

# Maintaining the Integrity of the Cadastre in the Port Macquarie-Hastings Local Government Area

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## ABSTRACT

*In 2013, the Port Macquarie-Hastings's Survey and Design Section reviewed Council's practices in relation to survey infrastructure in the Local Government Area. The review found that survey marks have been lost or disturbed when works have occurred within land owned or managed by Council, roadways or on land subject to a development application. As a consequence of this, determination of boundary position, mapping, planning and construction works become more difficult and costly. Also Council or Council's contractors could be fined for breaching the Surveying and Spatial Information Act, which states that it is illegal to "remove, damage, destroy, displace, obliterate or deface any survey marks." In order to reduce the number of survey marks being destroyed, it was decided that new workplace practices needed to be implemented. This paper documents these new practices as well as detailing the importance of survey marks and how survey marks may fit into the cadastral reform framework.*

**KEYWORDS:** *Survey marks, policy, procedures, Local Government, cadastre.*

## 1 INTRODUCTION

In the current climate of Local Government review and limited funding, councils need to ensure any funding received is spent wisely, and will strengthen their communities' economy and social position. One of the areas needing careful consideration is the relevance of councils managing the cadastre in their Local Government Area (LGA) now and into the future. With this in mind, Council's management may consider the following: Why is it important for a council to maintain the integrity of the cadastre in their LGA? Should ratepayers foot the bill for the upkeep of an asset that is managed by State Government bodies? Should ratepayer's money be diverted, from areas that are deemed essential services, to survey related services?

### 1.1 The Meaning of Maintaining the Integrity of the Cadastre

The Macquarie Dictionary provides the following keyword definitions to explain the meaning of maintaining the integrity of the cadastre:

- Maintain: to keep in due condition, operation, or force.
- Integrity: the state of being whole, entire and undiminished.
- Cadastre: an official register of property, with details of boundaries, ownership, etc.

Hence, to maintain the integrity of a cadastre, the boundaries of land and associated property information need to be kept free from error by long-term upkeep and repair. To ignore any part of the cadastre is risky, as a discussion between the Registrar General of NSW and the

Institution of Surveyors in the early 20<sup>th</sup> century highlighted (Crundwell et al., 1995): *“...Williams conceded some of the surveyors’ arguments and risked undermining the popularity of the Torrens System. After all his certificates did incorporate a land description and diagram, but the Institution was now saying loudly that these were useless without the backing of accurate surveys.”*

## **1.2 Council’s Important Role in Maintaining the Cadastre**

The majority of tasks relating to the maintenance of the cadastre are the responsibility of the Registrar General and the Surveyor General of NSW and their departments. For example, one of the main responsibilities of the Registrar General is to maintain the Torrens Land Register, and the Surveyor General is the overseer of cadastral surveys in NSW and the associated legislation. (These departments cannot show that they are partial to a particular LGA when maintaining the cadastre.) However, this does not mean that local government or private surveyors are free from responsibility to the cadastre and councils can play a crucial role in maintaining the cadastre as they are at the ground roots level, have their ratepayers’ interests at heart and view their LGA as one contiguous entity. On the other hand, survey plans, the majority prepared by private surveyors, represent a small isolated part of the cadastre.

Council is a public authority, but it is not one of the public authorities that are directly responsible for managing the cadastre in NSW. As mentioned earlier, the majority of tasks relating to the maintenance of the cadastre are performed by the Registrar General and Surveyor General of NSW and their departments.

Cadogan (1997) noted the following about the service the City of Sydney surveyors offer to their council (and the possible demise of the service of these surveyors): *“Some private surveyors with extensive city practices are dismayed at the impending demise of the custodians, and the data and marks they provide. They have neither the time, the background, or the interest in maintaining the system (which they need and whose absence will add substantially to the time taken and hence the cost of surveys in the city). In any case, no man can serve two masters – there is the private interest (in the land abutting) and the public interest (in the streets themselves) and the dividing lines between these often competing interests are alignments. To put this another way: What would you do if you owned a very large elongated parcel of the most valuable real estate in Australia? This land has extensive boundaries in common with a great many neighbours. These neighbours pay you for access (among many other services) and are continually changing, redeveloping and upgrading your common boundary occupations. In relation to these activities, you already have in place the data, the infrastructure, and the small, specialised and experienced staff to supply a certain service to these neighbours and at the same time, to protect your own interests. This service is to define or supervise, or supply data from which every millimetre of those boundaries may be defined, horizontally and vertically, at any time. Your predecessors and you have provided this service since the beginning of settlement...”*

Many local councils do not have the extensive boundary records or alignment survey control network of the City of Sydney, but the principles of valuing the infrastructure that relates to the boundaries of the council’s owned and managed land is the same. Also, the service of defining council common boundaries is of value to any council.

### 1.3 Role of Port Macquarie-Hastings Council in Maintaining the Cadastre

Over the years, Port Macquarie-Hastings Council has employed surveyors. These surveyors have been employed in different roles, e.g. registered surveyors, engineering surveyors, designers, technical managers and Geographic Information System (GIS) specialists. Like many other councils, there have been long periods of time where surveyors with extensive cadastral survey training have not been in management roles. Hence, decisions about the management of the cadastre have been made by GIS, property and engineering staff.

When practices relating to the cadastre were reviewed by members of the Council's survey and design staff in April 2013, it was found:

- No Council policy existed relating to the preservation of survey marks.
- The majority of preservation of survey marks work focussed on the maintenance and preservation of state control marks.
- Work practices were dependent on individual surveyors, designers or team leader initiatives.
- The majority of education work had been done by the local geodetic surveyor, not by an employee of Council.
- There was no adopted Council documentation on procedures.
- Surveyor General's Direction No. 11 (LPI, 2004) had not been followed when re-establishing survey control. Hence, many new survey control marks had no associated coordinate information and were allocated class U in the Survey Control Information Management System (SCIMS).
- Replacement survey control marks were generally positioned after the original mark had been destroyed.
- Protection of boundary marks and boundary reference marks was not being considered during the construction process.
- About 10% of all state survey control marks in the Port Macquarie-Hastings LGA have been reported as destroyed, uncertain or not found (L. Gardner, 2013, email comm.).
- Boundary reference mark database information was lacking.
- Survey marks were not considered as a council asset.

On a positive note, a minority of cases did comply with Surveyor General's Direction No. 11 and with Survey and Spatial Information legislation. The GIS department of Port Macquarie-Hastings Council has also been instrumental in creating a survey-accurate Digital Cadastral Database (DCDB) for about 1/3 of the parcels in the LGA. The term survey-accurate cadastre relates to a DCDB created using dimensions of lots stated on a survey plan and connections from the lots to state survey control marks (Todd et al., 1999).

It was clear in the review that the ratepayers of the Port Macquarie-Hastings Council area are being adversely impacted by limited resources being allocated to preserving survey infrastructure and managing the cadastre in the LGA. It should also be remembered that survey marks and the cadastre are not the exclusive domain of the survey services. If these items are not managed properly, they will affect other council sections that deal with any land (whether a road, lot or waterway). It therefore makes sense for councils to use funds to protect survey marks in the LGA and strengthen the cadastre, which will in turn protect one of Council's most valuable assets – land.

Benefits of improving practices related to the cadastre include:

- Preserve an asset that benefits Council.

- Preserve horizontal and height control across the LGA.
- Minimise boundary disputes between Council and property owners.
- Minimise the financial loss Council experiences due to the destruction of survey marks.
- Improve the value of the cadastre in the LGA.
- Provide a clear idea of the area of an acquisition at the planning stage of a project.
- Sustain the value of land in the LGA.

#### **1.4 Changes to Practices**

A preservation of survey marks project was started shortly after the review of practices in April 2013. This project includes the development of council policy and procedures relating to the preservation of survey marks and the implementation of the new policy and procedures. After the preservation of survey marks project has been finalised, a more general Boundary Improvement Project (BIP) will be commenced. This project will be developed by the Survey and Design Section, in conjunction with the property and GIS departments of Council.

#### **1.5 Future of the Cadastre in the Port Macquarie-Hastings LGA**

Like the rest of NSW, Port Macquarie-Hastings Council will have a simpler boundary system, a quicker starting point for boundary surveys, and all employees will have easy access to complete property information about a land parcel.

Bennett et al. (2010) outlined how the cadastre will change in the future: *“Firstly, [there] will be a need for survey-accurate cadastral data; secondly, a shift in focus from land parcels to property objects. Third will be a need for height and time information, and fourth for real-time updating and accessing cadastral databases.”*

It is essential that surveyors consider how the cadastre will be in the future, when considering how to manage the cadastre today. Practices adopted by current surveyors must be able to be built on by surveyors in the future. Present day surveyors must also consider the currency of adopted practices and if the practices are delivering the desired outcome.

## **2 THE CADASTRE**

Cadastral systems are used for land tax and ownership purposes but are also used for facilities management, base mapping, value assessment, land use planning and environmental impact assessment (Kaufmann and Steudler, 1998). From a surveyor’s perspective, the cadastre would be a group of parcels where the boundaries of those parcels are as per the intention of the cadastral survey that created the parcel.

A modern cadastre (or a cadastre of today) as defined by Kaufmann and Steudler (1998) will:

- Show the complete legal situation of land, including public rights and restrictions.
- Abolish the separation between ‘maps’ and ‘registers’.
- Model (not map) the cadastre by sourcing different databases.
- Be computerised.
- Be highly privatised with public and private sectors working closely together.
- Be cost recovering.

This definition extends the cadastre to include the title registers and traditional, private and public land dealings and rights. In the future, understanding all the land-related issues affecting a parcel will be simpler.

## 2.1 Graphical Representation of the Cadastre

One of the first graphical representations of the cadastre was created by the Lands Titles Office in the late 1980s. This was the inception of the DCDB managed by Land and Property Information (LPI) (Crundwell et al., 1995). The DCDB is classified as a graphical cadastre, while other representations of the cadastre include the upgraded graphical cadastre, survey-accurate cadastre, reinstated cadastre and legal cadastre (Todd et al., 1999).

Graphical and upgraded graphical cadastres are created by digitisation of cadastral maps. The main difference is that an upgraded graphical cadastre is referenced to a datum. The survey-accurate cadastre uses dimensions from survey plans ('metes') and connections to the datum. The reinstated cadastre uses both dimensions from survey plans ('metes') and the 'bounds' or monuments described on survey plans or deeds. A legal cadastre is a 'fixed boundary system', where coordinates define the corners of a parcel and interests (Kaufmann and Steudler, 1998; Todd et al., 1999).

## 2.2 Boundary Determination in NSW

A reinstated cadastre closely reflects how boundaries are determined in NSW. Prior to the adoption of the Torrens Land System in 1863, NSW had adopted the common law system of deeds from the United Kingdom. Land was described on a deed by a 'metes' and 'bounds' description. 'Metes' are the dimensions of the land and 'bounds' are objects (or monuments) used to describe the position of a boundary line. An example of a 'mete' in a deed description is "*bearing south fifteen degrees six minutes west sixteen feet three inches*" and an example of a 'bound' is "*to the south-west face of brick wall*".

Instead of using a 'metes' and 'bounds' description of land, modern Torrens title refers to title diagrams. These title diagrams relate to the survey plan that created the parcel. These survey plans show the dimensions of the lots (to be created) and have connections between permanent survey marks and boundary reference marks and the lot corners. The nature of the boundary marks is also shown on the plan.

A hierarchy of marks, defined by Gordon and Allen (2005), is used by surveyors in NSW to help determine the positions of boundaries. This hierarchy includes:

- Natural features.
- Original Crown markings of grant boundaries.
- Monuments.
- Original undisturbed markings of private surveys.
- Occupations.
- Measurements.

The main aim for a surveyor is that the boundary position can be reproduced with confidence, and reflect the original surveyed position.

### 2.3 The Cadastre and Port Macquarie-Hastings Council

The DCDB used as a base layer in Council's GIS is a combination of an upgraded graphical cadastre and a survey-accurate cadastre. The limitations of this system include:

- Varying accuracies of boundaries.
- Cadastre not reflecting current subdivision layout.
- Incorrect utility (e.g. sewer, water, stormwater or street light) boundary offset representation shown.
- Incorrect proposed works to boundary offsets shown.
- Inability to use layer for survey and design work.
- Easements and other encumbrances not shown.
- Misinterpretation of data.
- Unclear picture of property acquisition.

On the other hand, the survey-accurate cadastre model reflecting the current subdivision layout is a powerful tool used by all sections in Council. Significant efficiencies have been gained in the planning and design stages of many projects by being able to utilise this model. Generally, lot corners are accurate to about 0.07 m, which is an acceptable accuracy for design work. Surveyors also use this layer as a base to help locate cadastral survey marks, stake boundaries at construction sites or as a starting point for boundary definition surveys. As surveys are conducted in any location in the LGA, there are many occasions where a digital representation of the cadastre is not available. In these cases, surveyors need to rely heavily on existing survey infrastructure. In some areas, survey infrastructure is lacking, thereby making boundary determination difficult.

## 3 SURVEY INFRASTRUCTURE

Until another boundary system is realised in NSW, survey infrastructure plays a vital role in determining boundaries and hence the cadastre. Consequently, the Survey and Design Section made preservation of survey infrastructure a primary objective when maintaining the cadastre in the Port Macquarie-Hastings LGA.

The two types of survey infrastructure mentioned in the Surveying and Spatial Information Act 2002 are permanent survey mark and survey mark (NSW Legislation, 2014a). These marks are used by the surveyor to “*locate or relocate boundaries*” and connect to the state control network (NSW Legislation, 2014b). The definition of a permanent survey mark under the Act is “*a survey mark that is in a form or style declared by the regulations to be the form or style for a permanent survey mark under this Act*”, and a survey mark is defined as “*a mark that is in a form or style declared by the regulations to be the form or style for a survey mark under this Act*” (NSW Legislation, 2014a).

The Surveying and Spatial Information Regulation 2012 splits survey marks into the following forms and styles: boundary marks, reference marks, bench marks and permanent survey marks (NSW Legislation, 2014b). It should be noted that the regulation also refers to broad arrows, which are survey marks only used when authorised by the government. Boundary marks are used to mark boundary lines and corners. Reference marks make reference from a survey mark placed to a boundary corner, angle or line. A bench mark is a survey mark with an allocated height. A permanent survey mark is a mark used or placed by surveyors when connecting to the state survey control network. Each of these groups of marks

is described in separate schedules, appended to the Regulation. A monument is described by the Regulation as “*a natural or artificial object, or a point on a natural or artificial object, that is shown on an existing survey plan held by a public authority for the purpose of locating or relocating a boundary or point in a survey*”.

Like most jurisdictions, NSW has laws relating to the protection of survey marks. Under section 24 of the Act a “*person must not remove, damage, destroy, displace, obliterate or deface any survey mark unless authorised to do so by the Surveyor General*”. If found guilty, the maximum fine a party will be required to pay for destroying a survey mark in NSW is \$22,750 (NSW Legislation, 2014a). This is equivalent to about a third of the average yearly wage in NSW.

As applications for authorisation to remove survey marks (mentioned in section 88 of the Regulations) only applies to “*permanent survey marks and reference marks*”, this would infer that some bench marks and boundary marks are not protected under the Act. An application for authorisation has to be lodged at least 14 days before survey marks are going to be impacted. The template Survey Mark Report can be used as an application form to seek authorisation from the Surveyor General. Authorisation would probably be given if the removal or alteration is deemed necessary – see section 20(1) of the repealed Survey Co-ordination Act 1949 (NSW Legislation, 2002).

### **3.1 Who is Responsible for Survey Marks?**

In NSW, the Surveyor General and LPI are responsible for establishing, improving and maintaining the State’s geodetic and survey control network. Both public and private surveyors add permanent survey marks to the network.

After notice has been given by the Surveyor General to a public authority, who manages or controls the land on which permanent survey marks are located, that authority must maintain and repair those marks “*identified in the notice*”. A public authority can apply to the Minister and the duty may be reallocated to the Surveyor General (section 9 of the Surveying and Spatial Information Act 2002). The notice given to the public authority by the Surveyor General is in the form of a locality sketch of the permanent survey mark, which is required to be drawn by the surveyor placing the permanent survey mark. Hence, if a permanent survey mark exists on a council managed or controlled road, the council needs to pay for any repair out of Council’s maintenance budget for the road.

### **3.2 Who are the Main Users of Survey Infrastructure?**

Anyone who is involved in the science, management and development of land may use survey infrastructure. Permanent survey marks also include Global Navigation Satellite System (GNSS) Continuously Operating Reference Stations (CORS), which are used to realise the national and state datums and provide fundamental positioning infrastructure for a wide range of applications across the State, e.g. via CORSnet-NSW (Janssen et al., 2011, 2013). GNSS CORS networks allow users to derive accurate coordinates by using only one receiver. This has substantially increased the market and affordability of GNSS-operated machinery.

Permanent survey marks are also used on any projects where accurate horizontal coordinates and height values are needed. These projects may be in the field of asset management, mapping, GIS, cadastral surveying, infrastructure construction, building, planning and design.

Even if a permanent survey mark is not an established survey mark (as described in the Surveying and Spatial Information Regulation 2012), the mark is still used for cadastral surveying, engineering surveys, plan and design applications and could be coordinated at a later stage to help provide an accurate digital cadastre model in the locality or aid with the development of the area.

Unlike permanent survey marks, boundary marks, reference marks and bench marks (generally) do not have allocated coordinates in SCIMS. The purpose of these marks is to define the cadastre, i.e. to locate and relocate the boundaries of land and any restriction limit.

Councils, sometimes unknowingly, require contractors or customers to use the survey infrastructure in their LGA. At Port Macquarie-Hastings Council, the following drafting requirements for Council's Computer-Aided Drafting (CAD) standards and specifications are imposed (Port Macquarie-Hastings Council, 2004):

- All works shall be provided on the Map Grid of Australia (MGA).
- The adopted height datum for all plans shall be the Australian Height Datum (AHD).

Development Applications and Construction Certificates also require boundary setbacks to be shown between proposed or existing structures and the boundary line or easement or encumbrance. Especially in the case of permanent survey marks, survey marks are directly or indirectly used by many industries in Australia. Even though land surveyors (i.e. cadastral surveyors, engineering surveyors and geodetic surveyors) and geodesists are the two main groups that place, measure and maintain survey marks in NSW, the information obtained benefits everyone in the community.

### **3.3 Placing a Monetary Value on Survey Infrastructure**

One realises the value of survey infrastructure, when a Class A and Order 1 (high) accuracy permanent survey mark is destroyed or disturbed during construction works. Survey information and infrastructure lost, when a high-accuracy mark is destroyed or damaged, includes:

- A survey marker.
- Established survey mark near job site.
- Very accurate horizontal coordinates and height information.
- Measurement data between the destroyed mark and other marks.
- Measurement data between the destroyed mark and the boundary (if referenced on a plan).

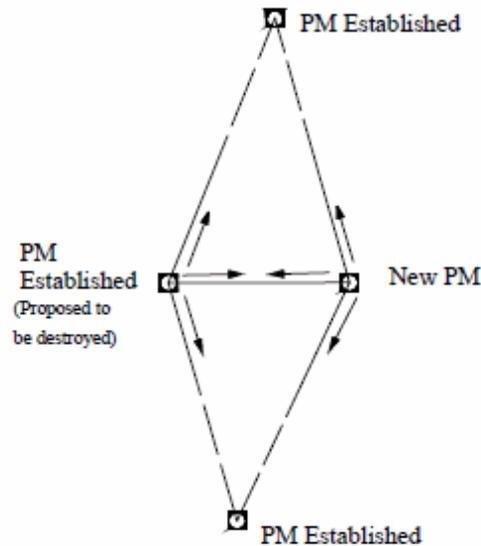
Once the value of each of these items is added up, the above mentioned mark would be worth at least \$10,000. Table 1 provides an approximate fee estimate of the costs associated with re-establishing a new mark.

Hence, the cost of losing a survey mark and re-establishing a high-accuracy survey mark to the same accuracy of the original mark that was destroyed is about \$20,000. If the existing mark was kept and was able to be used to re-establish the new mark, costs are reduced. Figure 1 shows the different traverse requirements, specified in Surveyor General's Direction No. 11, which illustrates this point.

Table 1: Summary of estimated job costs for re-establishment of a high-accuracy survey mark.  
 Calculations are based on an average charge-out rate of \$200/hr and an 8-hour day.

Item	Estimated Time	Cost
Lost time (contractors)	¼ day	\$800
Lost time (Council's works engineer)	¼ day	\$400
Lost time (Council's registered surveyor)	½ day	\$800
Lost time (Council's survey technician)	½ day	\$800
Directing the re-establishment of survey mark works and calculations (LPI's geodetic surveyor)	1 day	\$1,600
Re-establishment of survey mark (contractor's survey team)	2 days	\$4,800
Allocation of temporary mark coordinates and registration of locality sketch (LPI's SCIMS staff)	½ day	\$800
Allocation of mark coordinates (LPI's geodesy section)	1 day	\$1,600
<b>Total</b>	<b>6 days</b>	<b>\$11,600</b>

If the PM to be destroyed is "Established", then proven connections to at least 3 established PM's are required.



If the PM was "Established" and has been destroyed, then the proven connections to establish the new PM are more extensive (See below).

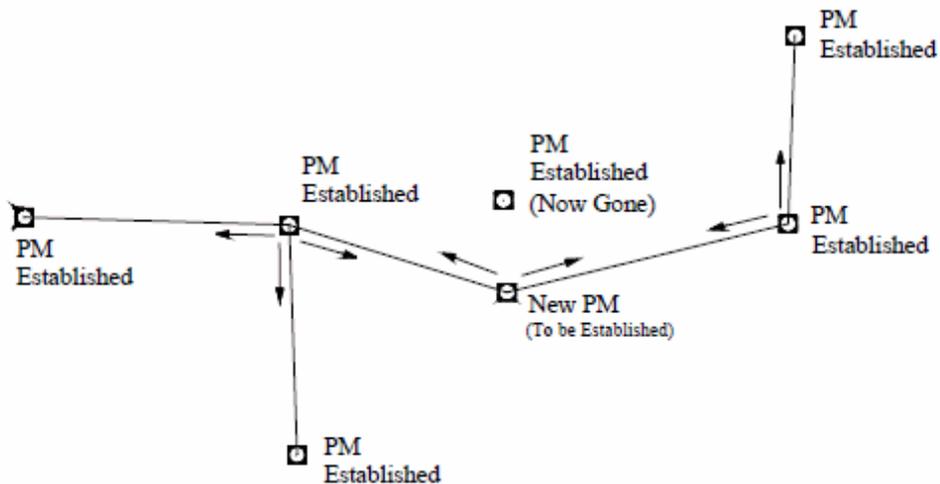


Figure 1: Establishing a new permanent survey mark (original mark existing vs. original mark gone) (LPI, 2004).

It has been stated that the cost to replace a survey mark after the original mark has been removed is four times higher than if the mark is replaced before removal (L. Gardner, 2013, email comm.). As well as the legislation relating to survey infrastructure, NSW has a number of directions and guidelines relating to survey infrastructure. These documents set out the standards for establishing survey marks of varying accuracy. For example, high-accuracy marks require numerous sets of observations, rigorous calculations (including least squares adjustments) and error analysis.

In the Port Macquarie-Hastings area, it is estimated that the average cost to establish new permanent survey marks to replace the marks that have been destroyed is \$40,000 per annum (L. Gardner, 2013, email comm.). This amount does not include the extra survey costs that arise when boundary marks, reference marks and bench marks are destroyed or the long-term cost of depletion of survey infrastructure in the LGA. Given there are about 3,500 listed SCIMS marks in the Port Macquarie-Hastings LGA, even if a very conservative value of \$1,000 was given to each of these marks, the cost of constructing this survey infrastructure is \$3.5 million. A 5-to-1 benefit-to-cost ratio was determined, by Price Waterhouse for the Land Information Centre, when assessing the survey control network (L. Gardner, 2013, email comm.). Hence, the overall value of the survey control network for the Port Macquarie-Hastings LGA is about \$18 million.

Unlike permanent survey marks, very little database information exists about other survey infrastructure in NSW. In the Port Macquarie-Hastings LGA about 20 Cadastral Reference (CR) marks have been included in SCIMS. Other database information about reference marks exists in LPI's DCDB. Otherwise, reference mark information needs to be extracted from survey plans on public record. A gross estimate of the costs incurred to establish each of the existing reference marks in the Port Macquarie-Hastings LGA is \$3.5 million. This calculation is based on each parcel having one reference mark, a mark value of \$100/mark and 35,000 parcels existing in the LGA.

### **3.4 Cost of Establishment, Maintenance and Repair for Council**

In the last seven years, Port Macquarie-Hastings Council has spent \$10,000 on the establishment of survey control marks (Brierley, 2013). Very little money has been spent on maintenance and repair work (J. Thompson, 2013, pers. comm.). Figure 2 shows a trigonometric station that was repaired by Council. Materials for the new vane were sourced from LPI. Total time taken to repair the trig, including travel time, was about half a day.



Figure 2: Trigonometric station repaired by Port Macquarie-Hastings Council.

### **3.5 Why is Survey Infrastructure Destroyed?**

There are a vast number of reasons why survey infrastructure is destroyed but the main reasons are lack of planning and ignorance. Non-surveyors generally underestimate the value of a survey mark, are unable to identify survey marks or do not know where survey marks most probably occur on a site. Unlike services, survey marks are sometimes not considered in the planning and design stage. This means, during works, survey marks are either destroyed or disturbed or construction is stopped, so the required fieldwork can be completed.

Maintenance work, which has a minimal planning stage, is performed quickly without consulting surveyors or checking if any survey marks will be impacted by the works. Even slashing, which generally does not affect other services, has damaged survey infrastructure when the machinery has run over a mark or hit a mark that is set on a concrete pillar. Another reason is that it is difficult for surveyors to place survey marks in a safe location that is unlikely to be disturbed as there is no service allocation space for survey marks within footpaths. Other service authorities have various sections of the footpath allocated to them for their service. In 1933, survey marks were allocated the 2-foot strip from the road boundary but the Post Master General's Office (now known as Telstra) used their overriding powers to place their cables in the 2-foot strip reserved for survey marks (Beaver, 1980). Survey marks are often placed in the kerb line, which has a finite lifespan, or on roadways, which make the marks very hard to access and expose them to resurfacing works.

### **3.6 Who Destroys Survey Infrastructure?**

As the majority of survey marks are within the roadway or on council reserves, these marks are destroyed by anyone performing works within this area. Following is a list of workers, who are most likely to destroy survey marks – some of these workers may not physically destroy the mark but the mark is destroyed due to their actions (or lack of actions):

- Engineers
- Designers
- Site foreman
- Civil construction workers
- Surveyors
- Trades persons
- Handymen
- Slasher operators
- Tree loppers
- Project managers
- Excavator operators
- Home handyman
- Farmers
- Sucker truck personnel
- Maintenance crews

### **3.7 Asset Management and Survey Infrastructure**

Land is already recognised as an asset. Survey infrastructure is just a subset of this asset. Hence, one way to better managing land as an asset is to manage survey infrastructure effectively as an asset. Appreciation or depreciation values can be placed on each survey

mark. The location of each mark can be stored in one central database. For example, a drill hole and wing will depreciate in value as the kerb moves or the kerb is due for replacement.

### **3.8 How are Survey Infrastructure and Boundaries Currently Being Managed?**

The Surveyor General and LPI manage survey infrastructure in the following ways: legislation, directions, guidelines, fines, work programmes, audits, advice, the SCIMS database and other databases.

Councils manage survey infrastructure by making survey infrastructure information available to all council employees, abiding by and following relevant acts, regulations, directions and guidelines, and by maintaining and repairing permanent survey marks. The City of Sydney Council has extensive boundary and survey infrastructure records, while North Sydney Council has a development condition relating to the preservation of survey marks. Ryde Council has adopted a practice of placing cover boxes over buried reference marks or reinstating drill hole and wings (de Belin, 2012).

Private surveyors manage survey infrastructure by purchasing survey infrastructure information from LPI and abiding by and following relevant acts, regulations, directions and guidelines. Also, these surveyors may choose to seek approval from the Surveyor General to defer the placement of survey marks, if the proposed construction works are going to impact the newly placed marks.

## **4 MANAGING SURVEY INFRASTRUCTURE INTO THE FUTURE**

How can survey marks and boundaries be better managed in the future? These are some of the things the State could consider in this regard:

- Review and consider adopting some of the practices of Land Information New Zealand.
- Improve the accuracy of the DCDB.
- Allow 2-way exchange of cadastral model data between LPI and councils (or other organisations), to avoid duplication of work relating to the improvement of the DCDB.
- Reconsider being a Dial Before You Dig (DBYD) provider by offering spatial data at a discounted price to DBYD, in exchange for them waiving their fees.
- Keep moving forward to a realisation of Cadastre 2014.
- Make ePlan compulsory in 12 months' time (and assist surveyors whose software provider has not come on board by using saving provisions or providing surveyors with temporary licences for other software packages).
- Establish a 'mark destroyed' hotline to LPI for councils.
- Work with councils and surveying organisations to develop a preservation of survey marks training package (including a short induction video starring the Surveyor General).
- Include 'preservation of survey marks' clauses in the LGA and Roads acts (Noad, 2013).
- Review the nature of current reference marks.
- Encourage increased use of the Cadastral Reference (CR) mark type in SCIMS and consider adopting CR marks as a fourth level of mark in SCIMS to allow movement of these marks to be monitored.
- Flag survey control marks, which have been used as boundary reference marks, in SCIMS.
- Have one integrated land administration database, e.g. combine SCIMS and DCDB databases in the future.

- Include questions related to the preservation of survey marks in the Board of Surveying and Spatial Information (BOSSI) exam for the engineering project as part of the registration process.
- Have less compiled plans (especially in rural areas).

Councils may consider adopting the following practices:

- Targeted ‘preservation of survey marks’ induction training to be undertaken by all council staff and contractors involved in any council works programmes.
- Develop a training package with LPI and surveying organisations.
- Develop project plans, relating to the preservation of survey marks and boundaries, to review and improve services in these areas.
- Design plans to show all survey infrastructure.
- Survey infrastructure to be considered in the planning stage of projects.
- If required, include a ‘plan of survey information only’ in the future capital works drawing sets (G. Randall, 2013, email comm.).
- Ensure all relevant survey information is captured at the preliminary stage of the design process to allow appropriate consideration to be given to this information in the preparation of design information (G. Randall, 2013, email comm.).
- Have all state survey marks and boundary reference marks (shown on registered plans) in Council’s mapping software, such that operational staff and engineers can view the mapping system for potential survey impacts due to maintenance works ahead of commencement (G. Randall, 2013, email comm.).
- Highlight the location of all survey marks prior to construction by placing indicator stakes adjacent to a survey mark or cover boxes over survey marks (de Belin, 2012; LPI, 2012).
- Use cadastral modelling software to improve the DCDB and add reference mark information to GIS.
- Get CR mark numbers allocated to critical reference marks.
- Collaborate with LPI on DCDB accuracy improvement.
- Help establish a fixed survey-accurate cadastre over the whole of the LGA.
- Include conditions about preservation of survey marks in development consents.
- Audit survey marks pre and post construction (L. Gardner, 2013, email comm.).
- Identify areas where boundary marks are lost and redefine boundaries in these areas.
- Coordinate unestablished permanent survey marks with connections to boundary corners.
- Have a cadastral vision for the LGA.
- Develop policy and procedure documentation.
- Include survey marks as an asset to be considered in land access notices.
- Include ‘Is a plan of survey information only needed?’ as a checklist item in development applications, construction certificates and reviews of environmental effects.
- Review rolling and capital works programmes to isolate projects that may impact survey marks.
- Assess survey human resources in the organisation and whether succession planning will be required in the near future.
- Assess if any survey marks have historical value.
- Hand out LPI’s *Survey marks: All about protecting them* brochure (LPI, 2012) to all contractors, including engineers.

Private industry surveyors and industry bodies representing surveyors and spatial scientists might consider adopting the following practices:

- Provide more Continuing Professional Development (CPD) events relating to the preservation of survey marks.
- Audit marks pre and post construction (L. Gardner, 2013, email comm.).
- Allocate a surveyor to be responsible for survey infrastructure on a construction site.
- Ensure all relevant survey information is captured at the preliminary stage of the design process to allow appropriate consideration to be given to this information in preparation of design information (G. Randall, 2013, email comm.).
- Show all permanent survey marks and reference marks on detail survey and design plans.
- Include survey mark notes on design plans or reports.
- Lodge mark status reports.
- Contact Council or LPI before marks are destroyed and advise of works that may impact survey marks.
- Be aware of any survey marks that have been destroyed on the site you are project managing.
- Include ‘Is a plan of survey information only needed?’ as an item in design plan checklists.
- Understand the lack of human and time resources in councils.
- Assess the knowledge base of your local council’s survey department.
- Be aware if a survey department does not exist at your local council.
- Make sure your council has a cadastral vision for their area.
- Consider having workplace policies and procedures relating to the preservation of survey marks.
- Inform the council surveyor of any areas where lost boundaries exist.
- Hand out LPI’s *Survey marks: All about protecting them* brochure (LPI, 2012) to all contractors, including engineers.

## **5 CONCLUDING REMARKS**

Survey infrastructure remains an essential element of land administration in NSW. The value of infrastructure needs to be clearly understood by all surveyors, as well as people who directly and indirectly benefit from the existence of this asset. Due to current NSW legislation, survey infrastructure is a component of the cadastre. This needs to be communicated to all surveyors, spatial scientists and any other users of digital cadastral databases. A series of small steps is required for cadastral reform in order to progress into the future. For example, this includes registered land surveyors taking an active role in the development of the DCDB of their LGA and being aware of the direction their council is heading in relation to boundaries and survey infrastructure. Prior to changing the methods of locating or relocating boundaries, it is required to gather as much information as possible about existing permanent survey marks and reference marks, including the marks’ MGA position. This information can also be used in the planning stages of future works.

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