

Government's guarantee of title is a guarantee of ownership, rights and restrictions in relation to a described parcel of land; it does not guarantee the extent or boundaries of that parcel. Therefore successful cadastral systems underpin the community's confidence in the spatial cadastre to which the Titles Register refers. The integrity of the cadastre relates not only to the community's confidence that all registered owners and interests are correct, but also to their confidence that the boundaries of all land parcels are correct and that errors are rare exceptions. In the event that there are errors, an effective system for fixing the errors is required.

Land surveyors are central to the Victorian cadastre and land registration system due to the nature of the information they record. Land surveyors provide the spatial definition that links land title information such as ownership, rights, restrictions, valuation and improvements which underpins the Victorian land registration system. Such information is critical if land parcels are to be identified with certainty and the government is to provide security of title in land, and therefore the indefeasibility of title, by maintaining an accurate record of registered interests.

It is in the interests of the community as a whole that the integrity of the State's cadastre is maintained. Responsibility for this is primarily borne by the Government. However, due to the nature of the land surveyor's role in creating and updating the spatial cadastre they also share this responsibility. All boundaries surveyed by a land surveyor define a boundary between at least two unique parcels and that information is stored for reference for future surveys. A surveyor acts as an agent for the Government in creating this ever-increasing spatial database.

RISKS TO THE CADASTRE

In the late 1800s, there were three Victorian Royal Commissions that investigated and reported on various concerns related to land surveying, land titles and land administration. In one way or another, each of the Royal Commissions arose from serious degradation of the Victorian cadastre.

The ability of Government to maintain the integrity of the cadastre requires the identification of the possible risks to the cadastre and the implementation of strategies to minimise these risks. The risks are many and varied and may include:

- Deliberate or accidental boundary errors in records or as marked on the ground
- Incorrect interpretation and application of evidence by surveyors
- Fraud, negligence and incompetence
- Ineffective or inappropriate governance
- Lost, damaged or ambiguous information in government registers.

The magnitude of the consequences of the respective risks is also very broad. At the minimalist end, the consequence may be a minor error to the marking of a boundary on the ground. Conversely, the construction of a high-rise building on high-value land in the central business district of Melbourne, which encroaches onto an adjoining land parcel, could potentially result in damages of tens of millions of dollars. Surveyors throughout Australia can recount many anecdotal tales in this regard.

More often the consequence of an erroneous survey is the necessity for an amendment to title or re-issuing of correct title. This alone may be a costly and time consuming process. In addition compensation may also be payable, possibly after long protracted legal or mediation processes.

The more obvious risk associated with the spatial cadastre is that of boundary errors. Such errors are evident when register information contained in such documents as survey plans and titles do not correspond to physical monuments or marking on the ground. The error source can be either the physical monumentation or the recorded information. Errors in boundary definition create a risk to the possessory rights of the community in the form of possible disputes and litigation surrounding parcel ownership.

In Victoria, adverse possession claims are not uncommon in older areas with long established occupation. Generally they arise from a discrepancy between occupation and the title boundary where after a period of at least 15 years an adjoining owner may wish to formalise possessory rights which may have been acquired.

The examination and subsequent registration of a plan by the Government's Land Registry (Titles Office) should not absolve a surveyor from his or her accountability for error. As is often the case, errors may not be detected for many years or decades and may ultimately require a correction to title at the expense of government. In the case of Crown boundaries, or former Crown boundaries, the Victorian Surveyor General may make determinations to correct errors and provide direction to the Registrar of Titles.

Over many decades, the Land Registry has provided a very comprehensive survey examination system. Requisitions issue to surveyors without any associated financial penalty and comprehensive instructions for corrections are provided. For some surveyors, this created an opportunity to use the Land Registry as their primary means of quality assurance. With the reduced level of examination, this has exposed the cadastre to greater risk from such surveyors whose errors may go through undetected. All Victorian surveyors are aware of the Government's reliance on their professional competence and integrity.

Erroneous boundary definitions can result from an action of fraud or from negligence, incompetence, unprofessional conduct or even professional misconduct by land surveyors. If regulation of surveyors and surveying is ineffective or inappropriate then these activities may occur, creating risks to the cadastre.

Since the 1860s, the Victorian Government has regulated to some degree, entry into the surveying profession. However, as evidenced by the first Royal Commission in 1870 which examined the standards of surveys being performed, these early regulations were failing and therefore putting the integrity of the cadastre at risk. In response to the Royal Commission, in 1873 Victoria introduced its first regulations specifying minimum requirements for surveying practice and standards.

The present form of occupational regulation of land surveyors in Victoria came about as a result of the 1885 Royal Commission on Land Titles and Surveys in Victoria because of the failure of a poorly regulated market in delivering reliable surveying services.

Surveying regulation aims to minimise the risk to the cadastre by ensuring that only competent surveyors define land boundaries and effect changes to the cadastre.

The 1885 Royal Commission found that the surveys made in the early days of the colony were extremely faulty and unreliable and that the survey methods used perpetuated and even magnified errors in the original surveys. The Commission recommended that licences to practice as surveyors only be granted on recommendation of the Board of Examiners and that inspecting surveyors be appointed to check the accuracy and marking of surveys.

Currently, Victoria surveyors are licensed for life and there are no mandatory legislative requirements for maintenance of competency or continuing professional development (CPD). A large number of surveyors chose to undertake professional development programs offered by the Institution of Surveyors, Victoria (ISV) and the Association of Consulting Surveyors, Victoria (ACSV). Those surveyors who do not maintain their competency, especially an awareness of current government regulations, pose significant potential risk to the cadastre.

The Surveyors Act 1978 and its associated regulations and administrative directions provide the regulatory framework for land surveyors. Unfortunately, there are significant deficiencies which inhibit the Surveyors Board from effectively dealing with some elements of discipline, especially in the area of professional misconduct.

A reliable cadastre relies on robust surveying infrastructure. Any weakness or degradation of the surveying infrastructure creates greater opportunity for errors and inconsistencies. Land surveyors must be able to depend on the accuracy and integrity of the infrastructure in order for their surveys to support the integrity of the cadastre as a whole.

All risks to the integrity of the State's cadastre ultimately impact on the community's confidence in the entire land registration system. Disputes or litigation as a result of errors in the cadastre may expose Government to liability and impede on Government's ability to guarantee title. Confidence in the Victorian land and property market is essential for investment and economic growth. Therefore the risks to the cadastre must be minimised through taking the necessary preventative, investigative and rectification actions to ensure that the community's confidence in the cadastre is justifiably preserved.

The management of Victoria's cadastre in the 21st century must continue to heed the lessons of the 1870s and 1880s.

MINIMISATION OF RISK

Victoria continues to examine all survey plans submitted to its Land Registry. However, in recent years Victoria has reduced its level of examination. This has largely been as a result of government restructuring and down sizing. Whilst all plans are still examined when lodged, the level of checking is significantly less than in the past and relies on the competence and integrity of the licensed surveyor. As a consequence, the Surveyor General commenced an independent survey audit program in 1995.

The Government is responsible for regulating land surveyors and land surveying practice to ensure that the information submitted by licensed surveyors to the Land Registry does not diminish the quality of the cadastre. The occupational regulation of surveyors through the Surveyors Board of Victoria is the means by which the Government has traditionally sought to ensure this objective. However, occupational regulation can not of itself ensure the quality of the inputs to the cadastre. Current arrangements in Victoria do not allow Government to determine if the system is in fact working well and delivering those outcomes for which regulation exists.

The inability of the current system to deliver a practical understanding of the real level and nature of errors and omissions made by the profession has lead to the Victorian Government adopting a risk management approach by auditing cadastral surveys beyond legislative requirements. This auditing is in addition to examination of survey plans prior to their incorporation into the cadastre.

Many Australian States employ variations of survey auditing as a means of risk management. Most manage risk late in the process, that is, after the surveys have already been performed and submitted. Rectification of errors that affect titles is often costly and time consuming. Pre-registration auditing offers a more effective means of detecting and rectifying errors that threaten the cadastre, however such programs need to be in harmony with the timeliness of the registration process expected by the community. Introduction of penalties for requisitions issued as part of the examination and/or audit process would increase the effectiveness of the examination and audit program and help minimise risk to the cadastre.

Accreditation of land surveyors, whereby lodgement of survey plans is restricted to only those surveyors who demonstrate that their work is safeguarded by quality assurance methods, is being used by some Australian States as a means of risk minimisation. However, the principle behind an accreditation program is focussed on initial demonstration of competency without specific requirements for on-going assessment. The use of an accreditation scheme in isolation from other risk minimisation programs (such as auditing) has been seen by some States as ineffective in protecting the integrity of the cadastre.

Confidence to deal with the land and property market is achieved in some countries by means of insurance with respect to the risk of title, ownership or boundary discrepancies. While this approach may provide the community with enough certainty to enable the property market to function, it does not address the actual inputs into the cadastre and is unlikely to have any effect on the integrity of it. Insurance is a reactive measure rather then a pro-active one. A number of Australian States have already given some consideration to titles insurance. Given the recent collapse of large commercial insurance groups, the community and investors may lose confidence in the property market if title insurance was to replace or supplement government guarantee.

Professionals of all disciplines may subscribe to some form of professional indemnity (PI) insurance. However, PI generally only covers client (the second party) and does not extend to third parties. Therefore, from time to time, Governments may find themselves at risk from claims relating to title disputes.

Regulatory reform needs to provide appropriate mechanisms for professional competency and for the monitoring and measurement of risk to Victoria's systems of land registration. The proposed introduction of periodic licensing, in conjunction with the maintenance of professional competency through a Continuing Professional Development (CPD) program, is largely in response to this requirement.

Education has an important role to play in minimising risks as all decisions which affect the cadastre should be informed decisions. General awareness of the importance of the cadastre in the community benefits its protection as much as the direct education of land surveyors. A regulatory system needs to include feedback on performance to surveyors as part of this process. Such systems can be further enhanced when appropriate disciplinary powers are used as a means of modifying behaviour that puts the cadastre at risk.

Effective regulation of surveying must also be complemented by appropriate institutional arrangements within Government for managing the State's surveying and land registration infrastructure and information systems. Non-compliance with regulation can be partly attributed to confusing or ambiguous Government policy and direction. The Surveyor General and Registrar of Titles have statutory responsibilities which enable Government to set clear policy and direction for managing the respective spatial and legal elements of the cadastre.

When comparing the risk management strategies of land surveyors with other professions such as doctors, lawyers, engineers and accountants, is the Government over-managing the risks or are the requirements for the cadastre greater by necessity?

Take for example a general medical practitioner (GP). The GP initially undertakes a long course of university education, followed by a period of internship. Once registered by the relevant State board, the GP may be required to undertake CPD. The GP examines and diagnoses patients and prescribes medication. Generally, the GP has an independent relationship with their client, without any system of checking. In relation to the services provided by the GP, the risk is loss of human life or serious impairment or injury.

In comparison, the land surveyor completes a prescribed university degree, followed by a traineeship and examination by the State's Surveyors Board. Once registered, the Surveyors Board may require CPD. Those outputs of the surveyor which are required to be submitted to Land Registry, will be examined by qualified government staff, unless an accreditation system is in place. Many of the recent jurisdictional reviews into the regulation of land surveying undoubtedly considered whether governments are too risk averse.

However, surveyors have a responsibility not only to their clients but also to the adjoining owners, the local government, referral authorities, the Crown's registration agencies, and the community who will rely on the integrity of their surveys now and into the future. It may be argued that a surveyor's responsibilities are unique compared to the responsibilities of other professions. It is incumbent on a surveyor to be impartial to ensure the maintenance of public confidence and trust in the actions of a surveyor.

REVIEW OF THE VICTORIAN AUDIT PROGRAM

Every year, approximately 10,200 cadastral surveys are lodged for registration in Victoria. They are examined by Land Registry prior to registration. The survey audit program, undertaken by the Office of Surveyor General, was established with the threefold objectives of:

- monitoring surveying standards
- protecting the integrity of the cadastre
- reporting back to industry to improve the quality of surveys.

All surveys lodged in Land Registry are *examined* at a basic level of detail. Essentially this is an office examination of documentation.

A small number (up to 2%) of surveys are also *audited* at a much greater level of detail by Government licensed surveyors employed by the Surveyor General. Audits comprise both office and field examination. To date, the number of audits performed have been set as a function of available resources in the Office of Surveyor General.

The selection of surveys for auditing has been on a targeted basis (see Table 1), designed to identify the surveys most likely to be sub-standard. When a non-conformance is found, the surveyor responsible is sent a requisition, requiring him to rectify the non-conformance prior to the plan being accepted for registration. Requisitions are classified as serious or non-serious and as cadastral or standards-related, as set out in Appendix A.

Table 1 – Priorities for Selection of Surveys for Auditing

1. Surveys lodged by surveyors who continually perform below standard.
2. Surveys lodged by surveyors whose last audit was unsatisfactory.
3. Surveys lodged by surveyors who have been licensed under reciprocal arrangements.
4. Surveys lodged by surveyors who have never been audited (other than newly licensed surveyors).
5. Surveys lodged by newly licensed surveyors.
6. Surveys lodged by surveyors who have not been audited for over 3 years.

In 2000, independent consultants conducted a Statistical Quality Control review of the survey auditing process. The aim of the review was to provide a more accurate measure of current Victorian cadastral survey quality and to make recommendations to improve the efficacy of the survey audit program in achieving its objectives. Analysis of survey audit data from 1996-2000 (see Appendix B), showed that the average survey generated:

- 1.40 serious requisitions
- 1.57 non-serious requisitions
- 0.70 cadastral requisitions
- 2.57 standards requisitions
- 0.59 serious cadastral requisitions
- 1.03 serious standards requisitions.

Survey audit data also showed marked variation in quality between surveys. Examination of frequency distributions for survey audit requisitions showed that 79% of surveys generated standards requisitions (of which 59% were serious) and that 38% of surveys generated cadastral requisitions (of which 36% were serious). Data also showed that only one in five surveys was completely free of non-conformances.

Frequency distributions for individual requisition types revealed that 26% of all serious cadastral non-conformances relate to incorrect measurements, that 32% of all serious standards non-conformances relate to a failure to connect to the required number of Permanent Marks and/or Primary Cadastral Marks (as required under the Survey Coordination Act 1958 and Surveyors (Cadastral Surveys) Regulations 1995), and that 23% of all non-conformances detected relate to easement table errors.

In order to ensure that the integrity of the cadastre is not diminished, it is necessary to be reasonably confident of detecting *all* serious cadastral non-conformances in surveys lodged for registration. To meet this objective requires *targeted* (non-random) sampling in order to be effective. A random approach would require close to 100% auditing levels in order to be reasonably confident of detecting all serious non-conformances.

Analysis of the survey audit data from 1996 to 2000, assuming that the audit priorities represent a perfect system of identifying potentially erroneous surveys, showed that to ensure that the integrity of the cadastre is not diminished, it is necessary to audit 36.44% of all surveys lodged in Victoria.

Based on the analysis, the Review recommended the following:

1. That both random sampling (for monitoring standards) and targeted sampling (to protect the integrity of the cadastre) be utilised concurrently and separately;

2. That – for the purposes of monitoring compliance with regulations (standards) – at least 270 surveys be audited per annum, utilising a random sampling methodology;

3. That – for the purposes of protecting the integrity of the cadastre (in the current climate) – at least 3,717 surveys be audited per annum, utilising a targeted sampling methodology (specifically, the six priorities currently in use);

4. That survey auditing targets for both random and targeted sampling be reviewed annually in the light of data from that year's random sample (and that the next of these reviews incorporate a comparative analysis of survey audit programs in other Australian jurisdictions); and

5. That monthly reports continue to be published by the Office of Surveyor General, showing quality standards for the month and detailing the nature of common non-conformances and be extended to incorporate comparisons with previous months and with previous periods of significant length (say, 4 years).

Since the commencement of the Review, the Surveyor General has made several key changes to the audit program including:

- All audits are undertaken prior to registration by Land Registry. It was found that surveyors were slow to respond to audit requisitions once a plan had been registered.
- Both the lodging party and the surveyor are advised of requisitioning of a survey by audit.
- Land Registry examiners now work closer with the Surveyor General in the auditing to eliminate any duplication of checks.
- The Registrar will not register a plan subject to an audit requisition until it has been attended to.

The enhancements to the audit program has meant that Recommendations 1, 4 and 5 have already been implemented. The implementation of Recommendation 2 is subject to gaining additional staff. On a positive note, the level of auditing has increased from 80 in 1995-96 to 176 in 2000-01. The benefits from aligning the Surveyor General audits with Land Registry examinations are beginning to flow with compliance improvements becoming evident with subsequent audits.

Recommendation 3 is clearly not practicable as it would involve auditing 36% of all surveys. However, the Office of Surveyor General considers that a more appropriate risk management response is through an effective program of pre-registration audits supported by an effective regulatory system that can deal with poor performance.

VICTORIAN REFORMS

The Victorian Government, through the Office of Surveyor General Victoria, is engaged in partnership with industry to reform the land surveying regulatory system. In line with National Competition Policy requirements, Victoria has identified that there is a net public benefit in retaining regulation of land surveying in order to protect the integrity of the cadastre. However, communicating the fundamental importance of the cadastre to central agencies and higher level Government is difficult. This is further complicated by the lack of understanding of the role of surveyors.

The primary objective of Land Survey Reform is to progressively introduce a better system for the regulation and administration of land surveying in Victoria. This system will be more efficient and streamlined and will enhance the existing underlying survey principles. It will protect and enhance the quality of the cadastre and provide for more efficient and effective regulation of the survey profession.

The key deliverables of the Reform of Land Surveying project will be:
- New surveying legislation to replace the *Surveyors Act 1978*
- Replacement of the existing statutory Surveyors Board of Victoria with a Board with wider community representation
- Revised arrangements for the registration and licensing system including periodic renewal

The major role for Government will be to set the standards and quality assure the inputs to the cadastre and the geodetic infrastructure. The Surveyor General will continue to have legislative responsibility and be the Government authority on surveying, survey control, land boundaries and the spatial cadastral infrastructure. As custodian of the

spatial cadastre, the Surveyor General has primary responsibility for the surveying of boundaries for both Crown and freehold land and the monitoring of compliance of surveyors with standards.

It is envisaged that more responsive professional administration will result from a new Board that has broader community representation, managing the surveying profession and promoting professional best practice. Surveying customers will have access to better and user-friendly information with a transparent complaint resolution scheme.

CONCLUSION

Government has a primary role in protecting the integrity of the cadastre. In the spatial context, because Government does not have the capacity to fully examine and audit every survey undertaken, an appropriate risk management approach must be undertaken.

Victoria believes that its approach to risk management of the cadastre is generally effective and efficient, but will be significantly enhanced once a new regulatory framework is implemented in 2002. The Reform of Land Surveying in Victoria project will arguably provide the most significant and far reaching changes to the State's surveying industry. The outcomes of this project will fundamentally change the administration of surveying for the first time in almost 150 years, since conception of the State's system of Government.

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APPENDIX A – REQUISITION ITEM CLASSIFICATIONS

Table A.1 – SGV Requisitions (field audits)

Item	Description	Severity	Area - Impact
Abstract			
1.	Survey not connected to AMG bearing datum	serious	standards
2.	Survey not coordinated on AMG	serious	standards
3.	Survey not connected to the required number of PMs and/or PCMs	serious	standards
4.	Boundary marks not described on abstract	not serious	standards
5.	Boundaries not marked on the ground where practical	serious	cadastre
6.	Incorrect measurements	serious	either or both
7.	Datum unsatisfactory	serious	cadastre
8.	Adoptions unsatisfactory	serious	cadastre
9.	Mathematically incorrect	not serious	either or both
10.	Omissions and/or transcription errors	not serious	standards
11.	Heading, street names, notations etc incorrect	not serious	standards
12.	Certification incorrect	not serious	standards
Report			
13.	Non-compliance with *Regulation 14*	not serious	standards
14.	Inadequate explanation of adopts	not serious	either or both
15.	Omissions and/or transcription errors	not serious	standards
16.	Not signed and dated	not serious	standards
Plan			
17.	Drafting standard unsatisfactory	not serious	standards
18.	Diagram plotted incorrectly	not serious	standards
19.	Mathematically incorrect	serious	cadastre
20.	Missing dimensions	serious	either or both
21.	Easement information incorrect	serious	cadastre
22.	Title connection missing	serious	cadastre
23.	Building located inaccurately	serious	cadastre
24.	Building cross-sections not shown where necessary	not serious	standards
25.	Heading, street names, abuttals, notations etc incorrect	not serious	standards
26.	Omissions and/or transcription errors	not serious	standards

Table A.2 – TRS Requisitions (plan examination)

Item	Description	Severity	Area - Impact
9.	Plan is not for a whole parcel / transferability	serious	cadastre
10.	Incorrect street names and/or abuttals	serious	both
11.	Lots mathematically incorrect	serious	both
12.	Incorrect dimensions	serious	both
13.	Areas incorrect	serious	both
14.	Incorrect parcel numbering (lots, roads and reserves)	serious	cadastre
15.	Plan and/or abstract certification incorrect	serious	standards
16.	Incorrect depth limitation	not serious	standards
17.	Adoptions unsatisfactory	serious	cadastre
18.	Stage of acceptance/degree of difficulty of re-establishment	N/A	N/A
19.	Surveyors Report unsatisfactory	not serious	standards
Easements			
20.	Location incorrect and/or mathematically incorrect	serious	cadastre
21.	Easement table errors	serious	cadastre
22.	Boundaries defined by buildings incorrect	serious	cadastre
23.	Other	N/A	N/A

APPENDIX B – ANALYSIS OF SURVEY AUDIT DATA 1996 TO 2000

Table B.1 – Descriptive Statistics – Comparison by Audit Number

NON-SERIOUS	1st Audits	2nd Audits	3rd Audits	4th Audits	5th Audits	Subsequent	Overall
Sample Size	247	70	23	8	5	8	361
Mean	1.57	2.14	2.17	3.38	2.67	2.67	1.76
Standard Deviation	1.58	1.91	2.04	2.13	1.91	1.91	1.71
Maximum Value	8.00	10.00	7.00	6.00	6.00	6.00	10.00
Theoretical UCL	4.73	5.72	6.11	6.40	5.74	5.74	5.12
Logical UCL	5.00	5.00	5.00	5.00	5.00	5.00	5.00

SERIOUS	1st Audits	2nd Audits	3rd Audits	4th Audits	5th Audits	Subsequent	Overall
Sample Size	247	70	23	8	5	8	361
Mean	1.40	1.73	1.87	3.13	2.53	2.63	1.57
Std Dev	1.39	1.68	1.91	1.46	1.85	2.45	1.55
Max Val	7.00	8.00	8.00	5.00	6.00	6.00	8.00
Stat UCL	4.16	5.05	5.74	4.37	5.54	7.34	4.66
Logical UCL	0.99	0.99	0.99	0.99	0.99	0.99	0.99

CADASTRAL	1st Audits	2nd Audits	3rd Audits	4th Audits	5th Audits	Subsequent	Overall
Sample Size	247	70	23	8	5	8	361
Mean	0.70	1.06	1.30	1.88	1.47	1.50	0.85
Std Dev	1.15	1.57	1.74	1.64	1.55	1.31	1.32
Max Val	7.00	9.00	6.00	4.00	4.00	3.00	9.00
Stat UCL	3.44	4.71	5.23	4.93	4.66	3.93	3.95
Logical UCL	0.99	0.99	0.99	0.99	0.99	0.99	0.99

STANDARDS	1st Audits	2nd Audits	3rd Audits	4th Audits	5th Audits	Subsequent	Overall
Sample Size	247	70	23	8	5	8	361
Mean	2.57	3.37	3.22	5.38	4.47	3.00	2.86
Std Dev	2.20	2.64	2.52	2.56	2.67	2.73	2.37
Max Val	11.00	13.00	8.00	9.00	9.00	6.00	13.00
Stat UCL	6.59	7.92	7.57	7.68	8.01	8.18	7.12

SERIOUS CADASTRAL	1st Audits	2nd Audits	3rd Audits	4th Audits	5th Audits	Subsequent	Overall
Sample Size	247	70	23	8	5	8	361
Mean	0.59	0.84	1.22	1.75	1.40	1.50	0.73
Std Dev	0.98	1.30	1.59	1.58	1.50	1.31	1.14
Max Val	5.00	7.00	6.00	4.00	4.00	3.00	7.00
Stat UCL	2.94	3.91	4.78	4.74	4.51	3.93	3.43
Logical UCL	0.99	0.99	0.99	0.99	0.99	0.99	0.99

SERIOUS STANDARDS	1st Audits	2nd Audits	3rd Audits	4th Audits	5th Audits	Subsequent	Overall
Sample Size	247	70	23	8	5	8	361
Mean	1.03	1.26	1.09	2.00	1.80	1.63	1.12
Std Dev	1.06	1.16	1.04	0.76	1.26	1.60	1.11
Max Val	4.00	4.00	4.00	3.00	5.00	4.00	5.00
Stat UCL	3.17	3.49	3.12	2.27	3.79	4.79	3.33
Logical UCL	0.99	0.99	0.99	0.99	0.99	0.99	0.99

First Audits	Non-Serious	Serious	Cadastral	Standards	Serious Cadastral	Serious Standards
Sample Mean	1.57	1.40	0.70	2.57	0.59	1.03
Population Size	10200	10200	10200	10200	10200	10200
Est'd Pop Sum	16022	14246	7102	26222	5987	10489

BIOGRAPHIES

KEITH C. BELL

Keith Bell was appointed the 24th Surveyor General of the Australian State of Victoria in August 1999. The Office of the Surveyor General Victoria is a division within the Department of Natural Resources and Environment. Keith is also the Chairman of the Surveyors Board of Victoria, the Registrar of Geographic Names and is one of Victoria's Commissioners for Electoral Boundaries. In addition, Keith is the Victorian representative on the Intergovernmental Committee on Surveying and Mapping (ICSM) and he is the chair of ICSM's Permanent Committee on Cadastral Reform.

Previously, Keith was the General Manager of the Australian Capital Territory Government's Land Information Centre (ACTLIC) for three years and prior to that a senior manager in the Australian Surveying and Land Information Group (AUSLIG) in the Australian federal government. He has worked as the Secretary to the Australian New Zealand Land Information Council (ANZLIC) and the Queensland State Government.

His early surveying career included working offshore as a hydrographer and in the geophysical exploration industry. In addition, Keith has served in the Australian Army, in both the regular and reserve forces.

Originally from Queensland, Keith Bell is a licensed surveyor. He is a graduate of the Queensland University of Technology and in addition holds a Master of Surveying and Mapping Science from the University of Queensland, Master of Business Administration from Deakin University and Graduate Diplomas in Management and Human Resource Management from the University of Canberra.

Keith is a Fellow of the Institution of Surveyors Australia (ISAust), the Institution of Engineers Australia (IEAust) and also the Australian Institute of Management (AIM). Also, he is a Member of the American Society of Civil Engineers (ASCE) and the Mapping Sciences Institute of Australia (MSIA).

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MARK CLEARY

Mark Cleary is currently the project officer responsible for the Reform of Land Surveying in Victoria project. The project is part of a broad reform agenda being undertaken by Land Victoria, a division of the Department of Natural Resources and Environment, that is focused on reforming the States regulatory and administrative framework to enable the integration and delivery of land information and transactions electronically to the community.

The objective of this project is to introduce a better system for the regulation and administration of land surveying in Victoria that is more efficient and streamlined by enacting new legislation to replace the existing outdated Act and Regulations.

Mark is currently seconded to the Survey Reform project from the Department of Natural Resources and Mines in Queensland. There he was a regional surveyor involved in all forms of survey activity from compliance auditing and professional advice to managing cadastral and Global Positioning System coordination projects.

Previously as a regional Titles Office examiner, Mark was involved with the pilot project that saw the introduction of the Automated Titles System in the first regional centre as part of the new Land Titles Act. He has also had a broad range of experience in other positions within the Department, such as managing a regional Land Service Centre and establishing and maintaining regional Local Area Networks.

A graduate of the inaugural year of the Survey Practice Course at Queensland University of Technology, Mark is also a Commissioner for Declarations in Queensland.

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