The Development of a Co-ordinated Cadastre for South Australia

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Abstract

Initiatives for the reform of the South Australian cadastral surveying system are outlined and the 1985 Feasibility Study into a Co-ordinated Cadastre is discussed in detail. This is the second of two articles examining reform in the South Australian cadastral survey system.

Introduction

The current state of the art of the cadastre in South Australia has been described in detail in a previous paper (Toms et al. 1986). In that study a number of problems associated with deficiencies in the cadastral surveying system were identified. These adverse factors are due, in the main, to the maintenance of surveying methodology based on the “running survey” or “isolated survey” principle. Although the shortcomings of this approach have been obvious from the earliest colonial days and although a number of attempts were made to reform the system, none proceeded to fruition. These initiatives are discussed in this paper together with a major feasibility study into a co-ordinated cadastre which was commissioned by the South Australian Department of Lands in 1985.

Initiatives for the Reform of the South Australian Cadastral Surveying System

Pre-World War II Moves

A number of initiatives for reform of the South Australian cadastral surveying system have been made over the past 150 years in the legal and administrative senses. As Butler (1953) points out, as early as 1842 Surveyor-General Frome had utilised a triangulation net of sorts to provide “...guides and checks upon the cadastral boundary measurements...”. Erroneous original surveys circa 1839 in the Hundreds of Encounter Bay, Goolwa and Waiparinga and ensuing boundary confusion led to the passing of the Encounter Bay, Goolwa and Waiparinga Boundary Act in 1884. In suburban Adelaide (in the Municipality of Henley and Grange) a case of severely confused boundaries arose from a 1921 alignment survey which involved some 800 certificates of title. In an attempt to remedy the situation, the South Australian Parliament enacted the Henley and Grange Alignment Act 1940. The essence of this legislation was to require a new alignment of road boundaries based on occupation (Kennedy 1978).

More Recent Initiatives

The Local Government Act as amended provides for a legislative solution to the problems of confused boundaries which occur in South Australia. Section 308 of that measure permits the Registrar-General, the Surveyor-General or the Commissioner of Highways to carry out a road alignment survey in an area in which confusion exists as to the location of cadastral boundaries. In carrying out the alignment survey due regard must be given to “... (a) any plans which are in the office of the Surveyor-General or in the Lands Titles Registration Office or General Registry Office; (b) existing physical boundaries erected; (c) any other matters which are considered necessary or proper to be considered...” The final alignment plan would then rule over any other plan or document as far as boundaries are concerned. The provision does not provide for cadastral survey improvement on a broad front.

In the Eastern Australian States of Queensland, New South Wales and Victoria so-called “survey co-ordination” legislation has been in force for a relatively long period of time. Typical of these is the Queensland Survey Co-ordination Act of 1952. Inter alia, this Act provides for the connection of surveys to existing surveys, the establishment of a central plan register and the establishment of permanent survey marks. In South Australia in 1946, the State Mapping and Co-ordination Committee resolved that “... all surveys that are of sufficient accuracy to be of use to other Departments should be recorded in a Central Office...” This was to be the fore-runner of “...consideration of the necessity or otherwise of introducing the co-ordination of surveys...”. However, no further action was taken until 1967 when a report entitled “On a Proposal to Introduce a Scheme of Survey Co-ordination into South Australia” was completed. The report includes a draft “Survey Co-ordination Act” (Butler 1985). In the same year the South Australian Government appointed a Survey Enquiry Committee which recommended that “... The Surveyor-General’s Division be made responsible for planning and implementing a programme for the establishment of a mathematically co-ordinated cadastre for the State.” (South Australia 1969). The Report led to an increase in the establishment of the Survey Division to the level where the Director-General of Lands was able to advise the Minister in 1978 that “...the staff complement for survey co-ordination is now complete” (Butler 1985).

In 1969 G. H. C. Kennedy was appointed Surveyor-General of South Australia. Kennedy had been and continued to be a driving force behind initiatives for the introduction of a co-ordinated cadastre into the State. As Deputy Surveyor-General, he had been an influential member of the Survey Enquiry Committee. A professional surveyor of high standing and a man of considerable vision, Kennedy, after his appointment as Surveyor-General, devoted a great deal of attention to research and investigation into the administrative and technical aspects of co-ordination. The outcome of this activity was the preparation of a draft State Survey Act which was circulated amongst the members of the South Australian Division of The Institution of Surveyors, Australia, members of the Association of Consulting Surveyors and individuals prominent in the profession. The proposal was for: “An Act to provide for a State Survey and the regulation of the practice of surveying; to repeal portions of the Surveyors Act 1975 and for other purposes.”

The legislation was designed to give legal status to the State Cadastral Survey to the exclusion of all other evidence. Division 2 of Part III of the draft bill provided for co-ordinates solely to describe and define boundaries (Kennedy 1978).
The proposed legislation was quite radical in its approach. For example it proclaimed the objects of the State Cadastral Survey as:
(a) to remove uncertainty in the description and location of boundaries;
(b) to determine unique descriptions of boundaries in terms of co-ordinates of the surveying points on the said boundaries;
(c) to provide that the unique descriptions determined pursuant to paragraph (b) of this section, shall be the sole legal description of the said boundary points; and
(d) to provide that the ground positions of the said ruling points mentioned in paragraph (b) of this section shall correctly mark the said boundaries notwithstanding any Act or law to the contrary.

The Surveyor-General was not to be bound by any Act or law or any rule of evidence pertaining to the re-instatement of boundaries and he was to be empowered to adopt as boundaries such lines as were considered just and equitable. These would be subject to a right of appeal. In his operations pursuant to the Act he was to have regard principally for:
(a) the occupation of the parcels as evidenced by fences, walls or similar structures apparently on or near the boundaries as originally marked;
(b) the original boundary marks, if intact and apparently in their original position, but not necessarily in derogation of the provision of paragraph (a) of this subsection;
(c) the expressed desires of parties having interests in any boundaries, for certain lines to be adopted as boundaries;
(d) any other matter deemed necessary or proper (Kennedy 1978).

Kennedy's intentions were somewhat radical. Where original boundary marking had disappeared, the surveyor would adopt substitute boundaries bearing a relationship to the original boundaries within the tolerance set by the inherent uncertainty of recovering original boundaries. These "substitute boundaries" were, however, to be subject to the agreement of all parties with an interest in the boundaries. On the technical side it was proposed to utilise photogrammetric methods for surveying parcel boundaries (Kennedy 1978).

The draft legislation was destined to be shelved. This was due to a number of factors including lack of support from the surveying profession and the retiree of Surveyor-General Kennedy. His successor, B. H. Bridges, extended the previously planned research into the feasibility of the system proposed by the draft legislation. The serious funding implications indicated at the conclusion of these investigations led the Surveyor-General to withhold further action as the Survey Division was at that time subject to heavy budgetary restriction. The question of co-ordination thus lay dormant until the advent in 1985 of the "Feasibility Study into a Co-ordinated Cadastre for South Australia" which will be dealt with at length in a later section of this paper.

Towards Computerised Cadastral Data Bases for South Australia

In the early seventies the South Australian Government identified the main problem in land administration as "...the lack of an effective communication ability between the sources of land-data and their potential users (Sedany 1981)". To provide a solution to this problem, a proposal was developed to create a computerised Land Ownership and Tenure System (LOTS) for the State. LOTS was to constitute a major part of the "legal-fiscal" element of an overall South Australian Land Information System. The general characteristic of LOTS is that of a multi-purpose (land-related) data-base gathering information from a variety of sources, centralising it in one comprehensive recording system and, as regards enquiry, making it available online to numerous remote enquiry locations. Importantly, LOTS can automatically generate information flows to dependent systems triggered by changes to particular data elements within the system. In essence, LOTS provides a centalised computer file with a record of every land parcel in the State with details of its ownership and tenure. The system, in detail, can be viewed as a number of separate systems, each with its own function, data input and update but integrated to the extent that the systems are independent. The component sub-systems of LOTS are:

1. Automated Indexing and Enquiry System (ARI);
2. Title System;
3. Valuation System;
4. Land Tax System;
5. Sales History System; and
6. Debtors Ledger System.

The on-line enquiry system provides access, on a restricted basis, to each of the above sub-systems by using any one of seven major enquiry keys such as title reference, valuation assessment numbers, owners name and so forth (Department of Lands 1985).

The LOTS system currently does not include cadastral survey data but the system specification produced in 1976 stated that "...an efficient graphic index, or reference map system should be established clearly displaying all current land parcels and their identifiers. (Department of Lands 1981). Subsequent studies led to the recognition that an investigation needed to be undertaken as a matter of high priority to establish the precision with which co-ordination of the cadastre should be performed. This would satisfy the requirements of particular sub-systems such as Land Information System for the State, (Department of Lands 1981). In 1980 the Public Service Board established an "Enquiry into the Further Development of a Digital Cadastral Data Base (DCDB) for South Australia". The Enquiry, inter alia, in its report of July 1981 recommended that the Department of Lands should immediately proceed with the development and implementation of a DCDB for the State and that initial data-base creation should be effected by manual digitisation of the largest scale mapping available (with due regard to geographic accuracy) which is constrained by or transferable to the Australian Map Grid (Department of Lands 1981). A further systems analysis study in 1983 confirmed the findings of the Report of the Enquiry and concluded that the creation of the DCDB be delayed no longer (Department of Lands 1983a). The development of the DCDB is currently proceeding apace. File creation is being achieved through the manual digitisation of the best available cadastral graphic which is generally 1:2500 cadastral base mapping on Metropolitan Adelaide and major urban centres. Losses et al (1985) report that "...the system is currently one year into its four year data acquisition (file creation) phase. The data base storage and enquiry system is currently being addressed and to a limited degree is expected to be operational by July 1986. This will enable access to a subset of the DCDB two years into the file creation phase." With continuous updating, eventually the co-ordinates of the DCDB would be those of a co-ordinated cadastre if one were to be established.

A further computer-based cadastral data system has been established in the Department of Lands. This software system is PLANS designed for the capture of survey data from cadastral plans lodged with the Registrar-General's Division and Survey Division of the Department. The prime function of PLANS is to check the data for closure and perform an adjustment of data if misalignment is within
allowable limits. Data in the form of angles/bearings and distances are retained in the computer on an off-line storage medium (Loree et al. 1985).

A further computerised system which is under consideration by the Department of Lands is the Digitised Survey Data Base (DSDB). The DSDB is envisaged as storing data for all permanently marked, accurate surveys, whether by Government or private surveyors, and to provide reliable homogeneous co-ordinates resulting from these surveys together with other related information in comprehensive form to users. (Department of Lands 1983b).

The 1985 Feasibility Study into a Co-ordinated Cadastre for South Australia
The Origins of the Study

Attempts to introduce varying degrees of co-ordination to support the cadastral system have taken place since settlement in South Australia. These have been traced above. Uncertainty as to the justification for the continuation of the development of the tertiary network, inter alia, led the Surveyor-General, in 1983, to call for a review to clarify the role of the Surveyor-General and the functions and organisation of the Survey Division contemporaneously with a broad strategic review of public sector survey functions and organisation. This request became the catalyst for a comprehensive review of the total Department of Lands. The Survey Division Review was to be the first of a three-phase review undertaken by the consultants W. D. Scott in association with Kindill Scarns.

The consultants presented their report in September 1983. The relevant recommendation was:

"that immediate steps should be taken to end the traditional cadastral surveying practices based on "running surveys" by utilising the tertiary geometric network to progressively develop a co-ordinated cadastre involving absolute rather than relative spatial fixation of land parcel boundaries. A feasibility study should be conducted immediately to confirm the long term positive net benefits to the State of progressively developing a legally proclaimed co-ordinated cadastre by the most cost-effective means available." (Scott, 1983).

Methodology for the Study

Subsequently, advice was sought from eight national and international authorities as to the appropriate method of tackling the feasibility study. The Land Registration and Information Service (L.R.I.S.) of the Canadian Maritime Provinces was selected to develop a detailed outline for the feasibility study. Ministerial approval was given to commence the study on 20 December 1984 and the Canadian study team arrived in Adelaide in February 1985. The concept of operation for the study was that L.R.I.S. would develop the format and be jointly responsible for the final report, leaving the detailed management of the study to a local firm of technology management consultants. In conjunction with the Project Director, L.R.I.S. chose, from six local firms, the consultants APTECH Australia Pty. Ltd. for on-shore management.

L.R.I.S. identified the subject areas, wrote terms of reference for the background papers required and jointly selected and briefed the potential authors. Subsequently APTECH prepared a substantial summary of all papers and comments received throughout the duration of the study. The local consultants also conducted a series of presentations, discussions and a workshop for the surveying industry and selected interested parties. In keeping with the original recommendation for the study, and being a major part of the report from APTECH, was an exhaustive cost-benefit study of the adoption of a co-ordinated cadastre for South Australia. The APTECH Report is discussed in more detail later in this paper.

Whilst the overall management of the study was the responsibility of the Project Director, an Advisory Panel was established to ensure that:

- all relevant issues were addressed by the consultants
- the recommendations developed throughout the study were realistic and achievable
- the current investment in the cadastral infrastructure was protected
- the impact on all stakeholders was identified.

Notwithstanding the long range consultations between Adelaide and Fredericton, the study resulted in workable logical recommendations and the L.R.I.S. draft final report was made available to the Survey Division by the end of September 1985. (See below).

An Overview of the Study Background Papers

A wide range of background papers were commissioned for the study. Authors were chosen who could give detailed background and constructive comment on local, national and international developments which would influence the choice of the approach to the development of a co-ordinated cadastre in some form. The papers directed at the existing South Australian systems also contributed valuable background data on costs for the benefit-cost component. The following topics covered by the papers indicate the depth and breadth of the co-ordinated cadastre study:

- the status of current survey systems in South Australia
- current systems of plan inspection
- impact of the use of co-ordinated surveys on present base-mapping programs.
- impact of co-ordinated survey systems on present thematic mapping programs.
- impact of the use of co-ordinated surveys on present information systems
- impact of the use of co-ordinate systems on the present Title Register system
- accuracy requirements for cadastral surveying and mapping within a co-ordinated survey system.
- options, implications and issues in finishing the cadastre
- cadastral options
- regionalisation of survey resources — impact on a distribution system for co-ordinate information
- training and education requirements needed by the surveying industry as a consequence of introducing a co-ordinated cadastre
- previous attempts to introduce co-ordinates into the South Australian cadastral system
- case studies of projects in South Australia which have used co-ordinate systems
- impact of technology and the co-ordinated cadastre
- impact of a co-ordinated cadastre on the utility authorities
- various options for marking the cadastre in South Australia

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- Ensure that all cadastral survey plans show grid bearings, ground distances and connections to Control Reference Marks, with co-ordinates shown only on such marks.
- Improve monumentation.
- Carry out a pilot study to better quantify and otherwise assess the value of eventually converting the resultant co-ordinated cadastre into a 'legal' co-ordinated cadastre.
- Continually monitor the capability and cost performance of Global Positioning Satellite (GPS) technology with a view to accelerating the completion of the tertiary network and/or using GPS for direct cadastral survey co-ordination.
- Continually assess the desirability of developing different forms of a co-ordinated cadastre for different land use areas.

For the benefit-cost analysis APTECH developed a simple predictive model for co-ordinated survey benefits. The Model is based on a number of assumptions concerning the gradual introduction of compulsory co-ordination of new cadastral surveys in "designated survey areas" in which the tertiary network control has been already completed at sufficient density. In essence, increasing percentage levels of savings on costs of co-ordinated surveys executed after a "commencement date" had been proclaimed for a designated survey area. A financial "model" was thus established which drew upon estimates of incremental costs of a co-ordinated system (e.g. completion and maintenance of the tertiary network, survey field work, plan examination and so forth), and the proportional savings assumptions. The model was run for the base-case (derived from the preferred option) and sensitivity tests were executed on eight other cases created by varying the base-case assumption. The time frame for the analysis was long term, 1985-2027. Intangible benefits were ignored in the analysis and for the base-case a maximum benefit-cost ratio of 1.31 was achieved in 2005. This result compares not unfavourably with those obtained in similar overseas studies (see for example Robertson & Partners 1977). It is pertinent to note that benefit assumption percentages and work values have been treated conservatively by APTECH. The recommendations flowing from the report are:
- Amend current legislation so that compulsory connection of new surveys in "Designated Survey Areas" (DSAs) would be required where co-ordinated tertiary network marks are already in place and of sufficient density. If possible, the necessary legislative/statutory amendments should be in place early in 1986. In effect, this step would formalise existing voluntary practice in South Australia.
- Review current land division (subdivision) practices with the objective of ensuring that newly created boundaries are clearly defined. It is considered that a "partial survey" (which is much less stringent than a normal "certified" survey), pegging and correspondingly simple survey examination procedures would suffice in the majority of cases. If possible, these procedural amendments should also be in place early in 1986.
- Via the proposed Survey Data Base, gradually update the co-ordinate values of the State's Digital Cadastral Data Base (DCDB) by incorporating the latest Australian Map Grid (AMG) co-ordinates derived from new field surveys tied into the tertiary network.
- Also via the proposed Survey Data Base, accelerate development of the co-ordinated cadastre by incorporating reliable historical survey data into the DCDB, where these data have been "connected" to the tertiary network via co-ordination of the respective permanent survey marks.

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Future Study Action

The next stage of the study will be the provision of comment on the proposed recommendations. This comment will come initially from the Department of Lands, APTECH and the Advisory Committee and later from the surveying and allied industries. It is anticipated that this wider participation will be completed by early 1986. A detailed implementation plan for the adoption of the final recommendations will then be prepared with initial legislative amendment made by mid 1986.

Conclusion

The paper has highlighted initiatives for reform of the South Australian cadastral system. In particular, it has highlighted the roles of land registration and cadastral surveying and mapping in the system. The latest initiative to improve and reform the system has resulted in a study aimed at introducing a co-ordinated cadastral system in South Australia.

One of the most important aspects that has come out of the study is that cadastral surveying and mapping cannot be treated in isolation. They are an integral part of the cadastral system, which itself is a central component in the State's land information system (LIS). A conceptual model of the State's LIS is shown in Appendix 2. The model clearly depicts the role of the cadastral system and the digital cadastral data base, in the cadastr and the broader LIS.

Another important aspect which is occurring is the trend for the cadastral and land information systems to adopt many of the principles of a modern European cadastr. It is considered that this trend will continue as a logical development of the system.

The views expressed in this paper are those of the authors and do not necessarily reflect attitudes and policies of the Department of Lands of South Australia.

References


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APPENDIX 1

Feasibility Study into a Co-ordinated Cadastre for South Australia
Abstracts of Background Papers

Current systems of plan inspection — status report
Smith, P. & Baldock, B.

The evolution of plan examination in the Registrar-General's Office and the Survey Division of the Department of Lands is briefly traced. The examination process is described in terms of survey lodgements, examination costs, examination statistics and criticism of the process. The impact of co-ordination on the search and checking aspects of survey examination is critically discussed.

Impact of the use of co-ordinate surveys on present base mapping programs
Birchby, J.

The standard series base mapping in South Australia is described taking into account responsibility, development of base mapping programs in the Survey Division, the characteristics of the various scales and the maintenance of the programs. Utilisation of co-ordination in the mapping program and the effect of tertiary network densification is discussed. Digital approaches to base mapping, both cadastral and topographic and the possibility of integrating such data within the co-ordinated cadastre is canvassed.

Impact on present thematic mapping programs
Chandler, W. & Wilson, J.

The paper presents an overview of thematic map systems in South Australia which are related to cadastral parcel-based information. Thirty agencies within government, local government, statutory bodies, educational institutions and professional bodies were identified as needing some aspect of thematic map production. The Digital Cadastral Data Base and its potential applications to thematic mapping are discussed. The paper concludes that the D.C.D.B. operation will satisfy the requirements for thematic mapping.

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the context of several megatrends which are gradually beginning to impact on society. Technological products currently utilised by the survey profession and the general public are identified and the likely influence that these systems will have on the establishment and application of a co-ordinated cadastre is discussed.

Previous attempts to introduce cadastre co-ordinates in South Australia

Byler, M. G.

The earliest attempts, primarily by Surveyors-General Light and Frome, to introduce co-ordination into South Australia over the period 1836-1945 are traced. The period 1945-1975 is discussed in detail dealing with the State Mapping and Survey Co-ordination Committee, the Survey Enquiry Committee, the Tertiary Network, the drafting of a proposed Co-ordination Systems Act and research into technical methods of co-ordination. The paper examines the concept of a legal cadastre and the events that led up to the drafting of a Bill and the steps taken to implement the proposals. Events are traced between 1979 and 1980 which led to the proposals being held in abeyance. Co-ordination matters post-1980, particularly the development of the State Geodetic Survey, work on confused boundary areas, the DCDB and the Department of Lands Review are discussed. A statement is presented of broad precepts that must be borne in mind when formulating strategies for implementing any outline of the study. A useful chronological table of events is appended.

Finishing the cadastre — options and implications

Hughes, T. W. and Major, J.

The paper comprises two parts. Part I deals with finishing control for the cadastre and covers density and accuracy, monumentation options and techniques for the co-ordination of control. Part II discusses critically the co-ordination of the cadastre in general and the use of photogrammetry, GPS systems, scaling or calculating, special purpose surveys, incremental capture of future surveys and co-ordination from other Departments. Co-ordination computation is discussed together with the maintenance of the co-ordinated cadastre. Several recommendations are suggested.

Options for marking the cadastre

Holstein, L. and Williamson, I. P.

This article discusses the demarcation and marking of parcels and boundaries. It only deals with the actual marking of parcels of real estate and the marking of reference marks associated with cadastral surveys. The article emphasises the importance of good monumentation and suggests that it is more important than measurements or monument descriptions. Further, it discusses and analyses the place of co-ordinates in a cadastral survey system. The article concludes that co-ordinates should not be allowed to over-ride monuments in boundary determinations and a number of issues are raised and recommendations are made concerning changes to marking the cadastre.

Impact on utilities

Porter, I. R.

This paper is concerned with the impact of a co-ordinated cadastre on South Australian authorities which are involved in operations associated with the purchase and use of land for the construction and maintenance of facilities provided directly to land parcels. Nine such authorities are identified and the current work situation for these bodies is discussed in terms of planning, pre-construction/maintenance and construction maintenance. Technological changes affecting cadastral surveys by these authorities are described. The changes include data-base creation, interactive cadastral definition, inertial surveying and GPS. The paper concludes by pointing out that public utilities already utilise co-ordinates and that, using current technology, a co-ordinated cadastre will realise only marginal benefits. This will change for the better with the advent of GPS technology. Concern is expressed that public utilities may wish to retain the superiority of monuments to measurements in certain circumstances.

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Impact of the use of coordinate systems on present information systems

(LOTS, DCDB).

Loree, P., Lunney, C. and Waring, G.

The paper identifies nine South Australian computer-based digital, land-related information systems which may be affected by a co-ordinated cadastre. These systems, which include the Department of Lands PLANS, LOTS and DCDB and INCAS and MOSS developed by Highways Department are examined in terms of description, effect on by, and benefits accruing to, each from the introduction of a co-ordinated cadastre. This comparative analysis is summarised and it is concluded that only the INCAS and MOSS systems will benefit (to the extent of $20,000 to $50,000 p.a.) from the introduction of cadastral co-ordination.

Status of current survey systems in South Australia

Warhurst, D. F. and Tucker, P.

This detailed study commences with a discussion on the primary and tertiary control networks of the State in terms of nature and extent, location of marks, accuracies and costs. The cadastral permanent survey mark system is examined in terms of categorisation, identification, distribution, condition and accuracies. Survey records are discussed, taking into account computerised and microfilmed files, searching and projected growth of records. The paper describes the survey mark maintenance process. The quality of boundary surveys is dealt with in terms of accuracy requirements under former and current regulations. Confused boundaries and adverse possession are discussed. The paper concludes by commenting on the effect of maintaining the "status quo" for the primary and tertiary network survey and the cadastral surveying system.

Cadastral options — surveying and mapping

Holstein, L. and Williamson, I. P.

The paper defines and discusses in detail the components of a cadastral survey system in terms of land law, institutional involvement, land tenure arrangements, land registration systems, parcel boundary systems, parcel boundary marking, parcel boundary description, cadastral surveying methods and cadastral mapping. Options for the introduction of co-ordinates into South Australia are presented for discussion. The paper is prefaced by a detailed summary of options or issues for reform in the cadastral survey system of the State.
Case studies — use of co-ordinates
Hughes, T. W., Mollison, R. J. and Randle, W. T.

The paper outlines the procedure for a case study mail and interview survey conducted with a number of private sector firms, government departments and statutory authorities in South Australia. Fourteen case studies are presented, each of which follows the same heading format: introduction, description of project, use made of co-ordinates, frequency and comment.

Regionalisation of survey resources — impact on a distribution system for co-ordinate information
Curnow, J., Bryant, F., Haylock, W., and Will, G.

The background to the present system of co-ordinate distribution is outlined. The existing system involves both Survey Division and Registrar-General’s Division and the paper discusses the services provided by both Divisions. Problems are identified in a number of areas including geodetic records, microfilm prints, terminal access to the Survey Mark Register, backlog of survey examination and progress of plans. Possible alternatives are explored and recommendations are put forward for the improvement of the system.

Cadastral models
Williamson, I. P.

Theoretical (e.g. Dale, McLaughlin, Ziemann) and existing (Canton de Vaud in Switzerland, LRIS in Canada and LIS in South and Western Australia) models are discussed. The paper concludes inter alia that cadastral modelling and strategic planning are integral components of any efficient land administration system, that “legal co-ordinates” are not feasible in practice and that, although all systems differ to some extent, there are several principles common to all which are relevant to cadastral model design.

Cadastral surveying and title registration in perspective
Williamson, I. P.

The existing requirements and procedures for cadastral surveys are reviewed in terms of New South Wales experience. In particular, the influence of the isolated survey system is emphasized. The basis for defining cadastral boundaries is discussed, with the major conclusion being that measurements have little weight. The requirements of title registration for cadastral surveying are then analysed. A commentary on accuracy standards, guaranteed boundaries and the role of adverse possession is presented, and some important principles are developed. Finally, the cadastral survey system as a whole is analysed to determine its effectiveness. Of specific interest is a discussion on Identification Surveys in New South Wales; an increasing phenomenon in South Australia. It is suggested that the title registration system is constrained within the requirements of the isolated survey system thus limiting the flexibility of the title registration system and its potential for using the Register in a multi-purpose role.

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Cadastres and land information systems in common law jurisdiction
Williamson, I. P.

Any study, such as the one being undertaken in South Australia, should firstly consider broad issues and then attend to the detail. As part of this process the “cadastral concept” should be reviewed and clearly understood. This article attempts to assist with this objective. In addition, the origins of cadastre are reviewed, with some interesting conclusions being made. The analysis of Common Law cadastral systems is important for South Australia considering its objective to introduce a system based on cadastral principles. In order to understand current thinking and research in this area, the article reviews the North American and Australian perceptions of cadastres. Finally the article suggests an ideal Statewide parcel-based land information system centered around a judicial cadastre. The model should be of particular interest to South Australia.

Accuracy requirements for cadastral surveying and mapping
Jones, A. C., O’Callaghan, B. T. and Burford, B. J.

This paper is the result of an investigation into the necessary accuracy levels to maintain a legal co-ordinated cadastre in South Australia. The investigation incorporated a survey of the public and professions as to their accuracy expectations and some sample error analyses of typical situations.

The legal implications of describing boundaries by co-ordinates
Kelly K. and Walter, M.

The paper sets out criteria which have been considered by the courts to have evidentiary value in relation to the location of boundaries. Mr. Justice Cooley's statement on the quasi-judicial role of the surveyor is cited. The question of evidentiary weight of co-ordinates is discussed and some legal procedures for the allocation of title data and the determination of boundaries are described. A method of implementing a co-ordinated cadastre is suggested and other legal ramifications explored. The paper concludes that the task of “fitting” the concept of a legal cadastre into the legal system of South Australia would be complex and challenging but would be legally and technically feasible.