University Library

A gateway to Melbourne's research publications

Minerva Access is the Institutional Repository of The University of Melbourne

Author/s:
Harcombe, Paul R.;Williamson, Ian P.

Title:
A cadastral model for low value lands: the NSW western lands experience

Date:
1998

Citation:
Harcombe, P. R., & Williamson, I. P. (1998). A cadastral model for low value lands: the NSW western lands experience. In, Proceedings, FIG XXI International Congress, Brighton, UK.

Publication Status:
Published

Persistent Link:
https://hdl.handle.net/11343/33922

Contents Page

Presented at FIG XXI International Congress, Brighton, UK July 19-25 1998

A CADASTRAL MODEL FOR LOW VALUE LANDS THE NSW WESTERN LANDS EXPERIENCE

Paul R Harcombe
Surveyor General's Department
Panorama Avenue,
BATHURST 2795
Ph 063 335 208
Fax 063 328 217
Harcombp@lic.gov.au

and

Ian P Williamson
Professor of Surveying and Land Information
Department of Geomatics
University of Melbourne
PARKVILLE 3052
Ph 03 9344 4431
Fax 03 9347 4128
i.williamson@eng.unimelb.edu.au

ABSTRACT

The operation of the cadastre in the semi-arid lands of Western New South Wales has remained relatively unchanged since settlement. The existing system is proving expensive when compared to land value and unable to cope with current economic, environmental and social issues. This paper examines the problem of sustainable resource use and how the introduction of a Multi-Purpose Cadastre can provide a more certain future. The development and use of a consistent spatial framework, comprehensive datasets and new rules and procedures for boundary definition and demarcation are proposed as improvements to the existing cadastral system.

INTRODUCTION

Semi-arid lands, which are often regarded as being of limited economic value because of their low production potential, require careful management to ensure sustainable use of land and renewable resources. There are numerous examples world wide where inappropriate land management practices have led to land degradation and desertification;

> "the impoverishment of arid, semiarid and some subhumid ecosystems by the combined impact of man's activities and drought" (Dregne, 1977).

and the consequences of social disruption and economic hardship. Globally desertification is revealed as "a pressing global problem of the first order" (Mabbut, 1978).

In mainland Australia, an examination of any atlas showing climatic zones will reveal that more than 50% of the continent is classified as arid or semi-arid. All of the largest States and Territory- namely Western Australia, Queensland, South Australia, Northern Territory and New South Wales, contain large tracts of semi-arid lands, commonly referred to as rangelands.

The Western Division of NSW is a land management unit covering 42% of the State or 32.5

million hectares and is characterised by its semi-arid climate, low population density and restricted production potential. This area is the size of Great Britain and Ireland combined. About 95% of the total area is held under perpetual lease for pastoral purposes from the Crown by some 1350 pastoralists. The typical size of holdings ranges from 4000 hectares to 70 000 hectares depending upon the landuse capability. Land use values can be as low as $1/hectare.

Figure 1 Western Division of New South Wales

The Division covers 42% of the State or 32.5 million hectares. This area is the size of Great Britain and Ireland combined.

Difficulties faced by low value rangelands comprising the bulk of the Western Division include:

- Land degradation including soil erosion, woody weed infestation and salinity problems as a consequence of past land management practices.
- Declining water quality, evidenced by the occurrence of blue-green algal blooms, increased turbidity and the need for increased water treatment for potable water.
- Low commodity prices coupled with rising production costs have increased economic pressures on farmers which in turn has forced some to adopt unsustainable practice.

No other region in NSW has experienced such a marked decline in productivity in recent times. Gross income in the region has declined by an estimated $200 million in the past 5 years. (Western Lands Commission, 1992)

Similar parallels can be drawn from other low value, marginal lands from around the world e.g. North Africa, and in particular those countries adjoining the Sahara. (Falloux, 1989)

New technology has given us the ability to better collect and use information about the landscape, however the rules and procedures which govern the operation of the cadastre and land tenure are largely unchanged since the 19th Century.

The purpose of this paper is to examine the role and impact of the cadastre in the Western Division of New South Wales and the benefits that can be gained by the adoption of modern multipurpose cadastral principles. A new approach, utilizing modern positioning and spatial information technologies and the application of general boundaries principles are discussed.

HISTORICAL DEVELOPMENT OF THE NSW CADASTRAL SYSTEM

The settlement and early colonisation of NSW followed the English (feudal) system of granting rights to colonists and the recording of those rights by the registration of deeds. In the Western Division, the "Squatting Era" between 1830-1884 was characterised by largely unregulated occupation of the Western Region, accelerated by the discovery of gold. Pastoralists occupied "runs", large tracts of land which were only regarded as suitable for grazing. The Robertson Land Act of 1861, brought some control to settlement by introducing selection before survey with the Crown Lands Act 1884 dividing "runs" into Leasehold Areas (short term leases) and Resumed Areas (available for settlement as smaller homestead leases) and introducing local land boards which took land allocation out of political control.

Legislation was subsequently introduced to encourage closer settlement and fairer allocation of land by the provision of new tenures, classification of land, survey before selection, and the "one man one selection" principle. The Western Lands Act 1901 was introduced to administer the Western Division after a Royal Commission inquiry. The inquiry followed a severe drought and depression which led to the abandonment of many holdings and the need for a period of financial and environmental rehabilitation.

The demarcation of these leases on the ground followed standards of survey established to support the introduction of the Torrens system of registration of title. These accuracy standards were related to topography and not land value. The scarcity of features or improvements also meant that general boundaries principles could not easily be applied or adopted.

This meant that in theory, a cadastral survey over "flat" land for the purposes of alienation, long-term lease or subdivision had to achieve the same accuracy standards (1:8000 linear misclose ratio) whether it was in the urban area of Sydney or over leasehold lands in the Western Division.

From 1950 to the late 1970's a large number of surveys were undertaken in the Western Division due to pressure for soldier settlement after World War II and the subsequent withdrawal of land from the larger holdings. Other lands also became available from expiring leases held by pastoral companies. These surveys were undertaken by contract and Department of Lands surveyors. The actual cost of survey was supplemented by the Government with the incoming lessee paying a prescribed concessional survey fee based on area.

Surveys were undertaken in accordance with directions issued by the Surveyor General and the Survey Practice Regulations, 1933. The Department of Lands Survey Directions 1963 for surveys of Crown land were later published as a supplement to the Survey Practice Regulations. Crown land in the Western Division was brought under the Torrens Title system and requirements of the Real Property Act from 1986-1988.

The application of these standards has caused many to claim that survey costs over small parcels or leasehold rural lands are more than the value of the land in many circumstances. Even though photogrammetry had developed as an efficient mapping technique Post World War II, it was not actively pursued as a means of assisting cadastral systems in the Western Division until recently.

PROBLEMS IN THE WESTERN DIVISION

The operation of a uniform cadastral system for the demarcation and recording of rights over land whilst having benefits to the people of NSW in terms of security of title and confidence in the marking of boundaries delineating different interest, poses some problems for the Western Division.

Some of the problems include:

- High costs of cadastral surveys when compared to land value. Local survey practitioners have confirmed that in heavily vegetated areas subdivision survey costs (typically $300/km for new boundaries) can approach or exceed land value.
- Emphasis placed on marked "artificial" boundaries which represent the legal cadastre as distinct from "as occupied" boundaries which have a greater significance for landholders.
- The nature of the cadastral pattern which, historically, was set out on cardinal bearings forming rectangles enclosing an allotted area, was relatively fast and cheap. This practice however largely ignored natural boundaries such as catchment, soil or vegetation type. Generally only major natural features, such as rivers and lakes were adopted as boundaries. This approach causes major problems to mechanised agriculture and the design and implementation of soil and water conservation measures.

In the early 1990's Government recognised an inherent legal problem in the current network of legal roads for the Western Division. In the past, when subdividing Crown land within the Western Division, the practice of ensuring that each subdivided parcel was serviced by a legal means of access in the form of a road, was only partially adopted. Whilst some legal roads were created in the Western Division, in the majority of cases reliance was placed on a covenant in virtually all Western Land leases that the lessee was "not to obstruct or interfere with any reserves, roads or tracks or the use thereof by any person".

This clause was traditionally interpreted by administrators and by virtually all lessees as providing unrestricted rights to members of the public to use any track or constructed road within the boundaries of a Western Lands lease.

However, there is some doubt as to the legal standing of this clause. As a result, the Government has taken steps towards implementing a program to re-establish a network of legal roads within the Division to provide adequate access for lessees, the general public and for community purposes.

To establish this network, tracks in current use which may be legally established as roads need to be accurately identified, then assessed or adjudicated as to whether the track is used solely for internal property management purposes or whether other persons, including adjoining lease holders, have used it from time to time for access.

The re-creation of a legal road network, that is, the "skeleton" of the cadastral pattern is a catalyst for cadastral reform and presents an ideal opportunity to examine and adopt a more relevant system.

During the 19th Century, settlement of the region was driven largely by economic imperatives to produce wool and other commodities for traditional European and domestic markets. Emerging

problems of land degradation and declining productivity brought about by inappropriate land management in the past has seen community standards change to give greater emphasis to improving environmental qualities and social issues such as recognition of native title.

The recognition and recording of native title interests requires information about the location of natural features, as these interests are defined by traditional owners by reference to natural landmarks. The current cadastral system largely ignores natural features as boundaries at the parcel level.

A VISION FOR MANAGING LOW VALUE RANGELANDS IN WESTERN NSW

Whilst the Western Division historically made a significant contribution to the economy of the State, new sustainable levels of resource use must be found.

It is suggested that any future strategy or vision for low value rangelands needs to include:

1. Comprehensive, integrated datasets related to land markets, land management, natural resources and the "as built" environment for better decision-making.
2. Simplified, cost-effective processes which underpin the operation of the cadastre e.g. "on line" conveyancing and land administration, demarcation/re-establishment of cadastral boundaries using fast and efficient techniques such as the Global Positioning System (GPS) and photogrammetric techniques.
3. Sustainable land-use in the long-term bringing together the concepts of economic and environmental sustainability with productivity sustained or enhanced over the long-term. (NSW Farmers Association, 1996).
4. A system of land parcel boundaries and interests in land clearly defined, easily relocatable, more closely aligned with catchment and sub-catchment boundaries and enclosing areas regarded as viable economic farming/grazing units.

The last three elements listed above form components of a Multi-Purpose Cadastre (MPC) as defined by Dale and McLaughlin (1988).

"A large-scale, community oriented land information system designed to serve both public and private organisations and individual citizens. Its distinguishing characteristics are that it:

1. Employs a proprietary land unit (the cadastral parcel) as the fundamental unit of spatial

organisation;
2. Relates a series of land records (such as land tenure, land value and land use) to this parcel;
3. Is wherever possible complete in terms of spatial cover;
4. Provides a ready and efficient means of access to the data".

TECHNOLOGY

The advent and rapid development of information technology which has the ability to capture, process, store, query and display large sets of spatial and textual data has given decision makers powerful tools for resource management.

Digital photogrammetry can be used to create comprehensive three dimensional models over large areas with the ability to spatially locate features on the ground such as railways, dams, fence lines, track centre-lines, waterways, catchments etc which can be used as land parcel boundaries with an estimated accuracy of 3-5m.

Global Positioning System (GPS) technology can be used to capture spatial information and other attribute information relating to natural resource or the "as built" environment. GPS is also a powerful tool for completing and densifying geodetic networks.

Geographic Information Systems provide a capability to store, analyse and manipulate geographic data and the ability to integrate various data types, particularly where temporal studies are involved.

The combination of these enabling technologies can deliver the comprehensive, reliable information sources required for better decision making.

A MODERN CADASTRAL SYSTEM FOR WESTERN NSW

The development of a multi-purpose cadastre suitable for the Western Division rangelands involves the provision of a number of components.

1. Consistent Spatial Framework

A consistent and comprehensive geodetic network, i.e a system of widely spaced marks with known position makes it possible to establish spatial linkages between all relevant land information, so that any features can be related spatially.

Over the past three years, the GPS High Precision network which comprises geodetic stations at a 100km spacing has been further densified by the NSW Surveyor General's Department. The establishment of an additional 100 marks in the Western Division provides a network of permanent marks at a nominal 50km spacing across the whole Division. The majority of these additional marks are along main roads, some of which were placed during the establishment of the Australian Height Datum in the early 1970's and until recently only had accurate heights.

The 50km spacing is based on the expectation that Differential GPS techniques will increasingly be used for positioning applications, including cadastral re-establishment, in the future. Whilst Wide Area Differential GPS techniques can now deliver sub-metre accuracies, geodetic and control survey networks are emerging as important elements for legal traceability of GPS measurements.

2. Comprehensive Datasets

The spatial framework or geodetic survey provides a basis for digital mapping. In the case of the Western Division, GPS controlled photography is being used to generate photogrammetric models which accurately shows natural and man-made features. It has been shown previously

(Kelly and Harcombe, 1996) that this approach is more cost-effective for the capture of road centre-line data in terms of coverage and the ability of the data to be used for a range of other purposes. A mapping project was undertaken in 1995 to test the possible efficiencies using GPS controlled aerial photography and helicopter assisted GPS control surveys over a 1:250,000 map sheet in the Western Division. The Pilot Project proved that "a re-definition of the pastoral leasehold occupations in remote areas is achievable using photogrammetric survey" (Grant and Mitchell, 1995).

Such an approach allows:

a. Road and Track centre-lines to be captured to an accuracy of 3-5m which can then be used to create road casements.
b. Fence-lines to be positioned to a similar accuracy, which when shown to be coincident with the "as surveyed" cadastral patterns, and integrated with the Digital Cadastral Database (DCDB) and road casements can be used to create Deposited Plans for legal road definition purposes.

This combination of digital topographic data with the DCDB provides the base mapping components of a modern multi-purpose cadastre. The enhancement or integration of other natural resource datasets relating to fauna, soils, vegetation and water derived from remote sensing or field survey methods with digital topographic data will also provide land managers with the best information for land-use planning.

The estimated costs of providing this infrastructure, including spatial framework improvement and photogrammetry, based on work done to date is $14 per square kilometre. (Surveyor General's Department 1997).

3. Simplified, Cost-effective Processes

The rapid development of modern communication and information technology such as the World Wide Web provides a means of reducing the problems of isolation and distance, as well as the potential benefits from automation of existing manual processes. Virtually all homestead stations now use satellite telephones.

Access to comprehensive mapping, natural resource and economic data for sustainable land use planning and business decision making is now almost a reality through the World Wide Web (WWW). Farmers will be able to access the latest information on climate, commodities, distribution of feral pests, animal and plant genetics, soil and vegetation data and topographic data through the development and deployment of customised search facilities on the WWW. Both the Federal and State Governments are developing prototype Web applications to deliver relevant information to people such as those in the Western Division.

Strategies are being developed for the electronic collection and processing of survey information. Some transactions supporting land markets are already partially handled in digital form e.g. Notice of Sale. The recording and processing of rights, restrictions and responsibilities that people have with respect to the land can be streamlined through further automation and be made more accessible "on-line".

Technical directions have been finalised to facilitate the use of GPS for cadastral surveys which can provide potential savings over conventional methods for the demarcation and relocation of cadastral boundaries.

Cadastral survey accuracy standards for various classes of land however will need to be revised, particularly for rangelands, to be compatible with the value of the land, user requirements and to take maximum advantage of GPS and digital photogrammetry technology.

4. Occupational or General Boundaries

The re-establishment of a legal road network using digital photogrammetry which enables fence lines or roads or rail lines to be positioned to 3-5m and when integrated with the DCDB provides a digital "cadastral mapping" solution rather than a system of individual cadastral surveys.

The adoption of occupations, such as intersection of fences and well established fence lines, roads or railways, which are recorded in a rectified digital photogrammetric model is suggested as an unambiguous, well defined system of demarcation of land rights.

5. Land Consolidation

A further step could be to investigate the application of land consolidation methodologies, which are well-established in Europe, to rangelands. This would involve the re-arrangement of property boundaries to more closely align with catchment and sub-catchment boundaries. Studies in Queensland (Hannigan and Webb, 1995) have identified:

> "It has been established that the optimum unit for the management of natural resources is the catchment, therefore Reconstruction Schemes would seek to improve catchment management by re-aligning boundaries to coincide with catchment and sub-catchment divides, and enclosing areas approaching what may be considered a viable economic farming unit."

Hannigan and Farmer (1995) have developed a broad social, economic, administrative and legal model for implementing farm reconstruction and boundary re-arrangement in Australia. Their study showed that a boundary re-arrangement can reduce ecological conflicts and better accommodate natures pattern of movement and flows. Further testing will establish the applicability of this model to rangeland Australia. Community/land holder input is an essential component to initiate and drive any re-construction scheme, while existing community/landholder environmental schemes such as Landcare may be useful catalysts.

CONCLUSION

The need for a sustainable future for rangelands in Western NSW and the re-establishment of a legal road network are catalysts for cadastral reform. The current cadastral systems limits flexibility and does not encourage sustainable development.

It is argued that concepts such as a Multi-Purpose Cadastre, use of new technologies, appropriate boundary definition and demarcation rules and procedures and re-arrangement of property boundaries can facilitate better land resource management.

Some components of a Multi-Purpose Cadastre for the Western Division of NSW are well advanced or underway, that is,

- Consistent spatial framework
- Comprehensive datasets providing digital base mapping
- Development of standards, procedures and systems to apply modern technology such as GPS, GIS, World Wide Web etc to improve processes underlying the operation of the cadastre.
- Development of appropriate boundary definition and demarcation rules and procedures.

Australian models of land consolidation are available and need to be further tested for their applicability to rangelands. Cadastral reform has commenced, however there is further work to be done to redefine the most appropriate cadastral system for rangelands. Most importantly the people of the West need to recognize the need for change to secure a sustainable future.

REFERENCES

Christie, E.K., (1986) *Pastoralism and Ecology in Arid Australia.,* Longmans, Cheshire, United Kingdom.

Dale, P.F and McLaughlin, J.D; (1988) *Land Information Management.,* Clarendon Press, Oxford. United Kingdom. pp 6,26

Dregne, H.E., (1977) *Desertification of Arid Lands.,* Longmans, Cheshire, United Kingdom.

Epstein F, McLaughlin J.D., (1983) - *Procedures and Standards for a Multi-Purpose Cadastre*. National Academy Press, Washington, D.C.

Grant, D.M. and Mitchell, C.J.(1995) *Towards completion of the core Spatial Assets for New South Wales - the Angledool Story*, Australian Surveyor, Volume 40, Number 3, September 1995. Pp 221-226

Falloux, F., (1989) *Land Information and Remote Sensing for Renewable Resource Management in Sub-Saharan Africa.,* World Bank Technical Paper No 108, Washington D.C., United States.

Hannigan, BJ and Farmer, R (1995) *Re-arrangement of Farm Boundaries to Facilitate Beneficial Adjustment in Primary Industries.* Final report of a Rural Industries Research and Development Corporation Project 1995. ISBN 1 864 35 021 0

Hannigan, BJ and Webb, RM (1995) *Re-arrangement of Property Boundaries to Facilitate Optimum Rural Land Use*, Land & Water Resources R&D Corp, Technical Report, Sept 1995. ISBN 1 86435 634 0

Kelly, P.C, Harcombe P.R., (1996) *Saving the Sunburnt Country.*, Australian Surveyor, Volume 41, Number 2, June 1996. pp 103-108.

Mabbut, J.A., (1978) *Desertification in Australia*., School of Geography Report No 54,

University of NSW. pp 127

NSW Farmers Association (1996) *Western Division Conservation Policy*, 1 Bligh Street, Sydney.

NSW Surveyor General's Department (1997) *Western Lands Mapping Project Budget Papers*, Panorama Avenue, Bathurst, NSW.

Western Lands Commission (1992) *The Western Division in Crisis.* Western Lands Commission Discussion Paper, Department of Land and Water Conservation.

Paul R Harcombe, B Surv. (NSW), MIS Aust., Registered Surveyor

Paul Harcombe is currently the Acting Deputy Surveyor General n the newly re-created Surveyor General's Department. Paul is also Chairman of the NSW Survey and Mapping Managers Forum and a Member of the Survey and Mapping Industry Council. He has previously held positions in State Government covering land management, land development, cadastral systems, control and geodetic surveys. He is currently undertaking a Masters Program through the University of Melbourne.

Ian P. Williamson, PhD (NSW), FISAust, FIEAust, Registered Surveyor, CPEng

Professor Williamson holds the Chair of Surveying and Land Information the Department of Geomatics at the University of Melbourne, Australia. He holds Bachelors, Masters and Doctorate Degrees in Surveying and is a Registered Professional Land Surveyor and a Chartered Professional Engineer. He is both a Fellow of the Institution of Surveyors, Australia and the

Institution of Engineers, Australia. Prior to his Academic Career, he worked in a State Government in Australia, an American Engineering Corporation based in the USA and ran his own Consultancy Practice in Sydney. He is Chairperson (1994-98) of Commission 7 (Cadastre and Land Management) of the International Federation of Surveyors. His interests are in the operation, management and development of land information systems, information systems, administration systems, with particular emphasis on cadastral, land and geographic information systems.