

# FIG WORKING WEEK 2019

22-26 April, Hanoi, Vietnam

Presented by the FIG Working Week 2019,  
April 22-26, 2019 in Hanoi, Vietnam

"Geospatial Information for a Smarter Life  
and Environmental Resilience"



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## Comparisons of Process Automation in Cadastral Digitisation Implementations in Australia From Fit for Purpose to Digital Rigour in Spatial and Transaction Processes.

Ian HARPER



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## OUTLINE

1. **SPATIAL DIGITISATION INNOVATION CASE STUDIES (after 15 years)**
  - I. **New South Wales (NSW)** - Capital Intensive strategy to achieve the highest levels of Digitisation and Automation
  - II. **Northern Territory (NT)**– Low Capital Investment to achieve relatively high levels of Digitisation and Automation with 3D cadastral capture.
2. **Progressing Fit For Purpose (FFP)**
  - I. How to progress the most cost effective spatial improvement of a FFP solution based on experiences from NSW & NT.
  - II. Transitioning data to be smarter and **Fit or the Future**.
  - III. Managing data in smarter processes



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## Digitisation of Survey Data and Processes in Australia

Whilst all States and Territories are part of a national Intergovernmental Committee on Survey and Mapping – (ICSM) ePlan initiative only the more populated States (Queensland, New South Wales and Victoria) invested in ongoing development. The Singapore Land Authority also adopted the ICSM LandXML data structure several years ago.

NSW has progressed the furthest into the national initiative whilst the Northern Territory has moved to a simpler digitisation implementation that does not utilise the ICSM data model.

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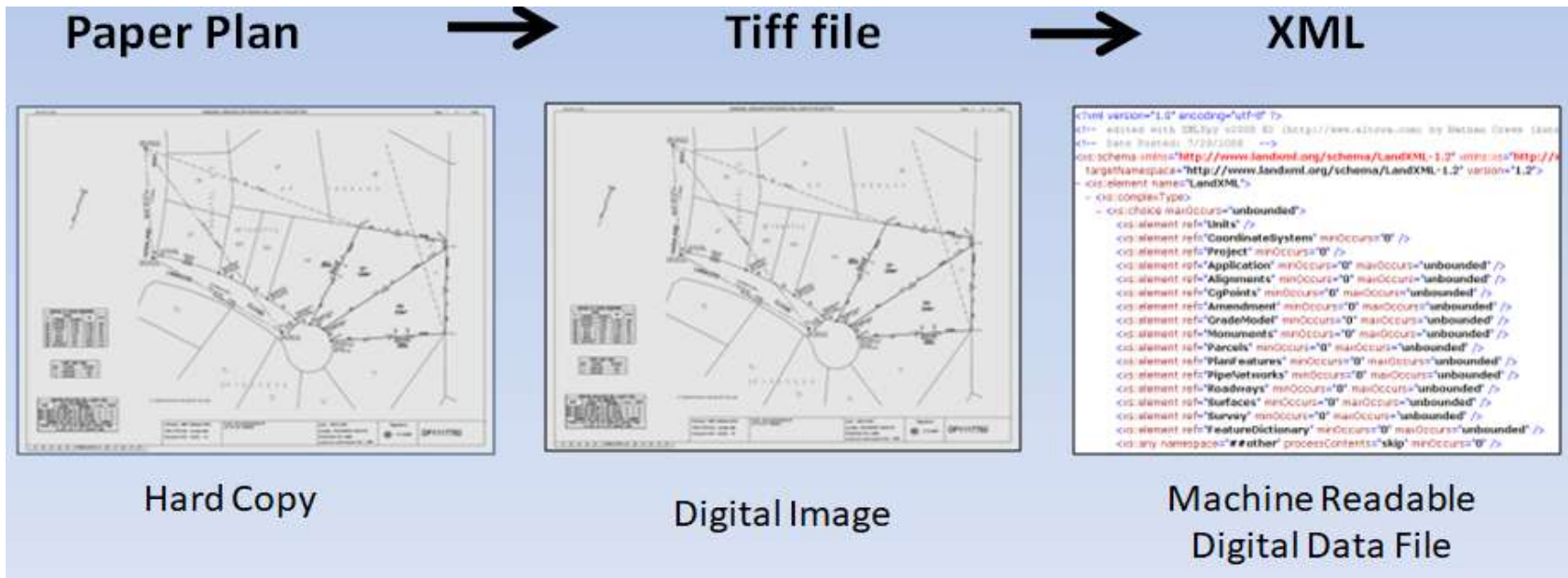
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## Digitisation of Survey Plans



The survey plan content is stored as a Parcel Fabric Survey Database in a machine readable (XML) digital data file to benefit from digital efficiencies.

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# DIGITISATION CASE STUDIES

## Northern Territory

Area - 1.3 mill sq kms

Population - 250,000

Total Parcels - 85,000

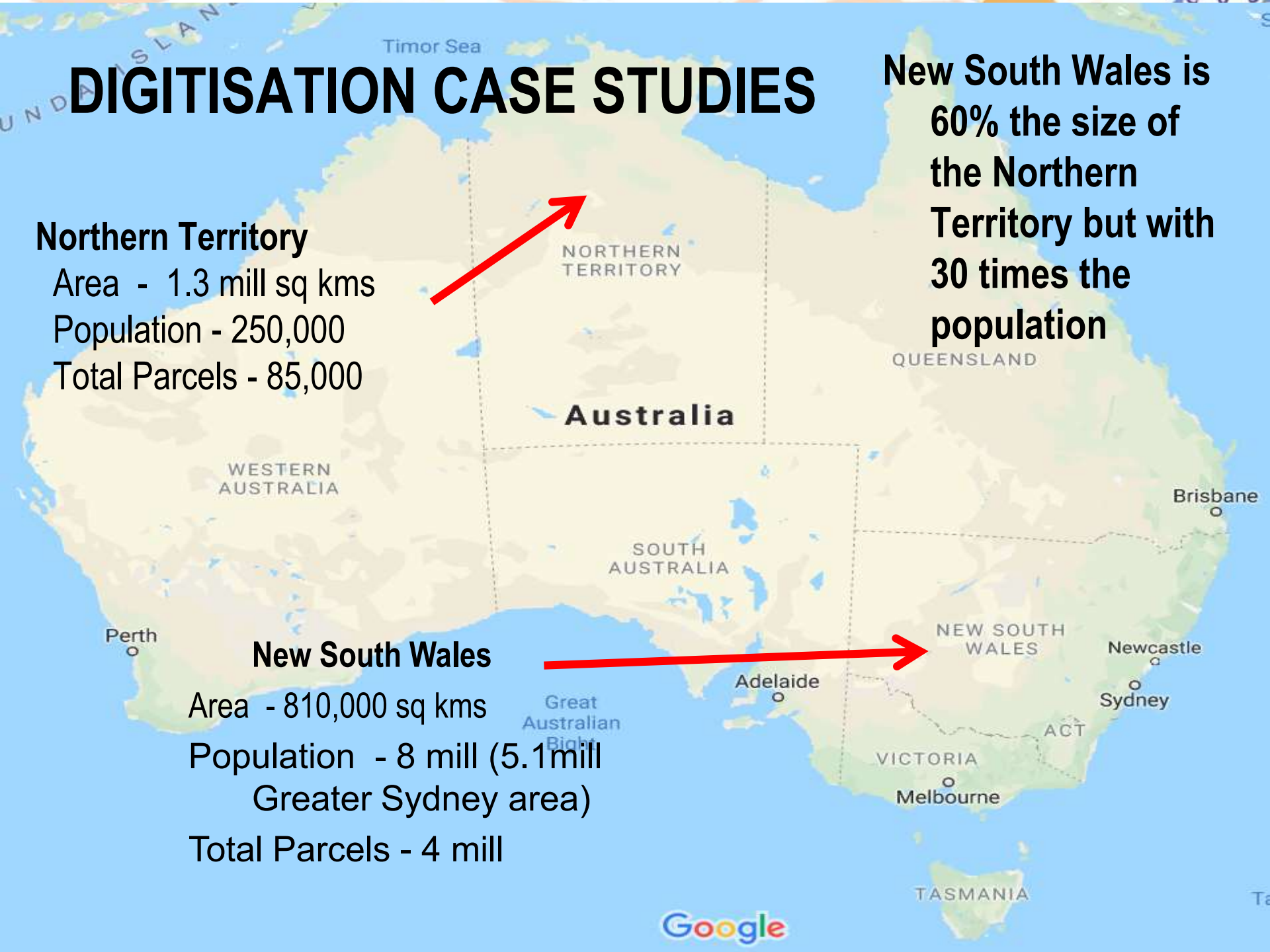
New South Wales is 60% the size of the Northern Territory but with 30 times the population

## New South Wales

Area - 810,000 sq kms

Population - 8 mill (5.1 mill Greater Sydney area)

Total Parcels - 4 mill





## Northern Territory

Area - 1.3 mill sq kms

Population - 250,000

Total Parcels - 85,000

NORTHERN TERRITORY

Australia

Brisbane

Perth

## New South Wales

Area - 810,000 sq kms

Population - 8 mill (5.1 mill

Greater Sydney area)

Total Parcels - 4 mill

Great  
Australia  
Right





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## Digitisation in New South Wales (NSW)

NSW has invested strongly in the ICSM LandXML schema to:

- represent every component of a survey plan in a machine readable format
- implement a high level of rigour and automation
- be able to regenerate the image of the survey plan from the machine readable data file so surveyors will only be required lodge one LandXML file.

When plans are complicated this has proved challenging.

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# NSW Survey plan

DP1031965

SURVEYS (PRACTICE) REGULATION 1996: CL 32(2)						
MARK	MGA COORDINATES		ZONE	CLASS	ORDER	
	EASTING	NORTHING				
SSM 52690	33 864.912	6246 487.860	56	B	U	U
SSM 125953	33 685.150	6246 245.702	56	B	U	U
SSM 125954	33 736.751	6246 362.511	56	B	U	U
SSM 125960	33 772.628	6246 468.828	56	B	U	U

COMBINED SCALE FACTOR (CSF) = 0.999996

SOURCE: MGA COORDINATES ADOPTED FROM SCIPM ON 21 MARCH 2000

Registered 78 2001

CA: SEE CERTIFICATE

Title System: TORRENS

Purpose: SUBDIVISION

Ref. Map: MARRICKVILLE SH 57

Last Plan: DP 600471

PLAN OF SUBDIVISION OF LOT 100 IN DP 600471

Lengths are in metres. Reduction Ratio 1: 500

LGA: MARRICKVILLE

Suburb/ Locality: ST. PETERS

Parish: PETERSHAM

County: CUMBERLAND

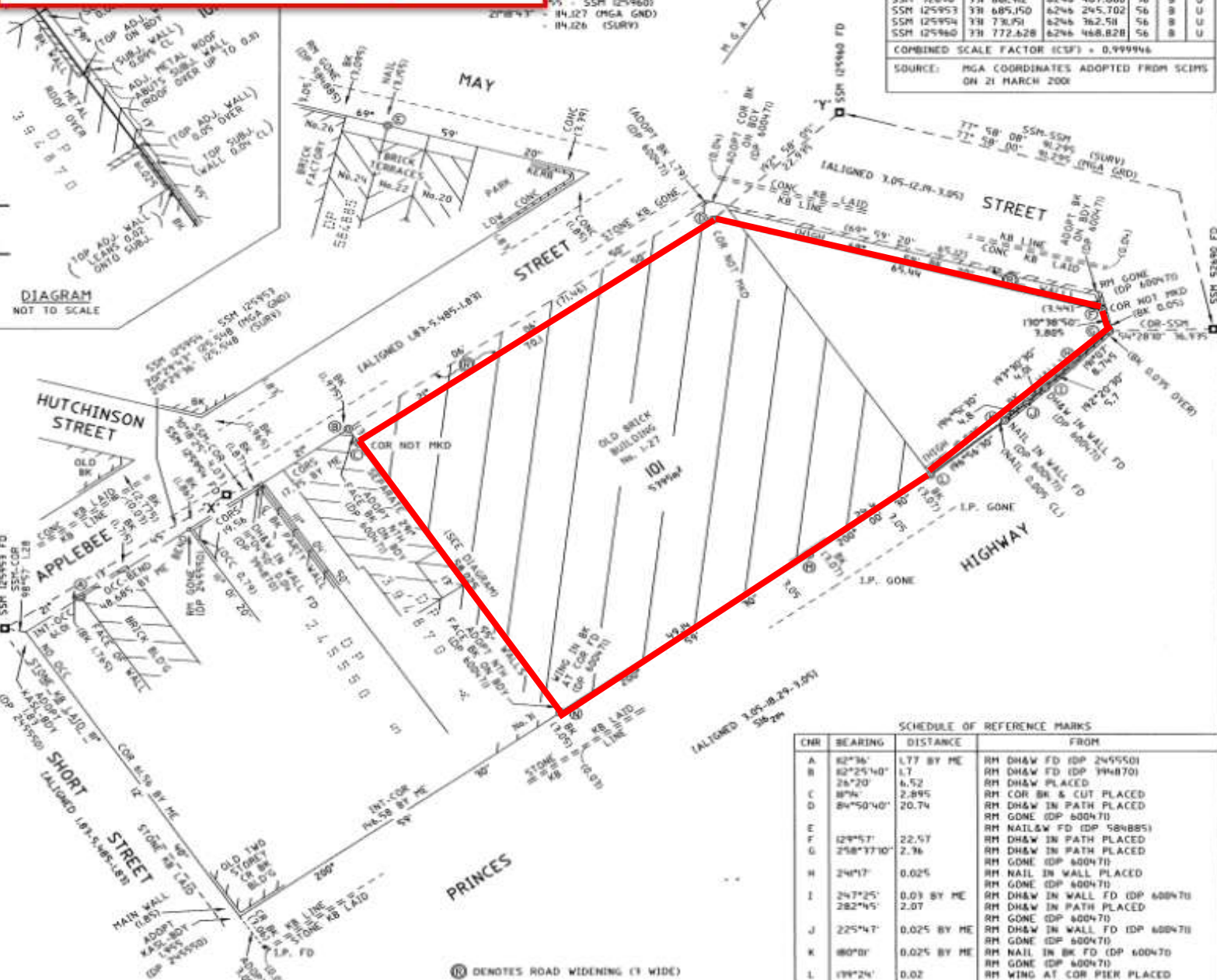


DIAGRAM NOT TO SCALE

Ⓡ DENOTES ROAD WIDENING (3 WIDE)

NOTE: EXISTING STRUCTURES ON LOT 101 AND ROAD WIDENING AREA ARE TO BE DEMOLISHED

This is sheet 1 of my plan in \_\_\_\_\_ sheets (delete if inapplicable)

I, GIUSEPPE JOHN BOTTARO of BEUTHEN de NETT PTY LTD PO BOX 440, SUTHERLAND NSW 1499 a surveyor registered under the Surveyors Act 1928, hereby certify that the survey represented in this plan is accurate, has been made in accordance with the Surveyors (Practice) Regulation 1996 and was completed on 16 March 2001

The survey relates to \_\_\_\_\_ LOT \_\_\_\_\_

(Here specify the land actually surveyed, or specify any land shown in the plan that is not the subject of the survey)

(Signature) *G. J. Bottaro*

Surveyor registered under the Surveyors Act 1928

Datum Line: 'X'-'Y' Zone: Suburban/Heavy

Plans used in preparation of survey/compilation:

DP 111187	DP 245550
DP 394870	DP 584885
DP 600471	

CHN	BEARING	DISTANCE	FROM
A	82°36'	1.77 BY ME	RM DH&W FD (DP 245550)
B	82°25'40"	1.7	RM DH&W FD (DP 394870)
C	26°20'	6.52	RM DH&W PLACED
D	87°4'	2.895	RM COR BK & CUT PLACED
E	84°50'40"	20.74	RM DH&W IN PATH PLACED
F			RM GONE (DP 600471)
G	129°57'	22.57	RM NAIL&W FD (DP 584885)
H	258°37'10"	2.76	RM DH&W IN PATH PLACED
I	247°25'	0.03 BY ME	RM DH&W IN PATH PLACED
J	282°45'	2.07	RM GONE (DP 600471)
K	225°47'	0.025 BY ME	RM DH&W IN WALL FD (DP 600471)
L	80°08'	0.025 BY ME	RM GONE (DP 600471)
M	199°24'	0.02	RM NAIL IN BK FD (DP 600471)
N	359°13'	0.025 BY ME	RM GONE (DP 600471)
O	247°25'	0.03 BY ME	RM DH&W IN WALL FD (DP 600471)
P	282°45'	2.07	RM DH&W IN PATH PLACED
Q	225°47'	0.025 BY ME	RM GONE (DP 600471)
R	80°08'	0.025 BY ME	RM DH&W IN WALL FD (DP 600471)
S	199°24'	0.02	RM GONE (DP 600471)
T	359°13'	0.025 BY ME	RM WING AT COR PIER FD (DP 600471)
U	247°25'	0.03 BY ME	RM GONE (DP 600471)
V	282°45'	2.07	RM NAIL&W PLACED
W	225°47'	0.025 BY ME	RM DH&W FD (DP 394870)

PANEL FOR USE ONLY for statements of intention to dedicate public roads, to create public reserves, drainage reserves, easements, restrictions on the use of land or positive covenants.

IT IS INTENDED TO DEDICATE THE LAND MARKED "ROAD WIDENING (3 WIDE)" TO THE PUBLIC AS ROAD.



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## Digitisation in New South Wales (NSW)

Land Registry Services NSW utilises the Plan Test application for a rigorous examination.

**Seaconis (inc)** developed the desktop or server application to immediately examine the content of a survey plan lodged as a Parcel Fabric Survey Database through a portal.

After passing the portal examination (140 tests) the spatial analysis based on automated comparisons with existing survey plans joined into a Parcel Fabric Survey Database is undertaken.

This process has also been adopted by the Singapore Land Authority.



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## Digitisation in the Northern Territory (NT)

Extracting relevant measurement and other data from all NT survey plans is all but complete after 15 years.

Local surveyors as major stakeholders were engaged in the data capture so they were part of the process and understood how it worked.

The NT the mapping based Cadastral Database has now been replaced by a Parcel Fabric Survey Database (SPICAD) built by compiling machine readable files of individual survey plans.

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## Digitisation in the Northern Territory

Total Digital lodgement was made mandatory in 2017. That lodgement is simplified with a mixture of formats:

1. **a digital image of the new survey plan**
2. **A file of machine readable XML text.** That content relates only to parcel dimensions and other measurements that can benefit the spatial upgrading of the parcel fabric (SPICAD) or statutory jurisdictional content needed for transactions.
3. **A standard Plan Examination Report** generated by Surveyors.

The NT approach is minimalist compared with NSW but scalable if more rigour or cadastral intelligence is required in the future.

Basic heights are also entered and stored as parcel attributes when capturing Strata/Apartment/Condominium survey plans for 3D modelling from the SPICAD survey database.

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Test



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# The Northern Territory Survey Database with 3D parcel Attributes



130.8340645°E 12.4563558°S 25 m Selected Features: 1

Layers X

Delete Calculate Selection: Zoom To Switch Clear Delete

Type	StatedArea	Accuracy	Shape_Area	OBJECTID_1	Plan	Lot	Floor_lev	Ceiling_He	Floor	Lot_Plan
59	81	2	81.259844	11	UTS2014016	9070	23	2.7	First_Floor	9070_UTS2014016
59	155	2	155.180805	15	UTS2014016	9074	26	2.7	Second_Floor	9074_UTS2014016
59	155	2	155.180805	57	UTS2014016	9116	44	2.7	Eighth_Floor	9116_UTS2014016
59	155	2	155.180805	50	UTS2014016	9109	41	2.7	Seventh_floor	9109_UTS2014016
59	155	2	155.180805	36	UTS2014016	9095	35	2.7	Fifth Floor	9095_UTS2014016

# Cadastral Database with 3D Parcel Attributes – Below ground

ion Inquiry Labeling



## UTS2014105\_parcel - 10135

Accuracy	2
Rotation	0.39624
Scale	1.000048
Unclosed	0
MiscloseRa	33084.590956
MiscloseDi	0.00766
MiscloseBe	66.741069
Constructi	0
ShapeStdEr	0.001
ShapeStd_1	0.002
BacksightB	224.633333
Shape_Leng	253.454509
Shape_Area	3072.912361
OBJECTID_1	2
Plan	UTS2014105
Lot	10135
Floor_lev	20
Ceiling_He	3.7
Floor	Basement
Lot_Plan	10135_UTS2014105



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## New South Wales and the Northern Territory - Similarities

Both operate under the Torrens Title System – (boundary definition by "Monument over Measurement" based on survey Title Maps/diagrams **registered by government which guarantees Title but not spatial extents**)

Both **began with a Fit For Purpose mapping based cadastral database** in the 1990s and transitioned to a Parcel Fabric Survey Database to pursue higher spatial precision and digital workflows.

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## New South Wales and the Northern Territory - Differences

1. The level of content captured from survey plans into digital survey database
2. The level of rigour involved in automated plan data examination

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NT - modern efficiencies





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## How do we progress spatially from FFP?

To improve the spatial integrity and introduce digital efficiencies:

- Smarter data structure
- Smarter database management

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## Smarter Data Structure

**SMART DATA** – Digital objects (parcels) with attributes that allow applications to create smarter solutions.

### Attribute examples

- Unique Identifier (mandatory)
- If nothing else available – default values can be applied
- Jurisdictional identifiers
- Source of data
- Parcel spatial integrity - indexing is high for modern survey/GNSS data or low from other spatial data
- Any other intelligence relevant to land administration

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## Smarter Management

### Parcel Fabric Survey Database

1. Strategic **Object based** computation environment compared with existing survey coordinate geometry computation methods (points & lines) and survey plan outcomes (local solution identifying parcel relationships).
2. **Manages any type of cadastral data**
  - Digital survey measurement data, plan records or basic measurement records
  - GNSS observations
  - Spatial
    - Migrating existing mapping databases
    - Parcel databases digitised from imagery or local cadastral maps
    - Crowdsourcing



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## Smarter Management

### A Parcel Fabric Survey Database

3. **Parcel spatial integrity indexed** – adjustment weighting is high for modern survey/GNSS data or low from other spatial data - good survey data is not corrupted by surrounding data of less quality
4. **Scaleable** – Local datasets can be uploaded to a regional or state Parcel Fabric Survey Database retaining the complete parcel fabric functionality.

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# A Parcel Fabric Survey Database – A Smarter Database

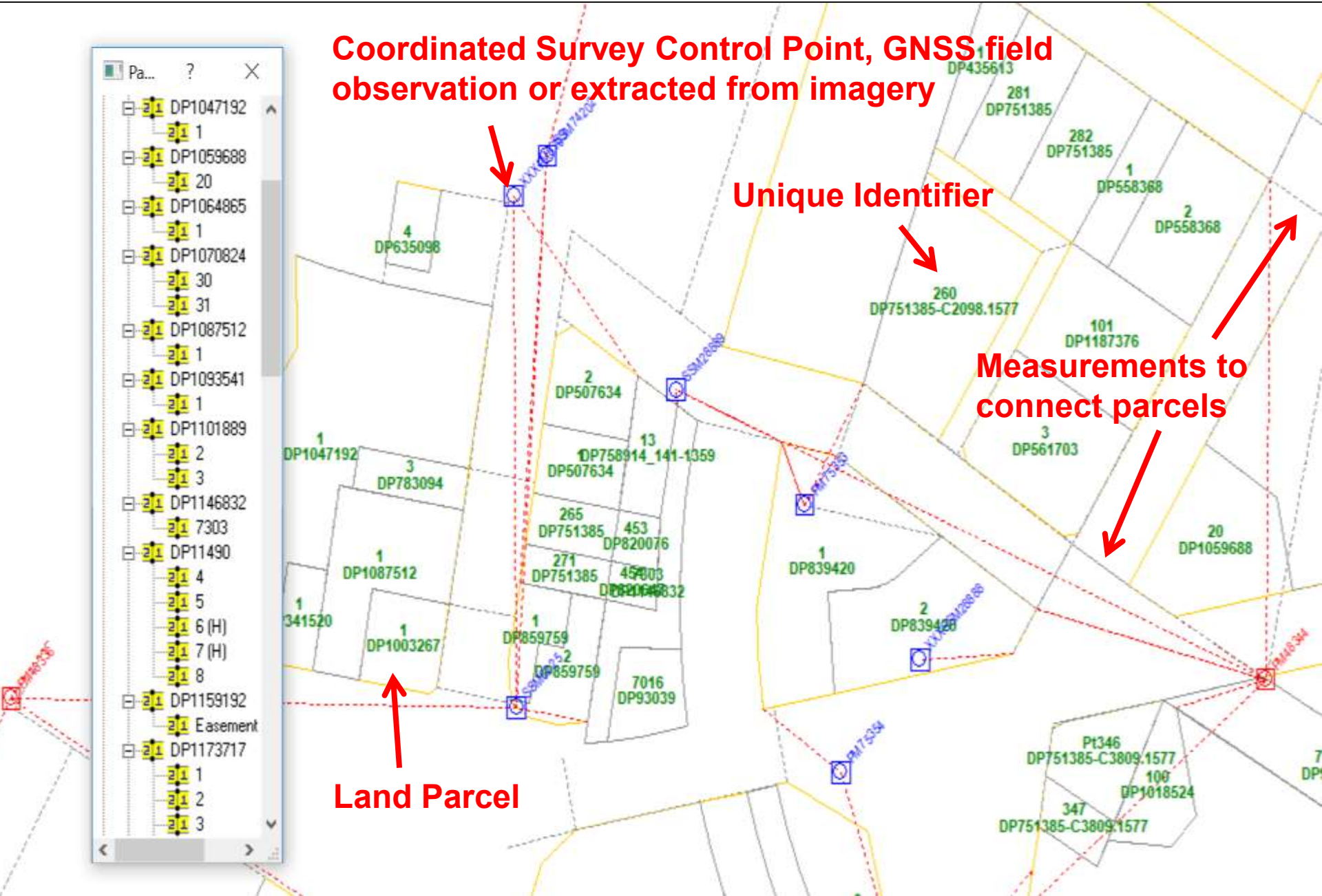
- DP1047192
  - 1
- DP1059688
  - 20
- DP1064865
  - 1
- DP1070824
  - 30
  - 31
- DP1087512
  - 1
- DP1093541
  - 1
- DP1101889
  - 2
  - 3
- DP1146832
  - 7303
- DP11490
  - 4
  - 5
  - 6 (H)
  - 7 (H)
  - 8
- DP1159192
  - Easement
- DP1173717
  - 1
  - 2
  - 3

**Coordinated Survey Control Point, GNSS field observation or extracted from imagery**

**Unique Identifier**

**Measurements to connect parcels**

**Land Parcel**





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## How do we progress spatially from FFP?

Conversion to a Parcel Fabric:

- The spatial integrity of the database does not change
- the parcel data structure is migrated to a machine readable text file storing all attributes.
- The parcel attributes entered as part of creating the FFP database are retained so the investment in creating the FFP database is not lost.
- The platform is set to add further intelligence to the data like Rights, Restrictions and Responsibilities (RRR). Even if these are not initially spatially defined, an attribute notification can be added to relevant parcels with reference to documentation.

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## How do we progress spatially from FFP?

The NSW and NT cadastres are based on a Torrens Title system underpinned by registered deeds and survey plans.

The Northern Territory has transitioned from a mapping database to a Parcel Fabric Survey Database as a vehicle to higher levels of spatial precision and differing levels of digital automation.

In any system where existing plans or other spatial records have a legal status, consideration of including some of the content of those documents should be the part of the process to improve spatial accuracy.

BUT that need only happen if budgets and resources permit.

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## The process to make Land Administration data Fit for the Future

- Collation of any available data into a Parcel Fabric Survey Database
- Resolve issues of parcel topology (or spatial relationships) and connectivity
- Upgrade small areas as new data becomes available using local resources.

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Nothing changes – nothing is lost





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## Digital Outcomes for the Future

- A locally sustainable process using a stand alone application that feeds into a regional or State ESRI Parcel Fabric retaining full fabric functionality in an XML file.
- An open text data structure allowing access by other applications
- Future efficiencies through:
  - Automation
  - Digital transactions
  - Blockchain

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## Thank you for your attention.

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