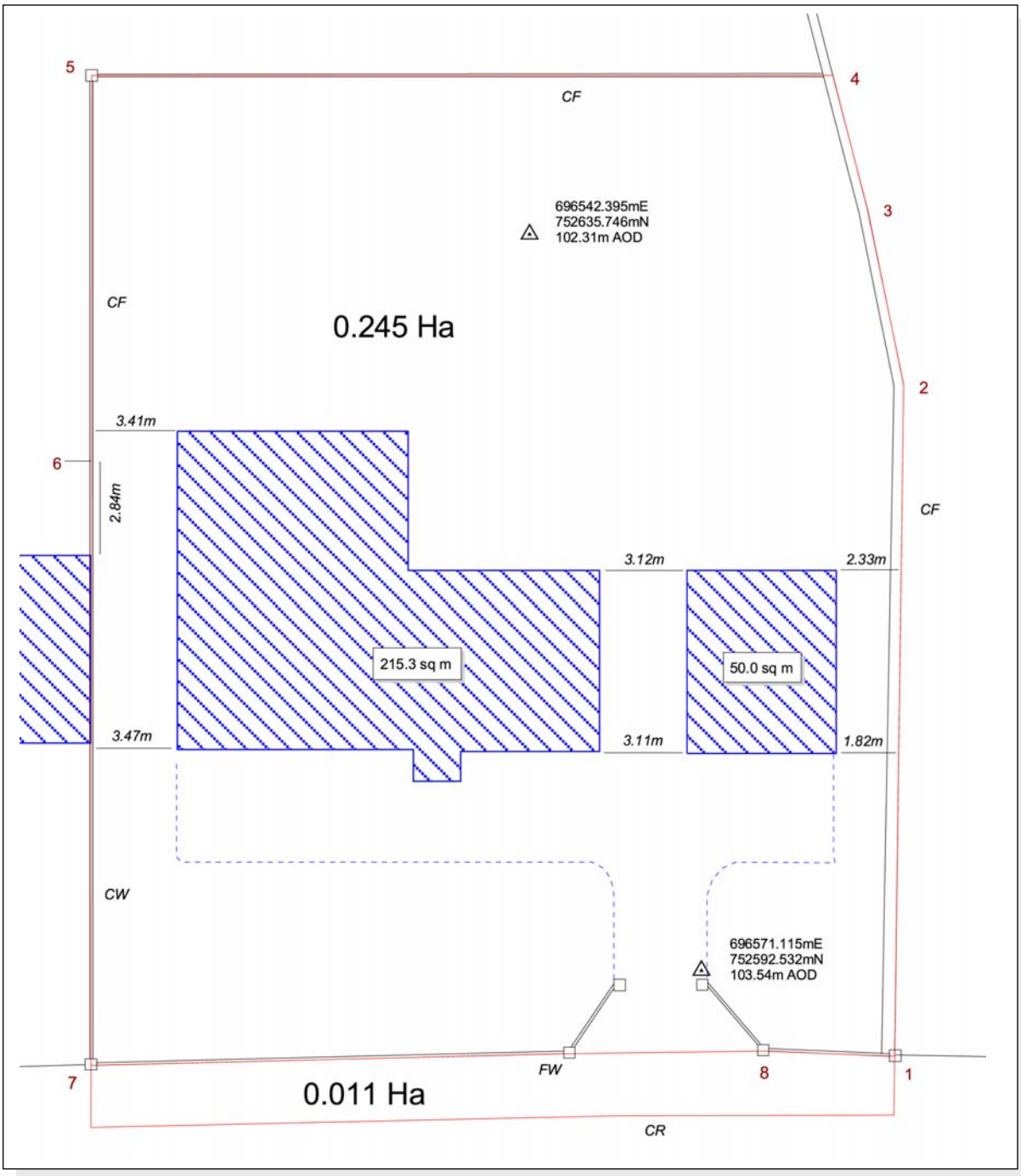
GREEN PAPER

PROPOSING REFORM OF

BOUNDARY SURVEYS IN IRELAND



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BOUNDARY SURVEYS

28th July 2008

Commission on Land Registration

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GLOSSARY OF TERMS

This glossary of terms should be used in conjunction with another glossary (ref DM3/2006) supplied on the Property Registration Authority's website under the Digital Mapping Project page at http://www.landregistry.ie/eng/Digital_Mapping_Project/

Accuracy	Proximity of a measured quantity to its true value
o Absolute accuracy	Proximity of a recorded position to its true value with respect to a coordinate reference system (external consistency). This is now determined using GNSS equipment and the Active GPS network (since maintenance of the Trigonometric and the Passive GPS networks has been discontinued).
o Relative accuracy	Proximity of the relative recorded positions of features to one another to their true values (internal consistency).
o Map accuracy	Traditionally related to map scale, and also known as map tolerance. The international norm is 0.2mm (width of smallest pen used to draw map features) multiplied by the map scale. Therefore, accuracy would be expected to be 0.5m for a 1:2500 scale map.
o Survey accuracy	Ground surveys can be carried out to defined standards of absolute and relative accuracy, which can be significantly better than map accuracy.
Boundary	A line determining the limits of an area
o Parcel boundary	A line determining the limits of a parcel of land.
o Title boundary	A line determining the limits of ownership (legal title) of a parcel of land, perceived as an imaginary line, having no thickness.
o General boundary	A line determining the limits of ownership of a parcel of land represented by a topographical map of physical features. General boundaries have three characteristics: ▪ The ownership of the physical feature is left undetermined; ▪ The location of the title boundary within the physical feature is left undetermined; ▪ Position of the boundary is regarded as approximate.
o Fixed Boundary	A line determining the limits of ownership of a parcel of land where all parties involved must agree on the position of each boundary point, after which these points are marked with a boundary monument, and a precise survey of all the boundary monuments is carried out (Stoter & van Oosterom, 2006).
o Dynamic boundary	A line determining the limit of an area which changes location gradually and naturally over time. Examples include the mean high water mark (MHWM) and mean

	low water mark (MLWM). In coastal areas ownership of private property extends to the MHWM, and ownership of the foreshore between the MHWM and the MLWM is vested in the State, where commonly the management of which is delegated to the relevant Local Authority. However the location of these two boundaries changes continually due to the effects of erosion or deposition, so landowners in these areas may loose or gain occupation rights in these areas. Legal title to these new areas may be extended via possessory title mechanisms.
o Property Line	In these best practice guidelines the line representing the current limits of occupation of a parcel is termed a property line for practical purposes to distinguish it from the other theoretical concepts above.
Boundary Monument	Monuments at discrete points along an agreed boundary which have been precisely surveyed and recorded so that they can be accurately re-positioned if necessary
Land Parcel	An area of land that is defined by boundaries and has unique ownership with homogeneous real property rights (ECE, 2005)

ABBREVIATIONS

CAD	Computer Aided Design
CRS	Coordinate Reference System
EI	Engineers Ireland
ESRI	Economic and Social Research Institute
EU	European Union
EULIS	European Land Information Service
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
Ha	Hectare
INSPIRE	Infrastructure for Spatial Information in Europe
IAVI	Irish Auctioneers and Valuers Institute
IG75	Irish Grid (coordinate reference system) 1975 realisation
IIS	Irish Institution of Surveyors
ITM	Irish Transverse Mercator - the new more accurate coordinate reference system for Ireland adopted in 2002
ITRIS	Integrated Title Registration Information System
ISDI	Irish Spatial Data Infra-structure
LR	Land Registry
mm	Millimetres
MSL	Mean Sea Level
OSGM02	Ordnance Survey Geoid Model 2002
OS	Ordnance Survey (single organisation for Ireland & UK prior to 1922)
OSGB	Ordnance Survey of Great Britain
OSi	Ordnance Survey Ireland
OSNI	Ordnance Survey of Northern Ireland
ppm	Parts per million
PRA	Property Registration Authority
RIAI	Royal Institute of Architects of Ireland
RMSE	Root Mean Square Error method for determining and reporting accuracy
RoD	Registry of Deeds
SCS	Society of Chartered Surveyors

EXECUTIVE SUMMARY

> *"I have a dispute with my neighbour over where the boundary lies. Can you tell me who is right?* ***No. The Land Registry map is an index map and identifies property, not boundaries. Therefore, we are not in a position to advise."*** *(Property Registration Authority website, accessed on 9/7/2008)*

This quote is taken directly from the Frequently Asked Questions page of the PRA website. For most property owners this answer is unbelievable. If the PRA cannot supply reliable information on property boundaries to resolve boundary disputes, who can, or more importantly, should the PRA be in a position to do so?

Information held in the PRA folios is widely considered as reliable, so a State guarantee is provided for the title, and the system is perceived as secure. In contrast, information in the PRA mapping is widely considered as unreliable, so a State guarantee is not provided for the location or extent of boundaries, thus the system is perceived as less secure.

The national rectification of property boundaries currently underway via the PRA digital mapping project is to be commended. It is addressing some of the mapping concerns and bringing the PRA index map into the 21st century. However PRA property boundaries are still associated with OSi maps, the accuracies of which have been quantified by OSi as:

- RMSE[1] = ± 0.60 metre for 1:1000 maps of urban areas
- RMSE = ± 0.69 metre for 1:2500 maps of sub-urban and peri-urban areas
- RMSE = ± 1.22 metre for 1:5000 maps of rural areas

The PRA digital mapping project uses the following criteria (PRA, 2007) as tolerances to move existing legal boundaries on PRA mapping into association with features on the new OSi maps:

- ± 2.0 metres for 1:1000 maps of urban areas
- ± 5.0 metres for 1:2500 maps of sub-urban and peri-urban areas
- ± 20 metres for 1:10560 maps of rural areas

These two sets of tolerances might, on their own be acceptable, but when combined there is potential for considerable change of the position of legal boundaries. Additionally, these changes are occurring without the knowledge of the landowners concerned, so landowners need to be particularly careful to ensure the new PRA records actually record the correct position of their boundaries.

OSi and OSNI have provided Ireland with one of the best surveying infrastructures in the world and surveyors now have the ability using this infrastructure to define the

[1] RMSE stands for 'root mean square error' which means that the accuracy of the OS detail in these maps has a 67% confidence of being more accurate than the figure specified.

locations of property boundaries to centimetres in a national context. This allows surveyors identify discrepancies in OSi and PRA maps which should now be amended when reported. The accuracy potential of modern surveying practice is not being exploited by the PRA to attain the potential of a truly digital property map.

These best practice guidelines for boundary surveys are proposed to address this mapping deficiency. They have been prepared with a view to improving the accuracy of maps submitted to the PRA. As a result solicitors and others can expect to get a uniform high accuracy product.

A more secure PRA mapping system where uncertainty in the map information is minimised or eliminated is required to rectify the current unreliable situation and to register landowners' most valuable assets with certainty. The minimisation of uncertainty in PRA maps is also urgently required for Ireland's e-Conveyancing needs, the Irish Spatial Data Infrastructure, compliance with the EU INSPIRE Directive, better compatibility with the EULIS initiative, to name just a few. The non-conclusive boundary system based on OSi maps was adopted for a post famine agrarian society in the 19th century and is now considered inappropriate for Ireland's needs for the 21st century.

The Registration of Title Act provides for the registering of boundaries as conclusive, as distinct from general boundaries, to provide greater certainty than a simple map index to folios. Landowners should be provided with the option to use this facility if they so wish, however, in a defined and controlled manner. These best practice guidelines also outline how this should be done in a manner which is consistent with international best practice.

The development of a national land management system will be critical for Ireland during the 21st century to develop and implement policies to maximise development and use of land and natural resources, but in a sustainable manner. These systems require information on the spatial definition of parcels and all the rights, restrictions and responsibilities associated with those parcels where uncertainty has been minimised or eliminated in order to maximise the benefits of the system. This is an ideal opportunity to implement radical change for Ireland's next century of development.

1 INTRODUCTION

1.1 *Introduction*

The implementation of the Land Registry digital mapping project was the main stimulus for this initiative to examine current practice and develop best practice guidelines for boundary surveys as a way forward for the future. International experience has shown that once Land Registry mapping systems are converted into digital form, the inconsistencies in the maps previously hidden in paper archives become more visible, and a range of new procedures are needed to deal with them.

1.2 *Reports*

The Irish Institution of Surveyors (IIS) established a Commission on Land Registration in autumn 2006 to examine surveying and mapping practice for land registration in Ireland and three reports were anticipated, including:

- Report 1 - was an interim report issued by Working Party 1 entitled 'The Property Registration Authority's Digital Mapping Project: A Surveyor's Perspective' which was submitted in confidence to the Property Registry Authority (PRA) in February 2007. This report was then published for general release in June 2007 after the PRA responded at the Survey Ireland Conference in Malahide in May 2007;
- Report 2 - This green paper which presents arguments for change and outlines best practice guidelines for boundary surveys;
- Report 3 - will outline best practice guidelines for boundary disputes (yet to be completed).

1.3 *Aims*

The aim of this green paper is to define modern practical standards for boundary surveys based on international best practice, and implement them in a manner in which property owners and legal professionals will be supplied with high quality maps of boundaries in a standard format by surveyors from different regions.

This document is primarily intended as a surveyor's guide on the best practice methods recommended for boundary surveys, but it also explains the reasons why these new guidelines are necessary. Although these guidelines have been specifically developed for Ireland, they are also particularly relevant for the other jurisdictions in the United Kingdom where the general boundary system is also used. Most countries in the rest of the world no longer use this system for land registration.

These Best Practice Guidelines have been prepared to advise surveyors on best practice for boundary surveys which is consistent with international best practice and to formulate practical procedures for dealing with discrepancies identified on PRA maps. The guidelines outline:

- Accuracy standards and a uniform methodology for surveys of property boundaries;
- A standard methodology for correlating surveys of property boundaries with PRA maps;

- A standardised process to rectify discrepancies in PRA records when identified;
- A mechanism to ensure these best practice guidelines are applied correctly and uniformly by surveyors.

1.4 *Background*

When Land Registry was established in 1891, Ireland was a much different place than it is today. It was still reeling from the effects of the great famine in the 1840s, was substantially agrarian in nature and the introduction of land registration was an initiative by the Crown to give tenant farmers freehold ownership of their farms, to replace the feudal system in operation up to that time. The registration system implemented used Ordnance Survey maps to identify properties using a concept of 'general boundaries'.

PRA maps and Ordnance Survey Ireland (OSi) maps are used daily by property professions to subdivide and register land in the Land Registry in the mistaken belief that these maps accurately record property boundaries and are fit for this purpose. This report will provide compelling evidence opposing this view, and proposes a change of attitudes and practices to rectify this situation.

The existing registration system of Land Registry folios and maps are generally viewed by property professionals as two separate systems (Figure 1). The folios are accepted as reliable so the title is registered as conclusive and consequently a State guarantee is provided for this portion of the system. In contrast, many PRA maps are widely regarded as unreliable. The location of the boundaries and the extent of the property (area) are registered as non-conclusive and consequently the State guarantee is withheld from the PRA mapping system. Therefore the mapping portion of this registration system is perceived to be less secure. This situation causes difficulty for the surveying and engineering professions and it is the contention of the IIS Commission on Land Registration that surveyors and engineers need to collaborate to change this less reliable portion of the system and significantly improve the standard of maps being submitted to Land Registry for registration purposes.

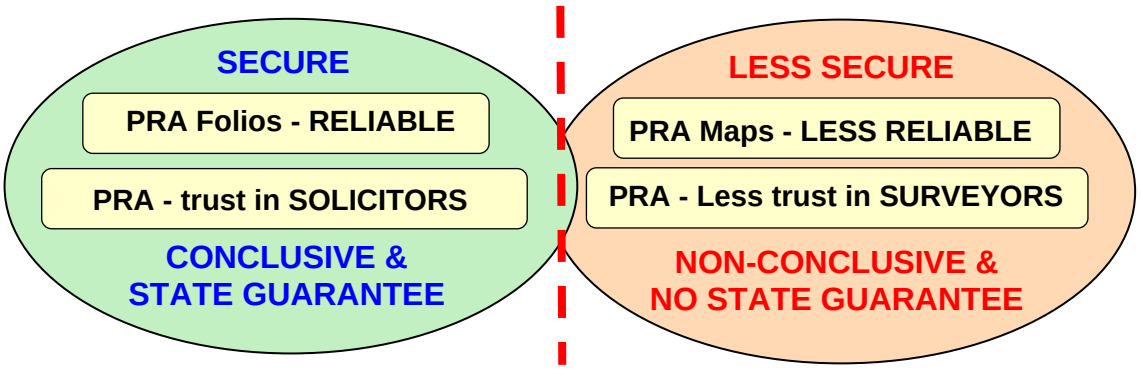


Figure 1 **Secure and less secure portions of the Irish registration system as currently operated.**

1.5 *Disconnections of the Current PRA Mapping System*

The responsibility for managing Ireland's Land Administration System for land ownership is entrusted to the OSi and the PRA, two longstanding organisations with good reputations. It is not the intention of the Commission to criticise PRA or OSi, but there are some 'home truths' which are only discussed privately at present, which need to be debated in public in order to arrive at good solutions for the general public, rather than solutions focussed on the narrower interests of the organisations involved.

The current mapping system used for land registration in Ireland contains four main disconnections which impact adversely on the 'fitness for purpose' of PRA maps. These are:

Disconnect 1 - between OSi and boundary features - Anecdotal evidence from surveyors indicates that the positional accuracy of OSi large scale maps has decreased of late (mainly 1:5000). This may be due to a combination of three factors. OSi substantially uses aerial photography for its large scale surveys (1:1000, 1:2500 and 1:5000) some of which is too high to distinguish boundary features with confidence. Secondly, field completion of photogrammetric plots has been systematically reduced for production efficiencies during the last two decades, contrary to best practice principles for ground truthing to ensure quality targets are achieved. Thirdly, the methodology used for the field revision of maps primarily uses the GeoDirectory of postal addresses and OSi field revisers to detect and collect change, so a significant amount of change remains undetected.

The difficulty with respect to boundaries is as follows. The lines on OSi maps depict topographic features (hedgerows, walls, etc) which may or may not represent property boundaries, and the PRA uses these lines on OS maps, without any checks on their veracity to depict the boundaries of properties.

The traditional paper archive of Land Registry maps, which was substantially based on the OS County Series mapping, is universally accepted by many property professionals to be unreliable. Although the old County series maps were appropriate for land registration from a cartographic perspective, they contained significant positional errors which could be as large as 15 to 20 metres along County boundaries (Byrne, 1998).

OSi traditionally revised these maps on the ground using OSi field revisers, but in 2001 for the first time since the establishment of the organisation in 1824, OSi sub-contracted a significant portion (some was carried out in-house) of the survey of the new 1:5000 map series (figure 2). This contract was substantially carried out in India (1) using high level photography captured for the 1:50000 map series, but then inappropriately used in the Commission's opinion (too high to distinguish boundary features with confidence) for the 1:5000 map series. These OSi maps were then supplied to the PRA (2) for their digital mapping project which was again sub-contracted and carried out in India (3). The legal boundaries resulting from this process

(4) were then adopted by the PRA in place of existing boundaries without reference to the landowners concerned.

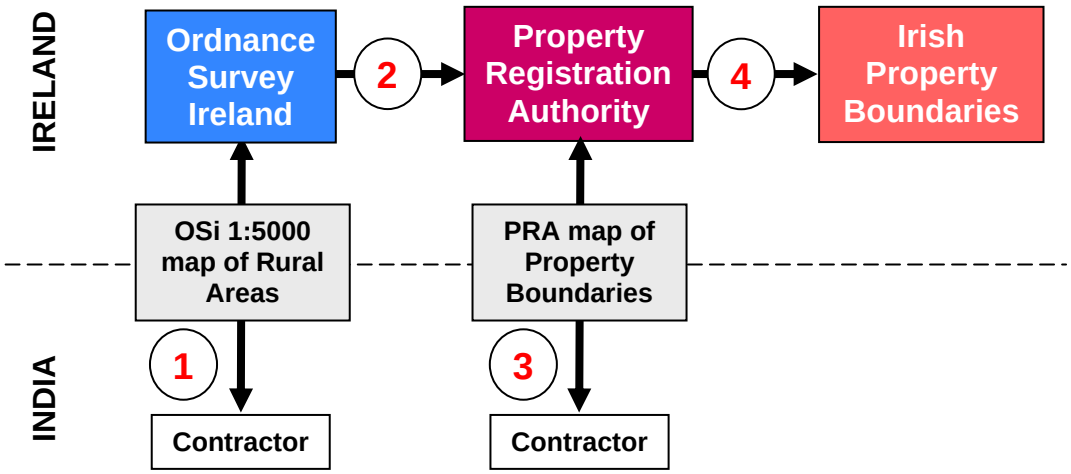


Figure 2 **Separate sub-contracts of OSi and PRA maps to India to create spatial definitions of property boundaries for Ireland.**

Much of the OSi large scale base mapping has been resurveyed during the last 20 years, and this new base mapping would generally be accepted as being more accurate in position than the old County series maps. Curran and Greenway, (2005) quantified the accuracy of the new OSi maps as:

- RMSE = ± 0.60 metre for 1:1000 maps of urban areas
- RMSE = ± 0.69 metre for 1:2500 maps of sub-urban and peri-urban areas
- RMSE = ± 1.22 metre for 1:5000 maps of rural areas

This RMSE method of quantifying accuracy equates to a confidence level of 67% that the accuracy will be within the tolerance specified. However, the reverse of this argument is that there is also a 33% chance that the accuracy will be outside the tolerance specified. So in boundary terms, there is a one in three chance that the accuracy of one of the boundaries of a property will be greater than ± 0.60 metre in an urban area, where land value is highest.

There is growing anecdotal evidence from surveyors which suggests that these figures significantly overstate the accuracy of the 1:5000 maps. Notwithstanding this, the digital PRA boundaries are being associated with more precise definitions of features because they have exact coordinates rather than just graphic lines on a paper map. The difficulty for property owners is whether these coordinates record the correct location of their boundaries or not.

Disconnect 2 - between PRA and landowners - The PRA's digital mapping project is changing the position of legal boundaries in what could be viewed as a 'national rectification of boundaries', such that the map in old title documents held as collateral in banks or mortgage agencies is unlikely to correlate exactly with the new PRA map any longer. The Irish public and the mortgage institutions have not been informed of this

issue with clarity. The difference between these two PRA maps may give rise to difficulties for mortgage institutions in property re-possessions, and the project is likely to be over before people wake up to understand what has occurred. It is important that these difficulties be addressed by all those concerned.

The PRA map may not correctly represent the boundaries of properties on the ground today for a variety of reasons, including:

- The map originally submitted to register the property predated the subsequent erection of physical features on the ground in an incorrect position due to carelessness (more likely) or intent;
- The boundaries on the map originally submitted to register the property were incorrect at the time of submission;
- The boundaries on the map originally submitted to register the property were incorrectly transferred onto the PRA map during registration;
- PRA boundary becomes associated with an incorrect feature. For example the OSi surveys a row of trees planted inside one boundary which given time hides the existing boundary feature underneath and the existing line on the OSi map is subsequently changed to represent the line of trees instead. This happens because modern OSi maps are increasingly surveyed using aerial photography;
- PRA boundary becomes associated with an incorrect feature because there are multiple features in close proximity on the OSi map and an incorrect one is associated with the property boundary;
- The boundary of the ground has changed since registration due to:
  - encroachment by either one of the neighbours, whether inadvertently or maliciously, such as rebuilding the boundary feature in a different position;
  - by means of an agreement between adjoining neighbours which has not been registered;
- The boundaries of the property were changed inadvertently during map re-construction within the PRA;
- The boundary is a dynamic boundary, such as the centreline of a river or the mean high water mark, and has changed its position gradually over time due to erosion or deposition since originally registered;
- Slippage of a retaining wall resulting in the displacement in position of the boundary feature on the ground.
- Land slippage on sloping ground (landslide) bringing the boundary feature with it.

Difficulties arise for landowners when the recorded position of a boundary on a PRA map does not correspond with its actual position on the ground. The PRA digital mapping project aims to address some of these issues, though not all, by adopting the positions of features on new OSi mapping for existing PRA boundaries within specific tolerances related to map scale. Landowners have not been informed by the PRA of any changes made to the recorded position of their boundaries, so landowners need to carefully check that the new position records the correct location of the boundary.

Disconnect 3 - between landowners and the PRA index map - landowners incorrectly believe that registering their property in the PRA will reliably secure their most valuable asset. However, many landowners who have experienced boundary disputes have discovered quite the opposite. The PRA do not stand over the accuracy of boundaries on their maps, and the positional accuracy and lack of attribute information on PRA & OSi maps ensures that solving boundary disputes is more difficult than it need be.

The PRA emphasise that the PRA map is only an 'index map' which identifies properties, not boundaries. This has arisen for historical reasons. The Irish system was modelled on the English system at the end of the 19th century which used 'general boundaries' based on Ordnance Survey maps which was the method accepted at that time for an agrarian society. Most countries in the rest of the world have adopted a different system where the land registration map is a cadastre which identifies properties, boundaries and areas by virtue of a good quality survey of the property on the ground by qualified surveyors to defined standards.

If the role of the PRA map has been restricted to identify properties only, why is so much money being spent on this reduced functionality? OSi and PRA between them spend tens of millions of Euros annually for mapping which does not identify boundaries or land areas with any degree of reliability. If Ireland is already spending tens of millions per year, where is the value for taxpayer money from the current service? The Commission contends that for a similar amount of money Ireland could implement a much more reliable system.

> *"I have a dispute with my neighbour over where the boundary lies. Can you tell me who is right?* ***No. The Land Registry map is an index map and identifies property, not boundaries. Therefore, we are not in a position to advise."*** *(PRA website, accessed on 9/7/2008)*

This quote is taken directly from the Frequently Asked Questions page of the PRA website. For most property owners this answer is unbelievable. If the PRA cannot supply reliable information to resolve boundary disputes, who can, or more importantly, should the PRA be in a position to do so?

Disconnect 4 - between the PRA and OSi - The PRA is statutorily required to adopt OSi maps as the basis of the PRA map. Yet the PRA does not accept responsibility for the accuracy of lines on OSi maps and the OSi does not accept responsibility for the accuracy of PRA boundaries (since they survey topographic features not property boundaries). This is a significant responsibility gap requiring urgent attention by the respective Ministers and Departments.

Both State Agencies have individually made significant strides to improve their products and services during the last few decades, including:

- Ordnance Survey Ireland:

- 2002 - Replacing the Irish Grid with a new national GPS compatible coordinate reference system ITM (Irish Transverse Mercator);
- 2005 - Completing the re-survey of OSi large scale mapping;
- 2005 to 2009 - Reformatting the OSi large scale mapping (1:1000, 1:2500 & 1:5000) to comply with one uniform specification;
- 2002 - Providing Ireland (jointly with OSNI) with one of the best surveying infra-structures in the world;

o Property Registration Authority:

- Ongoing since 1999 - Implementing the Integrated Title Registration Information System (ITRIS);
- 2006 to 2010 - Implementing the digital mapping project;
- 2006 - Providing access to Property Registration Authority information via www.landdirect.ie.

This is the ideal opportunity to decisively address this responsibility issue. Both organisations have recently been established as State Agencies and each separately are more likely to make decisions on a commercial basis than heretofore and this is likely to undermine decisions which should be weighted towards the national good.

1.6 *Moving Forward*

These significant disconnections have all played their part in undermining the 'fitness for purpose' of the PRA map. The new digital mapping system has brought these issues to the surface, and there is no better time for all the professions who use this system to take a stand to propose change to this unreliable system.

Increased Numbers of Land Disputes - It is not surprising therefore that there is growing anecdotal evidence of a significant increase in the numbers of boundary disputes in Ireland during the last few years. Denmark has a slightly smaller land area and a slightly larger population than Ireland, and has had an average of forty boundary dispute cases per year during the 1990s (Enemark, 2005). In contrast, one survey company in Dublin had eighty seven boundary survey requests arising from disputes in the first eleven months in 2007. This evidence and others suggests that the incidence of boundary disputes in Ireland is significantly more than the international norm, so there is a need to quantify this incidence accurately and try to identify the reasons giving rise to this situation.

Under the current system boundary information is unreliable. There is now an increasing need for landowners to check that PRA maps correctly record the current ground position of boundaries supplied for land for the following four reasons:

o Anecdotal evidence indicates that the positional accuracy of OSi maps has decreased of late and should be rigorously checked by surveyors on the ground before being used in property transactions;

o The high likelihood (33%) of features on OS maps being outside the accuracy tolerances quoted by Curran and Greenway (2005);

- The likelihood that boundaries on the new PRA digital maps will not correlate with older PRA paper maps;
- The information deficiency (reliability and comprehensiveness) on boundaries on PRA maps. OSi and PRA maps are great from a national perspective, but they fall significantly short from a local perspective involving just one property.

Technology - Surveyors now have the technology to survey features to centimetres in a national context so they now have the ability to identify discrepancies when they occur in the OSi and PRA maps. The difficulty for surveyors is not acquiring the necessary survey accuracy. Now the critical issue is relating the accurate survey of the boundary on the ground to the line on the PRA map.

Surveyors now have the technology to define positions to centimetres in a national context when using the OSi GPS network and considering that the value of land and property is so high, it seems inappropriate not to define the area and extent of properties more precisely than is currently practiced. The current system was designed for a different era, using different technologies and processes and is now considered inappropriate for the 21st century.

Duty of Care - Surveyors and solicitors have a duty of care to their clients to rectify discrepancies in ownership records when they are identified to ensure the PRA map records the correct position of property boundaries. When the PRA maps were in paper format these discrepancies were not noticeable, however the correction of spatial discrepancies should be a much easier task in the new digital system. More practical procedures are needed to minimise the delays and additional costs associated with current rectification procedures.

The PRA map may only be an index map, but there is no reason why, in this day and age, that it should not have sufficient information to clarify boundary issues. Does the State and its agencies not have as onerous a duty of care to Irish citizens as surveyors and solicitors have?

1.7 *Green paper Initiative*

These proposals represent a major change from normal current practice and will have a significant impact on surveyors. There is a need to enhance surveyor's competence in certain areas of best practice. There will be a need to explain to clients the existence of discrepancies in PRA maps and how the methodology proposed by these Best Practice Guidelines will identify such discrepancies for amendment by the PRA. There will also be a need to explain to clients in detail where costs arise when using this new methodology and the benefits which accrue from using it.

These proposals are being issued initially as a Green Paper and the Commission welcomes comments and suggestions from all the stakeholders involved in the land registration process, including engineers, surveyors, architects, mortgage providers, solicitors and their relevant professional bodies. The Commission is willing to meet with

individual stakeholders to provide detailed explanations of specific aspects of these proposals and develop a joint consensus on the way forward. The intention is that this feedback will be used to amend these proposals as a white paper towards the end of 2008 for eventual submission to government.

2 NEED FOR SURVEYING STANDARDS

The need to develop surveying standards for boundary surveys has now become urgent due to many factors, the most important of which are:

1. Developing an e-Conveyancing system for Ireland;
2. Implementing the EU INSPIRE Directive locally;
3. The extremely high cost of land in Ireland;
4. Exploiting the modern surveying technologies available.

2.1 *Developing an e-Conveyancing System*

EU leaders at the Lisbon Summit in 2000 set themselves a strategic goal to make the EU the most competitive and dynamic knowledge-based economy in the world by 2010. As a result the Irish government has adopted a number of multi-billion Euro strategies to achieve this objective, including the introduction of e-Conveyancing and the development of an Irish Spatial Data Infra-structure (ISDI), although the date of 2010 will not be achieved for either of these projects at this stage.

e-Conveyancing is an electronic system for the transfer of interests in land and is an important element of the Irish government's overall strategy for e-Government (Bearing Point, 2006). The increased demand to do business on-line such as the Revenue on-line service, e-Procurement, the motor tax on-line service and the land direct service to name a few, is consistent with international trends in this regard.

e-Conveyancing is expected to:

- have a higher operating efficiency than the current paper based method;
- reduce costs for the whole process for users;
- be more transparent and highlight the cause of delays;
- have more certainty and security by improving the quality of information;
- improve opportunities to develop and deploy new services.

The e-Conveyancing project which began in 2003 has three main strands:

- Substantive Law Strand - legislative change to provide for the introduction of e-conveyancing, such as the Land and Conveyancing Law Reform Bill 2006;
- Administrative Strand - application of information technology to modernise and implement digital procedures;
- Procedural Strand includes:
  - the development of an end to end process model of the current conveyancing process;
  - outlining the roles played by public and private stakeholders involved in the current process;

- developing a vision and strategy for e-conveyancing including conceptual models for the new process.

Bearing Point, management and technology consultants, were contracted to examine and report on the procedural strand (2006) and a project board has now been established to make a detailed assessment of the most appropriate model for e-conveyancing in Ireland, including the preparation of proposals to government for the design, establishment, operation, governance and implementation of the proposed model.

e-Conveyancing intends to transform the way business in the property sector is transacted, but its introduction will necessarily be long term because of the major challenges to be overcome and the need to proceed carefully (Figure 3).

E-CONVEYANCING				
LEGISLATION New Land and Conveyancing Bill 2006 due for enactment soon?	**LAND REGISTRY** Digital mapping project 2006 - 2010	**REGISTRY OF DEEDS** Completion of conversion to the Title system from Deeds	**E-REGISTRATION** E-applications, E-lodgements & digital signatures	**DIGITAL OFFICES** Adoption of electronic procedures by the professions

Figure 3 Areas requiring significant change to facilitate e-Conveyancing.

One of these difficult challenges is the completion of the registration of all land in the State. The State, which is the owner of thousands of square kilometres of land, must lead the way by registering their property according to Sperling (2008). Many government departments and State Agencies currently do not know in any detailed way the extent or condition of their properties which they manage on behalf of the State and its citizens.

2.2 *Implementing the EU INSPIRE Directive*

The EU INSPIRE Directive entered into force on 15th May 2007 and EU member States now have until May 2009 to bring into force laws, regulations and administrative provisions necessary to comply with the Directive. The Directive is required to address the general situation of fragmentation of datasets and sources, gaps in availability, lack of harmonisation between datasets at different geographical scales and duplication of information collection in EU member States.

Awareness is growing at national and at EU level about the need for quality spatial information to support an understanding of the complexity and interactions between human activities and their impact on land and the environment. The INSPIRE initiative intends to trigger the creation of a European Spatial Data Infrastructure (SDI) that delivers integrated spatial information services for users.

The implementation of INSPIRE requires the development of Implementing Rules laying down technical arrangements for the interoperability and, where practicable, harmonisation of spatial data sets and services to facilitate data sharing under four themes, namely:

- Metadata (for data discovery at map series and map sheet levels and data quality at spatial object/geometric element level)
- Network Services (ICT issues such as Geo Portals)
- Data Sharing and Reuse (financial and legal issues)
- Data specifications (harmonisation and interoperability - data models and quality models)

The Implementing Rules are being drafted by expert technical working groups compiled from the Spatial Data Interest Communities (SDICs). The Legally Mandated Organisations (LMOs) are consulted on the draft Implementing Rules before the European Commission formally adopt the final proposed Implementing Rules. Once adopted the Member States must then apply the Implementing Rules locally.

The Data specification theme divided the list of spatial datasets into three, representing decreasing order of priority. These three spatial data themes include:

- Annex I - (fundamental data) to be implemented within two years after adoption;
- Annex 2 - (other basic data suitable for multipurpose use) to be implemented within 5 years after adoption;
- Annex 3 - (environmental data) to be implemented subsequently.

The priority fundamental datasets included under Annex 1 include:

- Coordinate reference systems
- Geographical grid systems
- Geographical names
- Administrative units
- Addresses
- Cadastral parcels
- Transport networks
- Hydrography
- Protected sites (environmental)

The cadastral parcel theme was moved into Annex 1 from Annex 2 shortly before the adoption of the Directive and harmonisation of the data specification for this theme covers:

- definition and classification of spatial objects;
- geo-referencing;
- common system of unique identifiers for spatial objects;
- relationship between spatial objects;
- key attributes and corresponding multilingual thesauri;
- how to exchange the temporal dimension of the data;
- how to exchange updates of the data.

The Core Cadastral Domain Model (van Oosterom *et al.*, 2006) jointly developed by the Delft University of Technology, the Dutch Kadaster and the International Institute for Geo-Information Science and Earth Observation (ITC) has been adopted as reference material by the Cadastral Parcels TWG (Technical Working Group). The model caters for the future development of national land management systems and services two important goals to:

- Provide an extensible basis for efficient and effective land registration system development based on a model driven architecture;
- Enable parties to communicate based on a shared ontology implied by the model.

The model is specified in UML diagrams and the heart of the model is based on three classes:

1. RegisterObject - including all kinds of immovables and movables;
2. RRR - rights, restrictions, responsibilities;
3. Person - natural, non-natural and group.

The TWGs commenced their work early in 2008 and draft implementing rules are expected for all Annex 1 themes by April 2009.

The current concept being used internationally for developing national land management systems is to link information from different sources via the cadastral parcel which is the smallest spatial object. Consequently, data reliability of the whole national land management system is directly influenced by the quality of the spatial definition of the cadastral parcel. This Commission considers that poor parcel definition leads to increased uncertainties and risks when using the data, so consequently the Commission considers Ireland's non-conclusive definition of parcels to be inappropriate for implementation within INSPIRE.

The development of an Irish Spatial Data Infra-structure (ISDI) was proposed in a Government Action Plan in 2002 (DoT), and although a high level steering committee was established to develop national policy and implement the proposal, and a significant amount of background research and pilot studies have been carried out, there is little tangible evidence of progress made during the last six years. Many States across the EU have been preparing for the implementation of INSPIRE for many years, but Ireland seems to have adopted an approach to wait for INSPIRE to develop the ISDI.

2.3 *The Inflated Value of Land in Ireland*

The cost of agricultural land in Ireland has nearly doubled during the last four years (table 1). Hughes (2008) states that the growth in the value of agricultural land is being artificially increased due mainly to two interrelated factors;

- Compulsory purchase of agricultural land for building Ireland's expanding transport networks under Transport 21 have artificially increased the value;

- The farmers involved are re-investing these funds by buying more agricultural land, thus increasing the value further.

Table 1 **Average cost of agricultural land in Ireland (source - IAVI Annual Property Surveys, 2003 to 2007).**

	2004	2005	2006	2007
Cost of Agricultural land per square metre	€2.96	€3.81	€4.82	€5.26

The Permanent TSB and ESRI also publish a national house price index every quarter which indicates a significant rise in average house prices between 2003 and the end of 2006 before it began to drop back during 2007 and 2008 (figure 4). The value of the land now accounts for approximately half of the cost of a house. Therefore for the average sized semi-detached property with an area of 7 metres by 30 metres this equates to current valuations of €660 per square metre for the land alone.

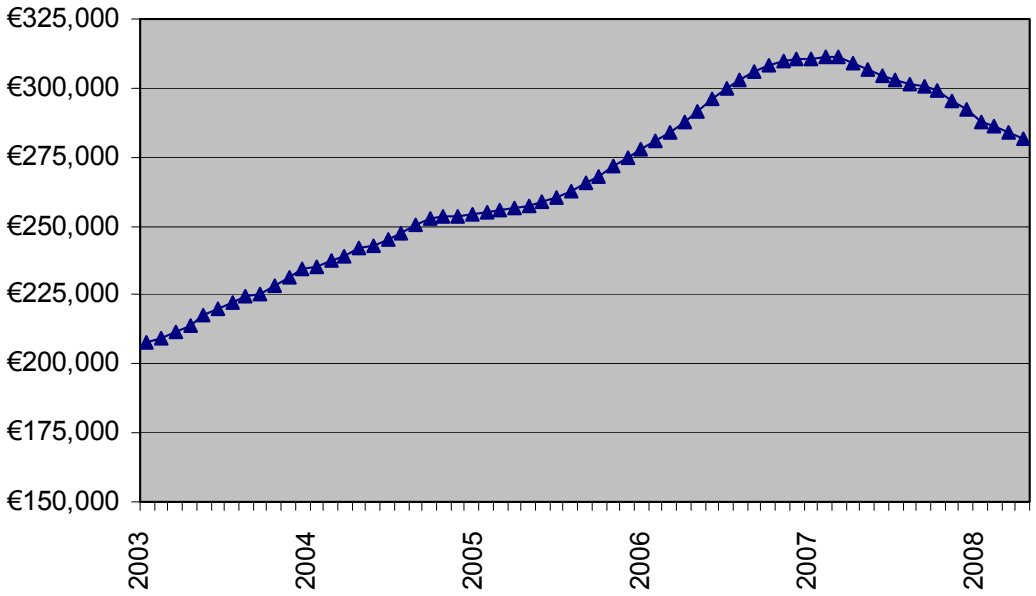


Figure 4 **The average cost of housing in Ireland (source - Permanent TSB & ESRI National House Price Index).**

At the top end of the scale, the cost of development land for multi million Euro developments in sought after urban areas is running at well over 1000 times the cost of agricultural land per square metre (table 2).

Table 2 Ten highest land sales for urban development in Ireland per year in terms of cost per square metre (source - IAVI Annual Property Surveys, 2003 to 2007)

	2004	2005	2006	2007
Cost of high end urban development land in Ireland per square metre	€1,950 To €12,400	€2,100 to €19,250	€3,000 To €13,500	Information not available

All of these sources indicate the high value of land, and even if these values are dropping somewhat in the current re-balancing of the market, there is a need to review the systems in place which secure these valuable assets for landowners and for financial institutions. The international trend is to improve the quality of the information recorded to secure these valuable properties. Sperling (2008) recommends using the facility available within the Registration of Title Act (Oireachtas, 1964) to register boundaries as conclusive in order to significantly improve the quality of the PRA mapping register. He also states that Ireland is now nearly alone in the western world for continuing to operate a system of non-conclusive boundaries since Canada recently moved towards recording fixed boundaries and the United Kingdom adopted a system for determining boundaries in 2002.

2.4 *Exploiting the Modern Surveying Technologies Available*

Ireland has one of the best surveying infra-structures in the world and Sperling (2008) states this modern surveying infra-structure is a pre-requirement for producing good quality surveys combined with the adoption of best practice. The new surveying infra-structure for the whole island of Ireland was jointly established by Ordnance Survey Ireland (OSi) and Ordnance Survey of Northern Ireland (OSNI) and includes:

- The Active GPS network (figure 5);
- The new GPS compatible ITM coordinate reference system.
- The 'GridinQuest' software (freeware) which incorporates a polynomial transformation for coordinates between the old (IG75) and new (ITM) coordinate reference systems and a geoid model 'OSGM02' for conversion of GPS heights (ellipsoidal) to Malin Head (orthometric) heights.

McGill (2008) stated that the Active GPS Network is currently being extended by the provision of four new stations in Donegal, Carrick-on-Shannon, Arklow and Bantry. It is also planned that the existing station in Kilkenny will be moved to Clonmel. The movement of one of the two stations in Dublin to the Meath area (possibly Navan) may also be examined in the future, though not at this time. These latest developments of the system should provide significant improvements, especially in the Donegal and Kerry areas which tended to be problematic in the past.

Figure 5 Ireland's Active GPS Network from June 2008 (McGill, 2008).

This infra-structure allows surveyors to reliably define positions to centimetre accuracy in a national context previously quantified at ± 60 mm for absolute accuracy from the Passive GPS Network (Prendergast *et al.*, 2004). When using RINEX data from the Active GPS Network this absolute accuracy figure increases to ± 100 mm at the extremities of the longer baseline distances from fewer Active stations, but ± 50 mm should be attainable for most areas. This gives surveyors the ability to survey boundaries to accuracies previously unattainable when using OSi maps and surveyors are increasingly graduating with undergraduate and postgraduate degrees which give them the skills and competence to exploit technology to provide these better solutions.

There is now a need to develop modern surveying and mapping standards and processes suitable for the digital age and in line with best international practice to ensure the new surveying infra-structure and modern surveying technologies can be exploited for the benefit of landowners and the PRA mapping database.

3 RELATIONS BETWEEN PROFESSIONALS

More formalised working relationships are required between surveyors and solicitors acting for clients and with surveyors acting for neighbours on the orther side of adjoining boundaries. These relationships are particularly important when clients intend to register properties in the PRA or when disputes arise over boundaries.

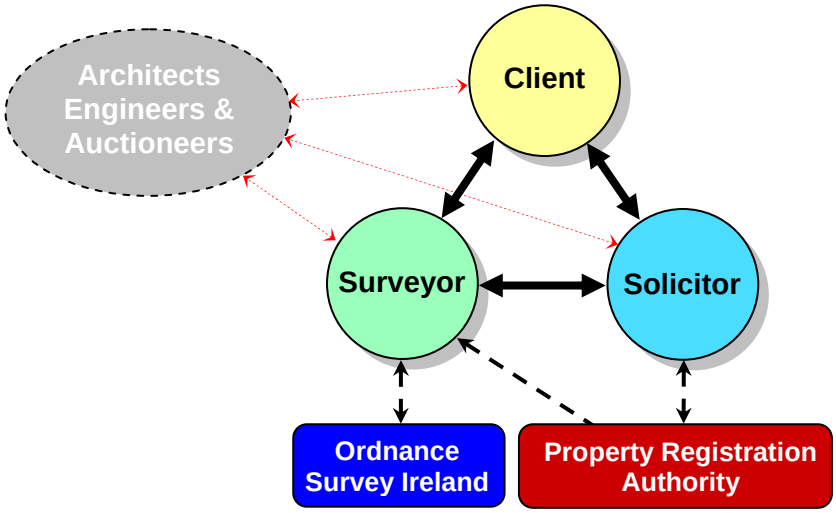


Figure 6 Relationships between solicitors, surveyors and clients for boundary matters.

In some cases the solicitor can position themselves between the client and the surveyor to ensure that all communication is carried out through them, but difficulties can arise where direct communication between the surveyor and the client might be best to clarify or resolve situations. Similarly, in some cases the client can position themselves between the surveyor and the solicitor to ensure all communications are routed through the client. Whereas this model can be useful to ensure the client is kept properly informed it can also hamper normal dealing between professionals and cause unnecessary delays. The Commission recommends a triangular structure (figure 6) where each can freely contact the other party to complete their tasks in a professional and speedy manner.

3.1 *With the Legal Profession*

The IIS suggests that the relationship between surveyors and solicitors should be similar to the model used for due diligence for company receivership between solicitors and accountants. Each professional provides a range of skills and brings their experience to ensure the service provided for the client is comprehensive. A person's property is normally their most valuable asset, and both solicitors and surveyors have separate but complementary roles to play to ensure that details of this ownership is as current, complete and reliable as is necessary.

Surveyors act as the solicitor's eyes on site by establishing the facts with regard to:

- Determining the location of the current property boundaries on the ground;
- Detecting the existence of any boundary encroachments;

Surveyors may also be requested to confirm the location of easements listed on the folio or in the title deeds. However this would be an additional service to what is being proposed by these best practice guidelines. Although surveyors are occasionally requested to confirm that the essential services lie completely within the property boundaries, this task can be problematical and is outside the scope of this document.

The widespread public belief that Ordnance Survey mapping is accurate enough to define property boundaries is a myth that surveyors and solicitors have to grapple with daily. However, this need not be so in the 21st century. Surveyors now have the technology to define positions to centimetres, and if surveyors adopt best practice by using agreed standards and procedures they can identify, clarify and rectify failings in existing boundary records as part of their service.

A good liaison between surveyor and solicitor is vital to ensure all the aspects have been covered when offering advice to a client, or registering a property or presenting a case in court on behalf of a client.

3.2 *With Other Surveyors*

The Irish legal system is based on common law which is adversarial in nature and gives rise to two surveyors being engaged by owners on both sides of an adjoining boundary. It has been normal in the past for these surveyors not to discuss the issue due to adversarial nature of Irish law, or on specific instructions from their clients, or the client's solicitors. However, this practice of surveyors not communicating can cause significant difficulties if important documents or facts are not discovered or identified before offering advice to the solicitors and the landowners concerned.

The IIS recommends a different approach, akin to mediation. When a boundary survey is completed, surveyors regularly have some issues for which they are required to make a judgement on the basis of scant mapping information available to them. The IIS recommends that surveyors operating on either side of an adjoining boundary should contact each other to discuss their findings to clarify and try to resolve as many of these issues as possible. The intent of this change in procedure is to try to reduce the number of issues in contention between surveyors before they are brought to the legal profession to deal with. This change is consistent with recent recommendations by the judiciary.

The onus is on each surveyor to check the information for the adjoining property and confirm that their judgements have been correct. The IIS proposes that the surveyor should:

- Contact the surveyor acting for the adjoining property owner after they have completed their boundary survey (never before, since the boundary survey should be an independent assessment) but before the report has been finalised. The surveyor should consult with their client in this regard beforehand, and outline the benefits of this course of action;

- Discuss the results of the two boundary surveys with an open mind to uncover any extra issues and clarify other issues so that both surveyors can adopt an agreed statement of fact on many of the issues involved;

3.3 *With clients*

Everyone, professional or layperson, owes a general duty of care to all other persons, but the duty owed by professionals is additional and is primarily to their clients. When advising clients, the professional owes a duty of care to exercise that standard of skill and competence appropriate to his or her professional status.

Duty of care is determined by the nature of the professional relationship, such as between a doctor and patient, so it includes ethical issues such as confidentiality of information and right and wrong on both moral and legal grounds. Surveyors should not offer advice in areas for which they are not competent, and should be guided by their qualifications and experience to confine their services to specific areas of expertise. They should attempt to build a professional relationship with their client, by explaining all the relevant issues, identifying the necessary tasks and outlining the impact of each task on fees in as a transparent a manner as possible. The exercise of duty of care by the surveyor will minimise any liability accruing from their professional services, and should be mandatory for their professional indemnity insurance in the elimination of claims of negligence.

In countries where the legal system is based on Roman law private surveyors are regularly licensed for cadastral work and in this regard they act as ‘agents of the State’. In this role they must show a degree of care and consideration, which a reasonable prudent man, a ‘bonus pater familias’ would show in similar circumstances. This approach requires surveyors to make sure their analysis is objective and impartial, and to ensure that the solutions derived are just. We encourage Irish surveyors to adopt this principle to ensure their boundary survey is a statement of fact, and where issues have not been determined with certainty, surveyors should explain their concerns.

4 BOUNDARIES

Many topographic surveys include the survey of boundary features as one of the requirements of the survey. This entails surveying the boundary features to whatever accuracy is specified by the client or implied by the required scale of the final map. There is no attempt to walk the boundaries with the landowner to identify the occupation line of the property. In contrast the primary task of a boundary survey (figure 7) is to identify and survey the occupation line of the property to defined accuracy specifications, and then to compare the result with the latest PRA map of the property to ensure the boundaries as registered in the PRA correctly record the position of the boundary.

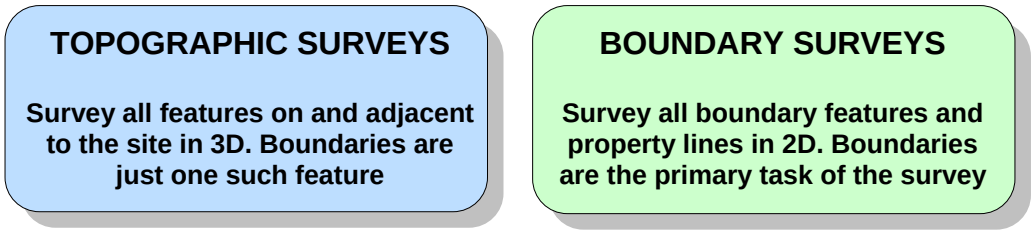


Figure 7 Distinction between topographic surveys and boundary surveys.

Surveyors now have the technology to survey locations to an accuracy of centimetres in a national context, so now the most critical issue influencing accuracy is determining the centreline of the feature to be surveyed when the boundary is to be registered as non-conclusive. This requires the surveyor to use all their training and experience to choose the correct points from the evidence they find on the ground. There is now an urgent need for surveyors to be consistent in their approach used to define boundaries.

However, if the boundary is to be registered as a conclusive boundary this difficulty does not apply since the surveyor will then be surveying exact points already agreed on the ground and consequently conclusive boundaries can be surveyed more precisely still.

Current practice in Ireland is to register boundaries as non-conclusive, so determining the centreline of the boundary feature will continue to be crucial. With some boundary features, such as a concrete block wall, the centreline is easily determined, since the blocks are 100 mm wide, so it should be possible to record the position of the centreline to ± 10 mm, and it should also be possible to repeat the procedure to the same accuracy. However, other boundary features, such as an overgrown hedgerow may be several metres wide, may not be of a consistent width, and may have multiple fences of differing ages running within it. In these circumstances it may be difficult to define the centreline of the feature to an accuracy of 200 or even 500 mms, and repeating the procedure on another day or with a different surveyor may yield slightly different results. A good rule of thumb is that it should be possible in most cases to survey the centreline of boundary features to an accuracy of +/- 10% of the width of the feature (Table 3).

This rule is for guidance only and needs to be evaluated on the ground on a case by case basis and reasoned arguments should be supplied when the survey tolerance applied for a particular boundary features differs from the rule. The main reasons why differences might occur are:

- The boundary feature has a substantially different width;
- The boundary feature does not have a constant width over its length;

Boundary features also may not be vertical. It should be stressed that the item being measured is the ground footprint of the boundary feature in question, not the top of the

feature, so surveyors should ensure that their survey procedures ensure the footprint is captured.

Table 3 Typical survey accuracies possible for different boundary features.

Boundary Feature Type	Typical Width of Feature (mms)	Survey Accuracy Possible (mms)
Brick & Block Walls *	100	+/- 10
Cut Stone Wall	300 - 500	+/- 30 - 50
Rubble Wall (uncut stone)	500 - 2000	+/- 50 - 200
Retaining Walls & gabions	1000 - 2500	+/- 100 - 250
Railings *	50	+/- 5
Fence - Post & wire, wood panel, palisade *	100	+/- 10
Fence - Stock-proof *	200	+/- 20
Fence Typical Land Commission	2000	+/- 200
Banks, drains, ditches, streams & moats	3000	+/- 300

For boundaries which are to be registered as non-conclusive it is impractical to measure to tighter tolerances than +/- 25mm, so we recommend this tolerance of +/- 25m as a minimum tolerance for all boundaries so registered, including features marked with an asterisk above.

The surveyor's judgement or opinion should be supported with reasoned argument and photos in all cases, since their task is to record the features of the property as a statement of fact to be presented to the PRA or as evidence in court.

4.1 *Boundary Types*

Descriptions and pictorial representations of the various types of features used to define boundaries in Ireland are supplied in Appendix A.

A description of the boundary feature should be recorded during the boundary survey which identifies the type of feature, the location where feature type changes, whether it is rendered or bare, the type of stone or the type of hedging used. For banks and ditches a height profile is advised at key points to assist the description if considered necessary. Best practice also includes capturing digital images of the different features for inclusion in the boundary survey report.

4.2 *Legal Presumptions for Boundaries*

Surveying boundaries is dependent on presumptions which surveyors' use to make judgements (based on ground and documentary evidence) on the position of the boundary line within boundary features or the position of the centrelines of boundary features. Presumptions are not evidence, but may substitute for evidence where the latter is lacking. Some presumptions are conclusive, but most are rebuttable. In the

absence of other evidence, boundaries may be determined by the application of legal presumptions. Common presumptions concerning boundaries (Speaight, 2004) include:

Hedge and Ditch:

Where two properties are divided by a hedge (or bank) and a ditch, the boundary is presumed to be on the far side of the ditch from the hedge (figure 8). This presumption is based on the surmise that the owner of the land, standing on his side of the boundary looking towards his own land, dug his drainage ditch within his own land and planted a hedge on the mound of earth removed from the ditch. This rule only applies to man made ditches. It does not apply:

- To naturally occurring streams;
- If at the time the ditch was dug the land on either side was owned by the same person. In this case, the root of the hedge on top of the bank is likely to be the boundary;

This presumption can be rebutted by evidence to the contrary. For example, if these presumptions were correct when the ditch was dug, but the circumstances have changed since, such as by an agreement between the two adjoining owners to accept another line in the feature to be the boundary, for example, the root of the hedge.

The owner may also be required to present evidence of (a) access through the hedge to the ditch, and (b) regular cleaning of the ditch to show that their ownership of the ditch was not ceded to their neighbour under rules of possessory title.

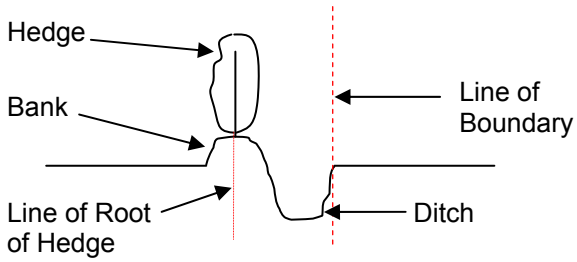


Figure 8 Presumption of position of boundary in hedge and ditch feature.

Fences and walls:

If a fence or wall is supported by posts or buttresses on one side, there is a presumption that it belongs to the owner on that side, and the boundary lies on the outside face of the fence or wall.

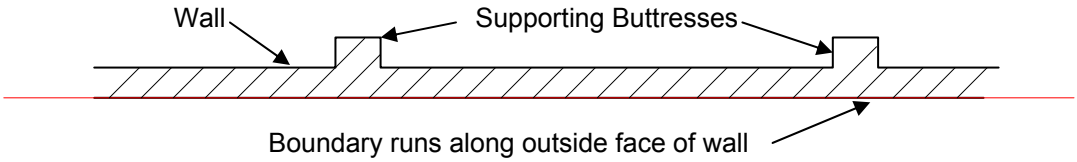


Figure 9 **Supporting posts on one side suggest the boundary lies along the face of the feature, normally used when adjoining public land.**

Party Walls:

Party Walls are walls that divide semi-detached or terraced houses from each other. There is a general assumption that ownership is divided down the middle, with half belonging to each owner. This means that maintenance and repairs should be a joint expense.

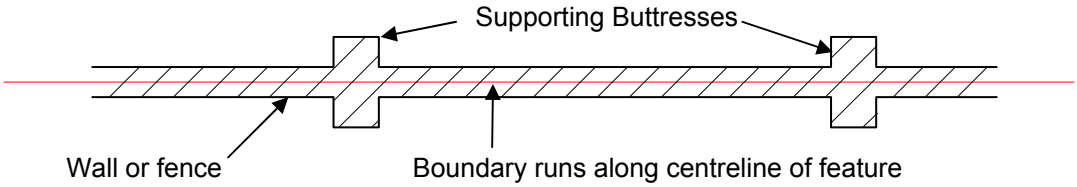


Figure 10 **Supporting posts on both sides suggest the boundary lies along the centreline of the feature.**

Apartments:

An apartment is normally taken to include its external walls notwithstanding the maintenance company has legal obligations to carry out exterior repairs.

It is common practice in Ireland to define the limit of ownership of apartments very precisely such as to the internal face of the plaster on structural walls and the external faces of windows, yet these boundaries are registered in the PRA as non-conclusive. This practice is inappropriate (IIS, 2004), because the position of the boundary has been defined with reference to the position of the boundary feature. The Commission contends that boundaries defined in this detail should be registered as conclusive.

The possibility of selling ‘air rights’ in the future under the new legislation, also raises the need for defining the location of boundaries far more accurately than heretofore. Again the Commission recommends that air boundaries should be defined accurately using precise 3D coordinates to specified accuracy standards.

Roadways:

The boundary of land abutting a public roadway normally extends to the centre of the public roadway, subject to the rights of the local authority which maintains the road surface. However, the owner of the land will own the subsoil, theoretically to the centre of the earth, and the space above. This presumption is subject to contrary agreement, which would normally be evidenced in the Land Registry documents. Mineral rights are normally explicitly excluded in the folio.

The centre of roadway is defined as the mean of the centre of the boundary features on both sides of the roadway as depicted on old OSi maps.

Non-Tidal Rivers and Streams:

The boundary of land abutting a non-tidal river or stream is presumed to extend to the centre thereof. If the course of the river or stream changes naturally then the boundary follows the changed course, but not if the course of the river or stream is changed purposely or by any sudden means (whether natural or unnatural).

Sea Shore:

Where land joins the sea the boundary lies at the mean high water mark (MHWM). The foreshore between the MHWM and the mean low water mark (MLWM) is owned by the State, and the management of the State's ownership of the foreshore is usually delegated to the relevant Local Authority. The same presumptions apply to land bordering tidal rivers and inlets.

The MHWM and the MLWM can move gradually over time, in which case the ownership boundaries may move with them, except where the land moves suddenly, or by virtue of construction. In the case of erosion where the mean high water mark moves landwards, the owner may only occupy to the high water mark, so they will lose occupation rights over the portion of land lost to erosion. In the case of deposition where the mean high water mark moves seawards, the owner will need to occupy the extra portion of land which nature has provided and in time may register their possessory right for title of this portion in order to regularise their ownership documents.

Where cliffs are eroded and land is lost in a sudden landslide or rock fall, the cliff may be repaired with the relevant planning permission to prevent erosion of the shoreline and protect the original title line.

Lakes:

The bed of a lake belongs to the owner of the surrounding land if the lake lies within his sole ownership. If it does not lie within his sole ownership there is no such presumption.

4.3 *Local Practices and Norms*

Responsibility to maintain boundary on right side facing the road:

There is a general assumption that ownership of features which define an adjoining boundary is divided down the middle with half the feature belonging to each adjoining owner. This means that maintenance and repairs should be a joint expense. However in some areas a local norm exists which assigns owners the responsibility to maintain the boundary on right side of their property facing the

road. The boundary of the left side should be maintained by their neighbour to their left.

Fallen trees in hedge:

In some areas a local norm exists which gives adjoining owners the right to every second tree blown down in storms in a jointly owned boundary feature. The presence of such a practice may indicate the likely position of the boundary.

5 PRIOR RESEARCH AND INVESTIGATION

The surveyor should normally carry out an appraisal of the property boundaries using the documentation supplied by the client and the client's solicitor prior to visiting the site to identify issues which may need special attention.

5.1 *Appraising Clients Needs*

The surveyor should contact the client and the client's solicitor to ascertain:

- The reason why the boundary survey is required.
- The existence and history of any boundary disputes with adjoining neighbours.
- The specification required for the boundary survey. The surveyor should suggest using the standard specification recommended by these IIS best practice guidelines (Appendix B – detail outlined in section 7.3).

Surveyors should be wary of dealing with clients through intermediaries, especially in the context of specifying the requirements, responsibility for, and authorisation of payment of fees. Where possible the agreed specification should be described in contract form which should be forwarded to the client for signature and return. A sample contract in this regard is supplied in Appendix B. The map correlation and the production of the boundary encroachment map and report should be considered as an additional stage which should be explained to the client at the outset.

5.2 *Primary Documentation Required*

The surveyor shall:

- Request the clients' solicitor to supply:
  - A copy of the legal description (folio and certified ITM filed plan if registered) of the property to be surveyed. In the case of a boundary dispute a certified copy for the adjoining relevant property. Where necessary, the surveyor should ensure that the map supplied includes 'special features' (rights of way, easements, etc). Old Land Registry maps should be used for indicative purposes only;
  - A copy of the contract map attached to the instrument which was used for the sale and registration of the property.
- Using the www.landdirect.ie website:
  - Confirm the details shown on the ITM Filed plans for the property and adjoining property are correct;

- Ascertain if there are any dealings pending for the property from the landdirect website.

- Obtain a copy of the latest version of the PRA map for the property and the adjacent properties in digital vector format from the PRA, when available;
- Purchase the latest digital version of the OSi map for the property (table 4).

Table 4 OSi current large scale mapping (now available on ITM, but must be specified. IG is still the OSi default).

SCALE	EDITION	PERIOD	COVERAGE	CRS
1:1000	First edition	1967 to circa 1994 & many revisions since	Urban areas with population > 1500 (using 1990 census)	Irish Grid (IG75)
1:2500	Third edition	1997 to circa 2005 & currently being revised	Sub-urban and peri-urban areas	Irish Grid (IG75)
1:5000	First edition	2001 to early 2005 & currently being revised	All rural areas not covered by the 1:1000 (1st edition) and 1:2500 (3rd edition). Some uplands, boglands and offshore islands not included in 1st edition, but will be included in the revision.	ITM

5.3 *Supporting Documentation*

If the surveyor subsequently has difficulty correlating the current versions of the PRA and OSI maps with the boundary as surveyed on the ground, the surveyor will also need to obtain:

- Older versions of OSi maps from OSi (listed in Appendix C);
- Aerial photographs of the property (listed in Appendix C);
- Other relevant legal mapping from the client's solicitor.

5.4 *PRA Practice Directions for Mapping*

Surveyors should have a thorough knowledge of the following PRA documents relating to mapping procedures and practice, available at http://www.prai.ie/eng/Mapping/:

- Practice Direction number 12 - Mapping Practice
- LR Map 1 - Mapping Procedures
- LR Map 2 - Mapping Procedures for the Registration of Development Schemes
- LR Map 2A - Mapping Procedure for Registration of Multi-storey Developments
- LR Map 3 - Requirements relating to the acceptance of computer generated paper maps
- LR Map 4 - Basic requirements for acceptance of maps in Land Registry

Revisions of these documents are notified via the PRAI website.

5.5 *Record of Existing High Quality Boundary Surveys*

To date it is uncertain whether it will be possible to:

a) Identify boundaries which have been registered as conclusive on the PRA www.landdirect.ie website;
b) Access detailed information for conclusive boundaries from the PRA (control point location diagrams, coordinates and descriptions for boundary monuments, etc.) prior to carrying out boundary surveys.

In the interim, the IIS intends to establish a database listing the high quality boundary surveys carried out in accordance with these best practice guidelines. The database will contain symbols identifying existing boundary surveys on Google Earth and will also contain metadata information relating to the survey (information specified in section 16.2).

Surveyors are encouraged to consult this IIS database to ascertain if the client's property or any of the adjoining properties were previously surveyed in accordance with these Best Practice Guidelines and (if appropriate) obtain coordinates of the survey control and boundary monuments from the relevant surveyor (which should be checked during the new survey). If the parcel has been surveyed correctly before according to these best practice guidelines, then a check survey should only be necessary to validate the authenticity and accuracy of the original survey.

6 FIELD PREPARATION

The surveyor should have knowledge of the main issues before they visit the site from discussions with the client and their solicitor and from the documents supplied.

6.1 *Notification*

The surveyor should inform the client and the client's solicitor as well as the client when they intend to visit the site to carry out the boundary survey.

6.2 *Access*

The surveyor should request the client's solicitor to write to the client and their adjoining owners to:

- Inform them of the date of the survey and the name of the surveyor;
- Request permission for access if required during the boundary survey.

When the surveyor arrives on site, they should introduce themselves to the client and the adjoining owners and request their permission to access their properties as required during the boundary survey. IIS identity cards should be carried to confirm the surveyors' identity. In the event of the relevant owners not being at home, notification of the call by the surveyor should be posted in their letterboxes.

6.3 *Boundary Identification*

The surveyor should request the client to perambulate the property and indicate their boundaries to the surveyor. The importance of this reconnaissance and perambulation of the boundaries cannot be over-emphasised. Photographs and notes should be taken to be compiled later as evidence. The surveyor should try to ascertain:

- Who is responsible for maintaining individual boundary features;
- The age and relative vintage of fences where multiple fencing exists.

The surveyor should:

- Make note of local reliable landmarks suitable for map correlation purposes.
- Check the quality of the map detail for accuracy, clarity and interpretation on the certified ITM filed Plan. Walls, buildings, and Townland boundary fences are usually reliable, whereas drains, streams, ESB lines etc may not be and should be avoided. Streams may be used if well defined, but bear in mind that the course may or may not have changed from that shown on the map.
- Check terrain regarding access to actual boundaries noting difficulties such as gorse, briars, under-wood, marsh etc, as this will determine the location of control points for best observations. Be prepared to gain access to the boundaries by clearing the growth to accurately measure the actual boundary (on both sides). Perhaps the surveyor should request the landowner to clear the growth in these areas in advance of the survey to speed up the process and reduce costs.
- Bear in mind that direct measurement is very important when it comes to boundary determination and dispute resolution, especially in the view of the courts, so offsets should be avoided whenever possible. This may require frequent use of mini prisms.
- In certain circumstances it can be more accurate to measure an overgrown hedge using taped offsets from surveyed points or from detail already surveyed and inserting the hedge in the office later using software. The centre of the root of the hedge can sometimes be best viewed at close to ground level

7 PROPERTY LINE SURVEY

It cannot be emphasised strongly enough that the property line survey is not a topographic survey which includes boundaries. The landowner should walk the boundaries identifying them to the surveyor, and the surveyor will be surveying features associated with the current occupation line of the property.

The property line survey will in all cases be carried out by reference to a GPS baseline.

7.1 *Measurement Specifications*

All observations shall be reduced to and processed and presented on the ITM coordinate reference system (CRS).

The following survey tolerances shall apply:

- Survey control outlined in section 7.2 (GPS baseline) at 95% confidence level (2 standard deviations):
  - Absolute accuracy less than ± 100mm for each survey control station.

    Manufacturers typically quote the accuracy for dual frequency GPS receivers as ± (5 mm + 1ppm), elements 3 and 4 respectively in the equation below for a 50 Km baseline from the nearest Active GPS station. Since the survey control will be observed in static mode and post-processed using RINEX files from the Active GPS stations the first element in the equation relates to the accuracy of the Active GPS station (± 10mm). The second element in the equation relates to the centring of the GPS equipment over the control station (± 5mm). If these errors are considered as standard errors, then the absolute accuracy for the control station is given by propagation of error theory as:

    Standard error (σ) = $\sqrt{(10^2)+(5^2)+(5^2)+(50^2)}$ = 51.48 mm, or 102.96mm @ 2σ

    However, since the location of most properties should be appreciably less than 50Km from the nearest Active GPS station, the absolute accuracy of the control stations should regularly be less than 50mm @ 2σ.

  - Relative accuracy between the two ends of the baseline less than ± 10 mm.
  - Relative accuracy of traverse stations (if appropriate) less than ± 10 mm to the control stations of the GPS baseline.
- Boundary features outlined in sections 7.3 and 7.4 at 67% confidence level (1 standard deviation):
  - Relative accuracy of boundary features will be dependent on the type of boundary feature (see section 4 on boundaries - as a rule of thumb an accuracy tolerance of 10% of the width of the feature should be used subject to a minimum of ± 25 mm);

7.2 *Survey Control*

GPS will be used to establish survey control points in order to:

- connect the survey to the ITM coordinate reference framework;
- attain the absolute accuracy standard necessary;
- identify discrepancies in OSi maps and PRA boundaries if present.

Survey control should be observed using a static GPS procedure to ensure that the computation is repeatable. A ‘rule of thumb’ for calculating a minimum observation period for static GPS is 5 minutes + 1 minute per Km to the nearest GPS station (Prendergast *et al.*, 2004). However, since there is no warning of stations in the network going down, it would be better practice to use 5 minutes + 1 minute per Km to the second nearest Active GPS station. This will increase occupation times by 20 to 30 minutes, but at least the surveyor can rest assured that re-occupation will not be required.

Network RTK is not recommended for the GPS baseline because:

- There is no record kept of the correction supplied by the NRTK system. All raw data needs to be stored by the surveyor because it must be possible to validate the result within:
  - a proposed new PRA procedure;
  - if another surveyor subsequently finds a problem;
- Coverage by the mobile phone network is not complete. Holes have been identified in the system in certain areas and coverage along the west coast is patchy;
- Different weather conditions and different geometry of the satellite constellation can give results of up to 200 mms difference between subsequent observations.

Boundary features may then be surveyed using GPS if appropriate. The following techniques are suitable:

- Standard RTK from the survey control stations of the GPS baseline;
- Network RTK, but the GPS baseline stations should also be included in this survey to supply a relative fit correction onto the GPS baseline.

A minimum of two inter-visible GPS control stations are required, with as clear a view of the sky as possible and using a 10 to 15 degree elevation mask so that satellite signals reach each antenna without obstruction from trees or buildings. The baseline(s) between the control stations should be as long as possible to optimise scale and orientation accuracy of the survey. If possible, one of the two GPS control stations should be located on public ground to minimise issues regarding access to the point subsequently for surveyors. Points should be located on footpaths in preference to being located on roads.

If the control stations are located one each in the front and back gardens, inter-visibility would normally be via any access at the side of the building, but may also be via a direct sight through windows (sightings through windows may cause refraction so they should be open if possible during observations with total stations).

The accuracy of the GPS baseline(s) should be checked using a total station to confirm the specified relative accuracy tolerance is achieved. When post processing the GPS points, the GPS station which has the better accuracy should be held fixed, and the coordinate for the second GPS station should be computed using the GPS bearing and the EDM distance from the total station observation.

The computation and validation of the accuracy of the GPS baseline is critical for acceptance of these best practice guidelines. This computation must be repeatable, and the result should be rock solid, to ensure that subsequent surveys in the vicinity of the property in 3 months, or 50 years time, should be able to confirm the accuracy of the original coordinates computed for the GPS baseline. If a property line survey is being carried out in close proximity to a property already surveyed according to these

best practice guidelines, the new survey should include a check of the coordinates for the GPS control stations and any boundary monuments (if appropriate). If for any reason the specified accuracy tolerance is not achieved, state it in the survey report, and supply reasons why this occurred.

It is recommended to use survey nails on hard detail (footpaths and roads) and ground anchors or rebar on soft ground. However, landowners may not want ground anchors in their gardens so it may be best to locate permanent control points in the public area adjoining the property and then traverse through the property. Control points located on soft ground should be buried 100 - 200mm below the surface. This avoids people digging them up, and they are less likely to be disturbed. Surveyors can easily find them using station location diagrams and metal detectors.

Although heights for the control stations are not currently required, they should be computed, and converted to orthometric heights (MSL @ Malin Head) using GridinQuest and recorded on the map of property line and in the location diagrams for the control stations (as per the example provided in Appendix D).

7.3 *Features to be included*

For new developments the architect/engineer should ensure that a) a proper boundary survey has been carried out, and b) that it should be correlated with the legal boundary recorded by the PRA. He should also be requested to specify:

- Whether walls and fences are wholly owned or in joint ownership;
- How overhanging eaves and underlying foundations should be treated in terms of ownership;
- Whether driveways of adjacent properties overlap;

The following features should be included in the property line survey:

- **Property line** - the centreline of topographic features associated with the property boundary should be surveyed.
  - Where features are ill defined, or there is evidence of multiple features, the surveyor's judgement is necessary to determine which points should be accepted as the position of the boundary. Document the reasons why a particular line has been chosen as the boundary and support it with photographic evidence. It is also prudent to take measurements to key points along the associated features for future reference should the need arise.
  - It is good practice to survey both sides of the feature to confirm the accuracy of the centreline. However it would be incorrect to survey both sides of foliage of a hedgerow and derive the centreline due to different growth patterns from prevailing winds and/or differences in hedge cutting on either side. Where possible the root of hedge should be surveyed in preference to both sides of the foliage and both sides of the bank on which it stands, if there is one.

- The survey should record changes in the types of features along the boundary and their nature - a digital image should be captured of each feature;
- A cross section of a feature, including ground and feature heights, may be required for clarity, particularly for earth and stone banks;

- **Buildings** - the footprint of key permanent buildings should be surveyed.
  - OSi maps regularly show building eaves which can be appreciably larger than the footprint of buildings;
  - Buildings provide a useful accuracy check on dimensions between buildings and boundaries, and can also be very useful to assist map correlation.
- **Access** - 25m to 50m (as a minimum) of the boundaries along the public road on either side of the property and access including the gateway and driveway to the property in question should be surveyed. For national primary and secondary roads this should be extended to 120 m, subject to lines of sight.
- **Encroachments** - where possible all minor encroachments such as overhanging eaves etc., should be noted in the survey. If foundations are considered likely to be encroaching, the surveyor should bring it to the attention of the solicitor.
- **Redundant points of Hard Detail** - a number of points of hard detail outside the property in question, in the vicinity, such as buildings on adjacent properties located near adjoining boundaries and boundary junctions or entranceways along the public road should be captured for correlation with detail on OSi and PRA maps. The features chosen should be as old as possible to increase the likelihood of them being included on older PRA and OSi maps.

7.4 *Additional Features*

The property line survey will not include the following features unless specifically requested. It should be noted that this will normally involve extra time and expense:

- **Easements** - the surveyor should request the solicitor to list all easements recorded in the folio or outlined in the text of the conveyance prior to carrying out the survey. The surveyor should attempt to confirm the location of any easements so listed if still in existence.

7.5 *Areas*

Land parcels have a finite area which should be possible to quantify accurately if the boundaries can be determined with any degree of certainty on the ground. The area of a property is best computed using the ITM co-ordinates of the property line measured on site during a property line survey. Areas shall be stated in hectares to 3 decimal places (accuracy of 10^2m) on the property line survey map and these areas will predominantly be more accurate than the areas stated on OSi maps by virtue of the differences in how they are surveyed and computed.

Areas carefully measured from paper OSi and PRA maps using planimetres can have a repeatability of 1%, but the accuracy will vary with the condition of the paper and the

degree of distortion of scale at the time of measurement. Additionally, there is no guarantee that the lines on the map accurately depict the actual boundaries of the property on the ground, unless verified. Consequently, areas calculated in this manner should be used for indicative purposes only.

Surveyors are advised against computing areas by adding up areas printed on OSi maps. This methodology is now considered unreliable since area braces are no longer used by OSi, and especially so on the 1:5000 maps, where printed areas have been found to be quite unreliable. Areas computed from coordinates surveyed on the ground during a property line survey should take precedence over areas calculated using any other methodology.

Surveyors are encouraged not to certify areas of properties unless a property line survey has been carried out. In all other circumstances surveyors are recommended to outline the methodology used to compute the area, and state that "based on this methodology, it is my opinion that the area of the property is …"

Where the boundaries of properties are currently given to the centre of the public road, the area of the property should be split into two, representing the land area (up to and including the front boundary) and the road area. The line dividing these two areas should be specified and annotated (i.e. FW for face of wall).

There are certain engineering applications where special conditions are established for scale-factor, but these do not apply with regards to property line surveys. Since ITM coordinates are required by the PRA and are used during property line surveys, scale-factor will be incorporated into the areas computed. The difference between using and not using scale-factor is less than 0.04% and consequently is considered insignificant (Table 5).

Table 5 Influence of maximum scale-factor (180 ppm) on area calculation.

Extent of Property	Area without scale-factor	Area with scale-factor m^2	Difference
Urban Semi-detached house	300.000m^2 10m x 30m	Max = 300.054m^2 Min = 299.946m^2	0.054m^2
Detached house on ½ acre	2023.450m^2 50m x 40.469	Max = 2024.179m^2 Min = 2022.722m^2	0.729m^2
25 acre field	101,171.411m^2	Max = 101,207.842m^2 Min = 101,134.992m^2	36.431m^2

The area of a property is a key characteristic for landowners, and areas are also excellent indicators of discrepancies in boundaries for surveyors. Accurate areas are also important for purchasers, mortgagers, solicitors, auctioneers and State agencies managing ownership, value, use and development of land. More accurate coordinates for boundaries ensures the computation of more accurate areas, dimensions,

perimeters and shapes of properties (figure 11). Accordingly, the prime focus should be on improving the accuracy of the boundary coordinates.

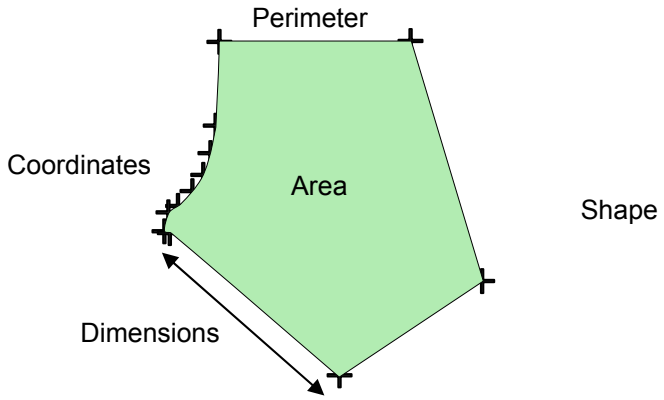


Figure 11 More accurate coordinates of parcels enable more accurate definition of location, dimensions, shape, area and perimeter.

8 REPORT AND MAP OF THE PROPERTY LINE SURVEY

The intention of these guidelines with respect to the property line map produced is twofold:

a) to encourage surveyors to adopt a common accuracy standard and survey methodology for property line surveys, and
b) to encourage surveyors to adopt a standardised format for content and presentation for the property line map and the boundary discrepancies map.

In time landowners, developers, solicitors and the Property Registration Authority will come to recognise the standard format and reliability of these maps, and will eventually demand this standard as the norm.

8.1 *Recommended Standardised Annotations for Boundaries*

Surveyors are encouraged to include boundary annotations on their property line maps indicating the location of the property line in relation to the boundary feature. The following annotations, used on Ordnance Survey maps for annotating townland boundaries, are recommended for this purpose.

CR	Centre of road or centre of river
CS	Centre of stream
CW	Centre of wall
CF	Centre of Fence
FW	Face of wall
FF	Face of fence
RH	Root of hedge

8.2 *Symbols not recommended for use on Boundary Maps*

The 'T' and 'H' symbols (figure 12) are sometimes used to indicate sole or joint ownership of boundary features.

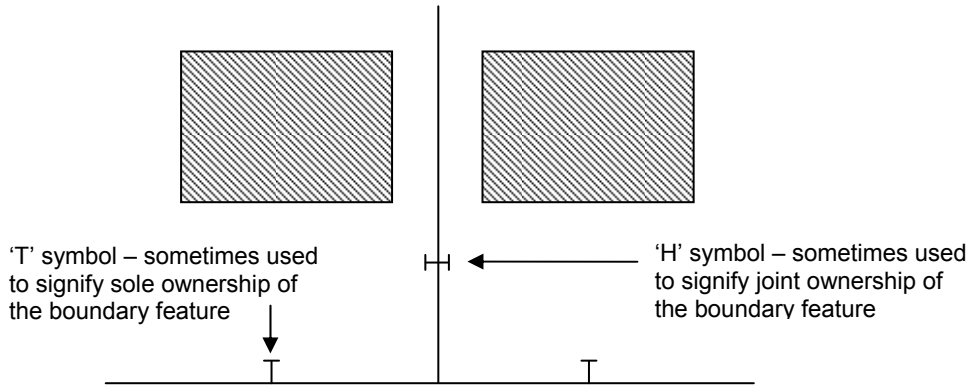


Figure 12 'H' & 'T' symbols sometimes used to indicate joint and sole ownership of boundary features.

However these symbols were also regularly used in the past to indicate the existence of ditches and drains along boundary features (figures 13 and 14).

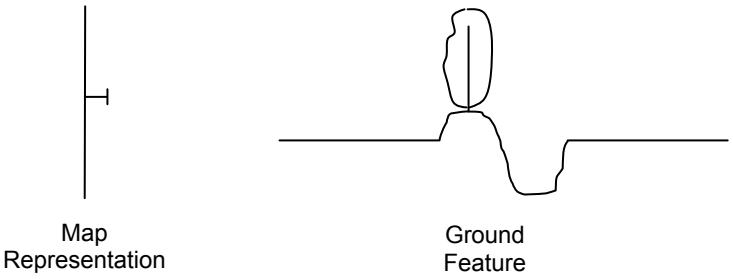


Figure 13 Line on OS map depicts the location of the centre of the earth bank (normally the root of the hedge). The 'T' symbol was used to indicate the presence of a ditch to the right of the bank, and the length of the 'T' was usually drawn at 3ft or 4ft 6" at map scale.

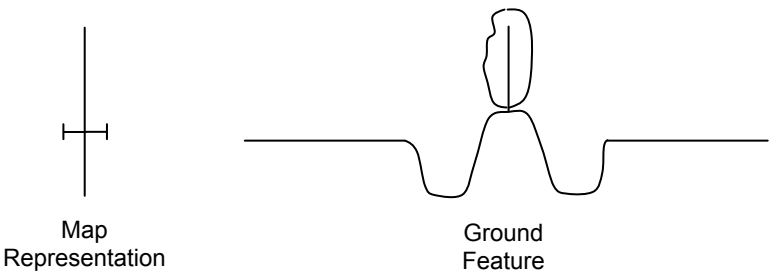


Figure 14 Line on OS map depicts the location of the centre of the earth bank (normally the root of the hedge). The 'H' symbol was used to indicate the presence and width of the ditches on either side of the bank, again drawn to scale to depict the width of the ditches (normally 3ft or 4ft 6" wide).

OSi also use a 'mereing' symbol (figure 15) for townland boundaries to indicate the location where the townland boundary changes in relation to the topographic features to which they are associated. This symbol was used by Dublin City Council to annotate property boundaries for about 40 years, but this practice was discontinued in the early 1980s.

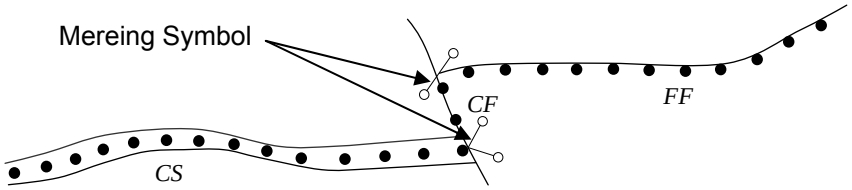


Figure 15 Two versions of mereing symbols used for annotation of townland boundaries on OSi maps to indicate the location where the boundary changes.

Due to the various interpretations of the 'T' and 'H' symbols, and the fact that the mereing symbol is no longer used by Dublin City Council the Commission recommends that surveyors should not use these symbols on property line maps.

8.3 *Property Line Map*

A sample property line map is provided in Appendix E. The features to be included in this map are listed in section 7.3.

ITM coordinates for the control points at either end of the GPS baseline should be printed on the map. The ellipsoidal height computed for the control points should be transformed into an orthometric height (MSL at Malin Head) using the 'GridinQuest' software and also printed on the map.

Where the ownership of the property extends to the centre of the road, the area should be supplied to three decimals of a hectare in two portions:

a) The land area - area of the parcel occupied by the landowner as defined by the property line survey and up to the external face of the boundary adjacent to the public road, including the areas of buildings on the property.
b) The road area - area between the outside face of the boundary adjacent to the public road and the mean centreline of the public roadway as determined from old OSi detail.

Areas should also be shown for the key permanent buildings included on the property line map.

8.4 *Report of Property Line Survey*

It is recommended that the property line map should be supplied with a report of the property line survey. The report should include the following information:

a) Description of task(s) requested;
b) Surveyors certification of accuracy standards achieved;
c) Survey Control including:

- Diagram of control network (GPS baseline + traverse if appropriate);
- Location diagrams for each control station;
- Description of the observation and adjustment methods used, including QC checks applied in the field and during processing;

d) Survey of the Property Line including:
- Coordinate list for the property line as surveyed in ITM on the ground;
- Property Line Map including boundary annotations and numbers for each point along the property line (corresponding to its coordinates in the list);
- A description of the boundary features, including a digital image for each;
- Description of the observation and processing methods used, including QC checks applied in the field and during processing.

9 MAP CORRELATION AND ANALYSIS

The property line map which has identified and recorded the current position of the boundaries of the property as occupied on the ground, should then be correlated with the following maps to ensure the position of the boundaries is recorded accurately on the PRA map:

- Latest version of the OSi map - this is carried out as a check to confirm that the property line map is correct (within the OSi mapping tolerances) and includes all the necessary detail;
- Current PRA map for the property - this is carried out to ensure that the record of the legal boundary conforms to the boundary of the property as occupied on the ground.
- Map originally submitted for registration - this is carried out to ensure that the current PRA map conforms to the boundaries originally submitted for registration (again within the OSi mapping tolerances).

9.1 *Correlation with Latest OSi Map*

Much of the Ordnance Survey large scale mapping has been resurveyed during the last 10 to 15 years and the accuracy tolerances of these modern OSi maps have been quantified by Greenway & Curran (2005), as:

- RMSE of +/- 0.6m for 1:1000 urban maps;
- RMSE of +/- 0.69m for 1:2500 sub-urban maps;
- RMSE of +/- 1.22m for 1:5000 rural maps.

This accuracy determination by OSi is slightly biased because a) only points of ‘hard detail’ were chosen and property boundaries regularly include much ‘soft detail’ with lots of foliage and b) it was carried out by OSi on their own maps and has not been independently checked. Notwithstanding these two points, surveyors would generally expect the OSi map to correspond (within the mapping tolerances) to the more accurate property line map.

9.2 *Correlation with Current PRA Map*

Since the PRA map is substantially based on the OSi map one would then expect a high incidence of correspondence between the boundaries on the property line map and the boundaries on the PRA map. However, this is regularly not the case for PRA maps in paper format, mainly because the PRA had not adopted the latest version of the OSi map. This may change with the implementation of the PRA digital mapping project where the PRA boundaries are being associated with the very latest versions of OSi maps. Therefore in theory, the results of the digital mapping project should give a high incidence of correspondence between the property line map and the current PRA map (within the OSi mapping tolerances).

However, the correlation of the PRA map with the property line map may not agree for a variety of reasons (listed on page 5 in the introduction), and it is one of the surveyor's tasks to investigate and document why this is so.

9.3 *Correlation with Map originally submitted for Registration*

The PRA digital mapping project is adjusting property boundaries using tolerances of up to +/- 20m to the latest version of the OSi maps (PRA, 2007). This has the effect of correcting many small irregularities which have crept into the PRA index map over the years and could be considered a national rectification process. The difficulty alluded to earlier is that it is likely that the current PRA (digital) boundaries may not correspond to the boundaries originally submitted for registration any longer. It is possible therefore that the legal profession may identify this anomaly during investigations for boundary disputes and use it as a means of casting doubt on the current PRA map. Rectifications of the mapping must have either the owners consent or be carried out on foot of a judge's order to be legal according to the Registration of Title Act (Oireachtas, 1964), but neither of these means was utilised during the digital mapping project, so this is potentially an Achilles heel for this project.

Landowners and professionals need to take a pragmatic view of these changes however. Firstly it must be stated that the boundary on the ground has not changed in most cases, only the official record of where that legal boundary is. Secondly, this rectification of the boundary records is expected in most cases to more accurately reflect the actual situation on the ground. However, if the result of this rectification does not reflect the intent of the original registration, the surveyor should then consult other information to try to identify where the discrepancy arose, including:

- Older versions of OSi maps;
- Older versions of PRA maps;
- Deed maps if available;
- Deeds making reference to the boundaries;
- Aerial photos.

Where multiple maps are involved in cases such as this, it is necessary to establish the legal provenance of the maps being used and then try to deduce which map carries more weight i.e. legal precedence. The reasons for this level of investigation is for the

surveyors to uncover the reasons why the current situation was arrived at in order to resolve it.

This task of correlating numerous maps of a property is considered to be a significant extension of the map correlation task, and should be clarified with the client with regards to any additional costs which may apply. Surveyors should stress to clients and solicitors alike that this task of map correlation is where most of the problems arise, and consequently can be quite time consuming.

9.4 *Report of Map Correlation and Analysis*

Difficulties can arise during this map correlation and analysis phase. In certain circumstances, through insufficient information, surveyors' judgements may be flawed, It is strongly recommended that surveyors operating on both sides of an adjoining boundary work together to identify and quantify the number of different scenarios possible for the situation at hand. A correct solution depends on access to evidence from both sides of the boundary and surveyors should discuss the merits of these different scenarios to identify the best one in order to mediate a solution. The surveyor should include a list of all these scenarios in their final report and outline a detailed and reasoned opinion why they chose a particular one.

It is recommended that a report of the map correlation and analysis be supplied containing the following information:

a) when using this 'graphical best fit' methodology, it is necessary to:
   - State how the correlation was carried out;
   - List the main scenarios possible (using different subsets of hard detail);
   - Identify which scenario was chosen and outline a detailed and reasoned opinion why they chose a particular one;

b) The results achieved (differences in coordinates and area) when correlating the property line map to:
   - The latest version of the OSi map;
   - The latest version of the PRA map;
   - The map originally submitted for registration;

In the event that all these map correlations are acceptable (within the tolerances of the OSi mapping), then the final report should state this, and in these cases the creation of a boundary discrepancy map and the regularisation of the PRA ownership records is not required.

9.5 *Map Correlation Methodologies*

Map correlation can be carried out using two different methodologies, namely:

- Graphical best relative fit - used exclusively in the past for updating paper records such as the PRA paper maps
- Mathematical by coordinates - becoming the norm for digital databases where the new data surveyed is more accurate than the legacy mapping to which it is being associated.

a) ***Graphical Methodology – 'Best Relative Fit'***

The best relative fit methodology has been traditionally used within the paper mapping environment. Essentially it entails fitting the new survey using a number of points of 'hard detail' in the vicinity of the property in question such as buildings on adjacent properties located near adjoining boundaries and boundary junctions or entranceways along the public road. The features chosen should be as old as possible to increase the likelihood of them being included on older PRA and OSi maps. The new survey is plotted out on film at the appropriate map scale and then overlaid on the PRA or OSi map. A subset of these points of 'hard detail' is then chosen to correlate the new survey with the old map.

However, this 'graphical best fit' methodology has a number of failings, including:

- The choice of different points of hard detail on which to base the correlation means that this methodology is not unique because of ambiguities in the legacy OSi and PRA mapping:
  - Scale errors due to the age of the mapping and the medium (paper is not dimensionally stable) on which it is stored;
  - Differences in map detail due to the differences in the ages of the maps;
- The graphical nature of this methodology means that it is not rigorous, cannot be repeated exactly, and different people can arrive at different results;
- The higher accuracy of the new survey is downgraded by fitting the new data to the old legacy data of lesser accuracy.

Therefore numerous relative fits are possible for any one correlation, all slight variations of each other. This means that a range of scenarios from using this methodology are both possible and likely. Surveyors should not allow themselves to be backed into a corner to justify the unjustifiable. Two approaches listed in order of preference are:

- Using points of hard detail in the vicinity the property in question specific to OSi mapping and not sub-division detail (from the whole to the part);
- Using the boundaries of the property in question. The surveyor should normally take the longest boundary, but one of the other boundaries may be used instead, if evidence found on the ground indicates it to be older and/or more accurate.

b) ***Mathematical Methodology – 'using coordinates'***

This methodology was developed in order to retain the higher accuracy of the new survey information and to incorporate it into the older less accurate legacy mapping. The main distinction in this methodology is that the old data is fitted to the new data, rather than the reverse as happens in the alternative relative best fit methodology. There is an international trend to migrate from the graphical to the mathematical methodology once cadastres or land registration mapping is converted into digital form (Enemark, 1998; Scheu, Effenberg and Williamson, 2000).

In its simplest form, a minimum of two coordinates are necessary for this mathematical methodology, which creates a correspondence between the two maps on the basis of their coordinate reference systems. The first coordinate fixes the location and the second coordinate fixes the orientation and scale. It is also good practice to use a third coordinate as a means to check the result obtained from the first two coordinates. One example of this methodology currently in use in the PRA is for multi-storey buildings where the maps of each floor of the building must have two coordinate intersections to ensure the storeys can be located vertically above one another.

This mathematical methodology was rarely used in the past for a number of reasons. Firstly, many of the PRA maps in current use were still on the old Cassini projections for individual Counties and they did not have coordinate information printed on them. Secondly, although the Irish Grid coordinate reference system was introduced on an all island basis in 1975, the maps were still in paper format, so the graphical means of acquiring a best relative fit was the preferred methodology used by most practitioners. The conversion of the PRA mapping to digital format and the introduction of the new more accurate ITM coordinate reference system should facilitate a more widespread adoption of the mathematical methodology for map correlation in the future.

The difficulty however, is the integration of these two datasets, which have different accuracies (figure 16). The concept is to try to retain the improved absolute accuracy of the new data and connect the old data to the new without degrading the relative accuracy of the older data. In practice this can be difficult to do, but the real advantage of this methodology is that the legacy mapping in existing databases is gradually upgraded using high accuracy surveys.

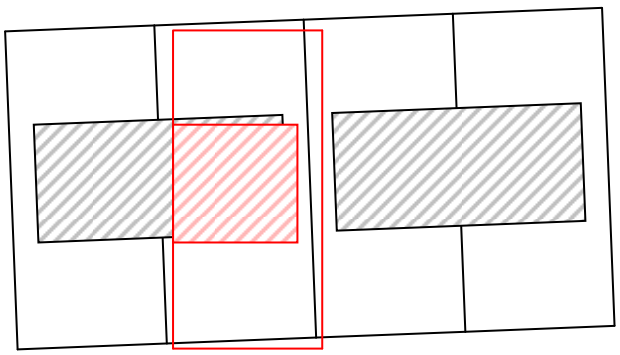
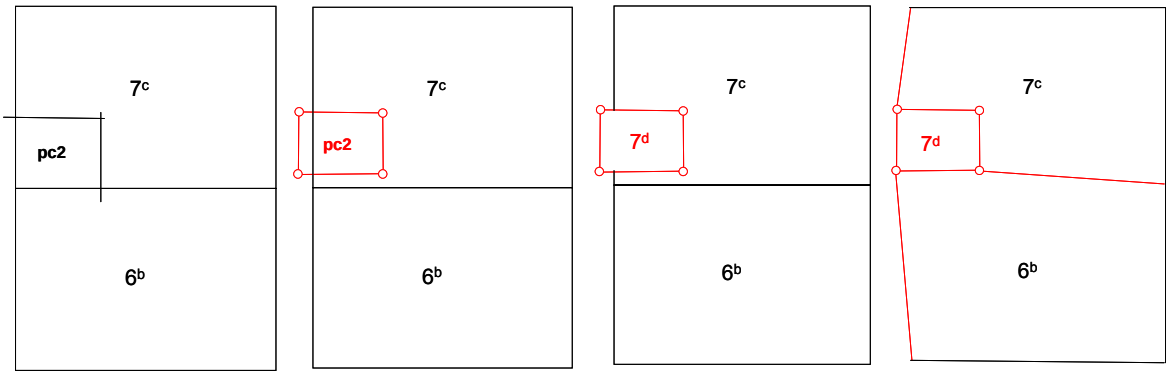


Figure 16 **Difficulty with integration of information from new surveys of higher absolute accuracy (red) into less accurate legacy mapping (black).**

A number of approaches have already been developed. The Danish approach outlined by Enemark (1998) retains the high accuracy location of the sub-divided parcel which is legally acceptable, and connects the existing legacy cadastral map to the new parcel with lines which are not graphically correct (Figure 17). However, these connecting lines are more correct than the existing legacy mapping because although one end is still of lesser accuracy (remains the same) the other end connected to the sub-divided parcel is of higher accuracy.



Existing digital cadastral map and sub-division of a new parcel is to be carried out.

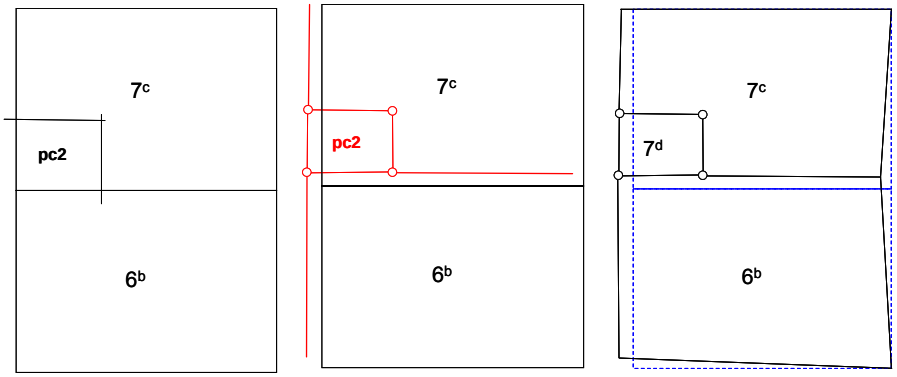
The legal survey of the boundary points of the new parcel are inserted directly into the map.

This result of an updating process is not acceptable and is not legally correct.

This result of an updating process is legally acceptable but not graphically correct.

Figure 17 Problems encountered when using the dynamic process for updating the digital cadastral map (Enemark, 1998)

The German approach (Scheu, Effenberg & Williamson, 2000) is to also include the connecting lines in the re-survey so that the final result is less graphically incorrect (figure 18)



Existing digital cadastral map and sub-division of a new parcel is to be carried out.

The legal survey of the boundary points of the new parcel and the adjoining boundaries are inserted directly into the map.

This result of an upgrading process is both legally and graphically acceptable.

Figure 18 Solution for a dynamic upgrading process for the digital cadastral map used in Germany.

The PRA will need to develop in collaboration with the surveying and engineering communities a suitable approach for using the mathematical method in Ireland to exploit the enhanced accuracy potential of modern boundary surveys.

10 THE BOUNDARY DISCREPANCIES MAP

The boundary discrepancies map should provide a graphical comparison between the property line map as surveyed on the ground and the location of the property boundaries from the current PRA map. The PRA do not yet have the ability to supply the ITM Filed Plan in vector format (it is hoped this will be resolved soon), so surveyors

must currently create the PRA boundary coordinates by digitising the boundary from the paper copy. This situation is not ideal because it incurs additional costs for clients, inefficiencies within private surveying practices, and the coordinates produced may include digitising errors.

Where differences occur between the extent and location of the property registered in the PRA and that of the property as occupied on the ground, a boundary discrepancies map should be prepared as follows (sample supplied in Appendix F):

- The area of land inside the title as per the PRA and inside the physical boundary on the ground (occupied) should be shaded green and annotated ‘G’;
- The area of land inside the title as per the PRA, but outside the physical boundary on the ground (not occupied) should be shaded orange and annotated ‘O’;
- The area of land outside the title as per the PRA, but inside the physical boundary on the ground (occupied) should be shaded red and annotated ‘R’;
- The area of land inside the title as per the PRA and the area of land as defined by the map originally lodged for registration (within the instrument) should be shaded blue and annotated ‘B’.

The area of each of these discrepancies should be included on the boundary discrepancies map. It also needs to be emphasised that there may be no encroachment on the ground, and that any discrepancies identified may only be imperfections in the records.

11 REGULARISATION OF OWNERSHIP RECORDS

Section 32 of the Registration of Title Act (Oireachtas, 1964) provides for rectification of errors in the Land Registry records. Cannon (2001) stated that the Registrar may rectify the error, but they must first obtain the consent of the registered owners. If they fail to get this consent, they may apply to the court for an order allowing rectification. The court will grant this order if it feels that such rectification may be carried out without injustice. Rules 6 to 9 of the Land Registry Rules (DoJ, 1972) also provides for alterations, revisions and corrections by the Registrar where the Registrar must serve notice to the parties or procure their consent.

Discrepancies in the PRA records constitute a risk both for the landowner and for the mortgager concerned (if appropriate) by introducing uncertainty and diminishing the security of the title documents. They also constitute a significant obstacle for the development of a national land management system within which the PRA tenure system would be the fundamental element. Internationally, there is widespread agreement of the importance of the accuracy of the spatial definition of property boundaries (i.e. the parcel) since it has been accepted and widely adopted as the smallest spatial unit in national land management systems to which all other information is linked. Uncertainty in the spatial definition of these parcels can significantly increase the potential for legal challenges for issues such as the

designation of areas for environmental protection or conservation which restrict potential development rights of property.

The two main functions of the property line surveys are:

- to determine and record the location of the property line as occupied on the ground (property line map);
- to identify any issues between the position of the property line on the ground and how it has been recorded in the PRA records (boundary discrepancies map).

Although information of similar quality to the proposed property line map is regularly available in Ireland for large scale development schemes, and occasionally available for isolated developments of high value, the PRA are rarely requested to rectify their records due to the impracticality of the current PRA procedures on the grounds of additional costs and extensive delays incurred (figure 19).

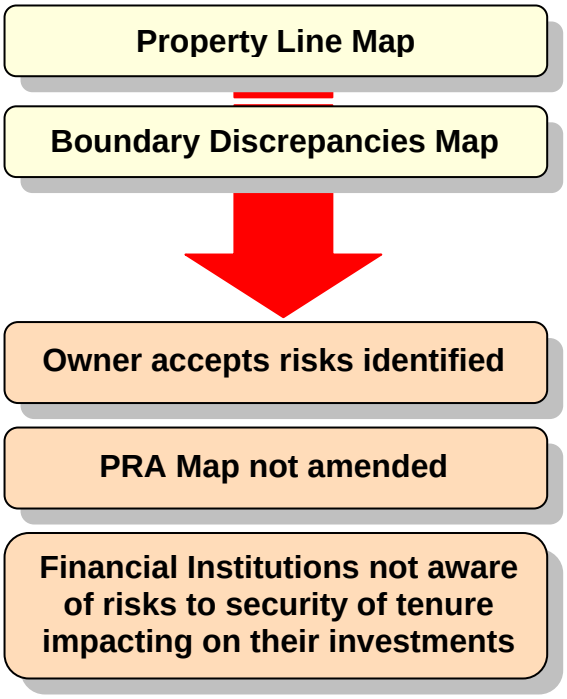


Figure 19 Predominant current practices where PRA records are rarely regularised when discrepancies in boundaries are identified.

It seems foolish to go to the expense of carrying out a property line survey and identifying issues between the property boundary on the ground and how it is recorded legally by the PRA, and then not to use this highly accurate information to regularise the PRA ownership records. The system should be weighted towards encouraging owners to correct discrepancies in the register, rather than making it difficult for them to do so. Additionally, since the State also benefits from the correction of its national land tenure database, perhaps it should accept a portion of the costs for rectifying these discrepancies. Furthermore sufficient resources should be provided to the PRA to minimise delays resulting from rectifying the records.

An emerging trend widely acknowledged both nationally and internationally is that new processes are necessary for digital databases to dynamically rectify errors as they are identified. The PRA national land tenure database is no different, and existing procedures need to be urgently modified and modernised to provide practical solutions and encourage discrepancies in the register to be rectified on an incremental basis. O'Donnell (1998) recommends that an accurate map is essential for a contract of sale and proposed that the conveyancer acting for the purchaser should give a copy of the map relating to the property to which title appears to be shown to the client and advise them to get the map checked against the actual property by a competent person. Since the PRA map is required by statute to use the OSi map, the IIS proposes two new procedures to exploit the highly accurate information from the property line surveys to amend PRA records:

- A new OSi procedure (separate from the normal map revision cycle) where discrepancies in OSi maps are reported to OSi to be checked, re-surveyed and corrected as necessary (section 11.1);
- A new PRA procedure (separate from the normal receipt of revised maps from OSi) where corrections using the new OSi procedure (section 11.1) are supplied to the PRA to amend the boundaries concerned for individual properties (section 11.2).

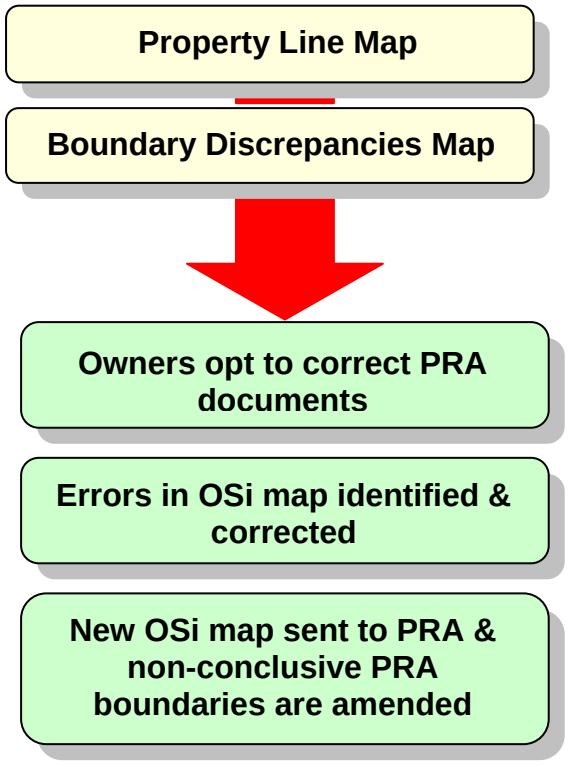


Figure 20 **Proposed new procedures firstly to amend OSi map and then to amend PRA ownership records when discrepancies in boundaries are identified.**

11.1 *OSi Maps* *(already piloted with OSi)*

If a discrepancy is identified when comparing the latest version of the OSi map with the property line survey carried out on site using these best practice guidelines, and the

discrepancy is greater than the OSi tolerances for mapping (page 4), then the following procedure should be used to rectify the discrepancy on the OSi map.

This procedure proposes a rectification of the OSi map outside the normal revision cycle (when a sale is pending OSi should act quickly). The Commission suggests a maximum period of 4 weeks to complete this satisfactorily):

- Type of boundary is established to assess if this could be the reason for the discrepancy (overgrown hedge or tall vegetation in close proximity to boundary feature);
- Property line map is annotated and plotted at an enlarged scale for clarification;
- The surveyor should notify the discrepancy to the OSi customer liaison officer via email at custserv@osi.ie. Documents clarifying the discrepancy should be attached. The email will be logged on the OSi customer relationship management (CRM) system to ensure all reports are dealt with and closed off in a timely fashion;
- Area is examined on screen by OSi using OSi digital maps and orthophotos;
- Initial notification via email by OSi personnel to the private surveyor involved that a discrepancy seems likely and commitment given that the problem will be addressed;
- Surveyor informs landowner that OSi field reviser will be carrying out a survey;
- OSi field reviser completes survey of property;
- OSi compares results of private surveyor and field reviser, and adopts correction as appropriate;
- OSi supplies new version of OSi map to private surveyor (free of charge - since the surveyor will have already paid for the map with the discrepancy);
- OSi supplies new version of OSi maps or just the corrected features to PRA on a monthly basis.

11.2 ***PRA Maps*** *(not yet piloted with the PRA)*

Proposed new rectification of PRA map outside the normal update cycle of OSi maps to the PRA (when a sale is pending PRA also should act quickly). The following tasks are proposed to develop a new process in collaboration between IIS, OSi & PRA)

- Private surveyor to ensure new version of OSi map (referred to in section 11.1 above) corresponds with the property line map;
- OSi to supply new version of OSi maps or just the corrected features to PRA on a monthly basis;
- Private surveyor to request solicitor to submit rectification documents to PRA including:
  - Old version of PRA map
  - New edition of OSi map;
  - New property line map;
  - Consent of relevant adjoining owners to carry out the rectification
- PRA to upgrade PRA boundary(s) to new location as defined by new OSi map;
- PRA to inform registered owner of result of the boundary rectification.

In cases where a property line map has been prepared for a landowner, the solicitor should request that it be appended to the folio in addition to the PRA filed plan (A4 copy of PRA index map at relevant OSi scale) for clarity and to ensure it is available on the public record for further dealings on the folio.

11.3 *PRA Folios*

Rule 8 of the Land Registration Rules (DoJ, 1972) provides that where a clerical error is discovered in a Register or Registry Map, the Registrar may make the necessary correction. This rule may be used to amend inaccurate areas of parcels quoted on folios. The surveyor should:

- Re-compute the area accurately using the coordinates surveyed on site during a property line survey;
- Certify the correct area measurement;
- Request the solicitor to have the area on Part 1 of the folio amended and arrange to have a declaration of Identity prepared in this regard.

11.4 *Delays due to Rectification Processes*

The rectification processes outlined in sections 11.1 and 11.2 are considered to be onerous and an additional burden on the client, surveyor and solicitor due to the lengthy delays incurred to rectify the boundary in question by both the OSI and the PRA.

In the past, these additional costs and delays were considered prohibitive and the OSI and the PRA were not informed of discrepancies in their mapping. There is a need to streamline these procedures for the future in order to minimise these costs and ensure discrepancies in the records are rectified whenever they are identified. It is necessary to change this old culture in order to exploit the benefits of utilising this highly accurate information from the boundary survey. If these rectification processes were incentivised by waiving registration and/or rectification fees when discrepancies in the register are rectified, then this might go some way to changing attitudes in this regard.

12 REGISTERING BOUNDARIES AS CONCLUSIVE

The registration of boundaries as conclusive has already been provided for in the Registration of Title Act (Oireachtas, 1964), but for some unknown reason this provision has been used very rarely. The PRA and some elements of the legal profession seem to be averse to using this provision, and during the operation of the PRA map in paper format this may have been the more pragmatic approach. However, once the mapping is converted to digital form, this approach may no longer be appropriate or desirable for the new technological era.

Sperling (2008) stated that he is convinced that Ireland will have to move toward the registration of conclusive boundaries due to the impact of digital mapping techniques and the general drive towards convergence in Europe through initiatives such as EULIS (European Land Information Service) and especially though the EU INSPIRE

Directive (European Commission, 2007). He also suggests that the move to adopting conclusive boundaries is a part of the jigsaw necessary for the successful implementation of an e-Conveyancing system in Ireland.

Sperling also suggests there is a need to adopt new ideas, and new technologies to improve service to citizens in order to align PRA practices with the rest of the world with regard to boundaries. The UK and Ireland stand alone in the world using this non-conclusive form of land registration. Although the Irish registration system is based on the UK model, the UK has been introducing significant change during the last 10 to 15 years. A new Party Wall Act was introduced in the UK in 1996 (UK Parliament, 1996) and a system of determined boundaries (fixed) was introduced in the UK in 2002 (UK Parliament, 2002). Perhaps the version of this system in operation in Ireland also needs to be reviewed from a 21st century perspective?

The Act (Oireachtas, 1964) provides for three circumstances for registering boundaries as conclusive, namely:

- Section 86 - conclusive registrations by agents of the State, including:
  - Commissioners for sale on Encumbered Estates;
  - Judges of the Landed Estates Court;
  - Land Judges;
  - Landlord and Tenant Act 1870;
  - Land Commission;
- Section 87 - conclusive registrations by agreement between owners of adjoining lands;
- Section 88 - conclusive registration for transfers of part of any registered land.

This Commission on Land Registration suggests that these three provisions be used in the following manner:

- Section 86 - all judgements in boundary dispute cases (including those agreed on the steps of the court) should require the registration of the disputed boundary as conclusive. The registration should be carried out in a manner which ensures the elements of the agreement are clear and it is possible to accurately set-out the boundary on the ground from the information recorded in the PRA so that a dispute on the boundary will not re-occur in the future;
- Section 87 - to be used occasionally when neighbours wish to agree an adjoining boundary;
- Section 88 - to be used for registrations of all new boundaries, including
  - Individual isolated developments (figure 21) - the existing owner would first register the new property in their own name and register the new boundaries as conclusive while doing so, and then transfer this new property (including the conclusive boundaries) to the new owner. Issues outlined in section 9.5 will need to be addressed to develop a practical approach for the Irish situation;

- Development schemes (figure 22) - purchasers at contract stage should be obliged to enter into an agreement with the adjoining purchaser (developer) that the common boundary is deemed conclusive and registered as such;

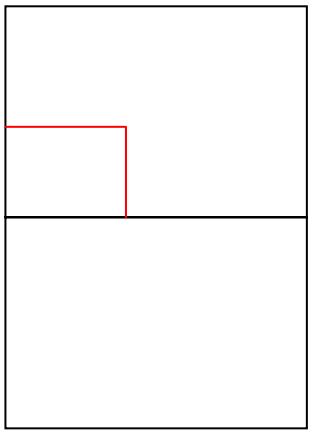


Figure 21 **New boundaries (red) registered as conclusive prior to transfer of property to the new owner**

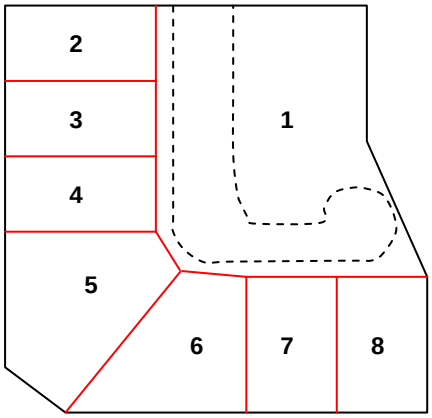


Figure 22 **Purchasers would be obliged to enter into an agreement with the developer to register new boundaries (red) sequentially as conclusive.**

The PRA have stated that there are approximately 15 million non-conclusive boundaries already registered, so even if landowners immediately commenced using these provisions to register boundaries as conclusive, the change from non-conclusive to conclusive boundaries in the PRA database would be very gradual. This will entail a process of slow incremental change over the next 100 year phase of development of the PRA, where new boundaries should be registered as conclusive and the 15 million existing non-conclusive boundaries will be progressively registered as conclusive, though voluntarily and gradually. OSi maps will still have a significant role to play during this period as the basis of the PRA index map.

These registrations of conclusive boundaries should be recorded in detail by the PRA for posterity since the Registration of Title Act (Oireachtas, 1964) states in section 87 that the boundaries shall be conclusive between the parties to the agreements and

their successors in interest. There is no use registering a boundary agreement if the details of that agreement are not recorded for the successors in interest in the relevant PRA folio and map. Secondly, once a property is registered in the PRA, it cannot be unregistered again. Consequently, there should be a similar stipulation stating that once a boundary is registered as conclusive, it cannot revert to a non-conclusive state.

12.1 *Additional requirements of Surveyors for Conclusive Boundaries*

This list includes all additional measures required of surveyors when boundaries are to be registered as conclusive.

- ***Measurement Specifications***
  - Boundary Detail - permanent boundary monuments to be inserted for all boundaries to be registered as conclusive;
  - Relative accuracy of boundary monuments to be ± 10 mm relative to the GPS baseline at a 95% confidence level (2 standard deviations) – similar to the accuracy requirements of traverse stations outlined in section 7.1. Therefore the absolute accuracy of boundary monuments is given by propagation of error theory as:

    Standard error (σ) = $\sqrt{}$ $(51.48^2)+(5^2)+(5^2)+(10^2)$ = 52.92 mm, or 105.83mm @ 2σ

    Where the first term is the absolute accuracy of the GPS control station, the second and third terms relate to the centring accuracy on the boundary monument and the control station respectively, and the fourth term relates to the relative accuracy of the boundary monument to the GPS baseline. Consequently the absolute accuracy of boundary monuments should be better than ± 106mm.
- ***Survey Control*** - Where boundary surveys have previously been carried out on adjacent properties in the vicinity, surveyors should wherever possible attempt to use one or both of the same control points for the new survey. This will ensure the new survey will be correct relatively to the previous survey, and it also permits a rigorous check on the coordinates computed for the survey control.
- ***Property Line Survey***
  1. Carry out the property line survey as described in sections 7.1 to 7.4. If adjoining neighbours have already agreed the position of the boundary on the ground then skip to step 4;
  2. Set out and peg the position of the property line as surveyed on the ground;
  3. Have the two adjoining owners (in collaboration with the surveyor) move the positions of these pegs (if necessary) and agree the final position;
  4. Surveyor to mark the agreed position with suitable permanent boundary monuments (Appendix G). It is strongly recommended that both owners assist the surveyor in this task to cement the agreement;
  5. Have the two adjoining owners sign their agreement for the position of the boundary monuments on the ground according to the agreement document (Appendix H);

6. Surveyor to survey the position of the agreed boundary monuments. Coordinates for boundary monuments must be validated by taking a second observation, preferably from a different control station. The result should be meaned and the accuracy tolerance (bullet 1 section 12.1) confirmed;
7. Boundary monuments should be described in the same manner adopted for survey control stations (Appendix D). Certain circumstances may prohibit the possibility of placing a monument on the corner of the boundary, or the boundary may not be suitable for placing monuments upon it. In these circumstances monuments may be offset from the boundary, and offset dimensions and their orientations should also be supplied.

- ***Property Line Map***
  - Standard symbols should be used for boundary monuments on the property line map;
  - The coordinates of boundary monuments should be listed in the legend on the property line map;
- ***Map Correlation and Analysis***
  - No change for non-conclusive boundaries (maybe only one boundary of the parcel is being registered as conclusive);
  - Correlation of conclusive boundaries should:
    a) Confirm that boundary monuments still exist on the ground;
    b) Confirm that their coordinates are correct (within their accuracy tolerance of ± 106 mm at a 95% confidence level (2 standard deviations);
    c) If the boundary monuments can be located within the accuracy tolerance of their coordinates, then the location of the boundary monuments should take precedence over their coordinates.
    d) If the boundary monuments cannot be located using their location diagrams, or can be located outside the accuracy tolerance of their coordinates, then the coordinates take precedence. In these circumstances the original observations should be re-computed to validate the accuracy of the original coordinates.
    e) This caters for the illegal movement of boundary monuments by owners attempting to encroach upon their neighbours, so it will be necessary to make the movement of boundary monuments a criminal offence within legislation.
- ***Boundary Discrepancies Map***
  - No change for non-conclusive boundaries;
- ***Regularisation of Ownership Records***
  - No change for non-conclusive boundaries
  - For boundaries registered as conclusive PRA should:
    a) Break the link associating the boundary with the OSi map detail;
    b) Use the coordinates of the boundary monuments to insert the boundary into the PRA index map in a layer for conclusive boundaries. The colour used for this layer should permit conclusive boundaries be distinguishable on www.landdirect.ie;

c) Store the location diagrams for the boundary monuments within the system for subsequent access by surveyors as necessary.

- ***Electronic Submissions***
  - Location diagrams for the boundary monuments also need to be submitted to the PRA via the solicitor.

12.2 *Validation of Boundaries Registered as Conclusive*

The Act (Oireachtas, 1964) states that the Registrar requires that prescribed conditions are complied with before they may settle and enter on the register boundaries as conclusive. These prescribed conditions, listed in sections 148 to 151 of the Land Registration Rules (DoJ, 1972), were written for a paper era, and the Commission now suggests that these provisions need to be urgently reviewed for the new digital era.

The Commission proposes the following draft procedure for conclusive registrations:

- Surveyor to ensure that these Best Practice Guidelines have been correctly applied for the Property Line Survey;
- Surveyor to inform solicitor that a specific boundary is to be registered as conclusive, and to supply the following documents:
  - Old version of PRA map showing non-conclusive boundary(s);
  - New property line map (in accordance with appendix E), indicating boundary(s) to be registered as conclusive;
  - Consent of adjoining owners to register boundary as conclusive (Appendix H) to be drawn up by solicitor in collaboration with surveyor;
- IIS audit to be carried out on 100% of all property line surveys where boundaries are registered as conclusive for an initial period to ensure that standards are being applied correctly;
- New PRA procedure required to validate procedures used to survey and record conclusive boundaries. If validation is successful PRA to adopt position of conclusive boundary;
- Conclusive boundaries to be distinguishable on the PRA index map;
- Property Line Map to be associated with the folio and the new PRA Filed Plan;

12.3 *Cost Benefit Analysis*

Additional cost is the most common reason cited for maintaining the current system of non-conclusive boundaries, notwithstanding other issues of reluctance to change and maintaining current monopoly status. The Commission agrees that the cost of creating a cadastre of conclusive boundaries from scratch in a short project timeframe would be excessive, but this is not what is being proposed. This green paper proposes a gradual progression from non-conclusive to conclusive boundaries (over 100 years or so) where all new boundaries are required to be registered as conclusive and existing non-conclusive boundaries are occasionally converted to conclusive as landowners require. The incentives provided to encourage landowners to make this change are important however.

Landowners should have the choice of two alternatives (figure 23), namely:

- Option A - to continue to register boundaries as non-conclusive but to carry out a property line survey as per these best practice guidelines and regularise the ownership records if necessary;
- Option B - to choose to register their boundaries as conclusive for the clarity and extra security this provides.

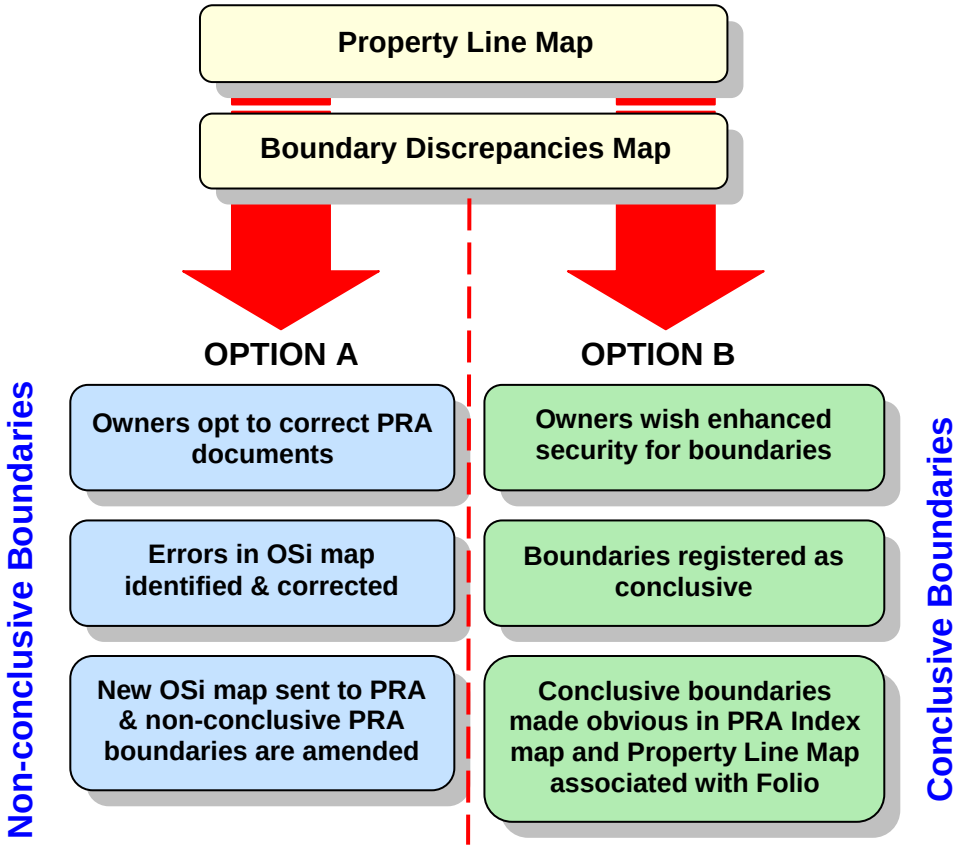


Figure 23 **Two options proposed to regularise PRA ownership records when issues are identified related to boundaries.**

Stages 1 and 2 (Table 6) can take between one to two weeks to complete due to the time spent in sourcing all the necessary information. Stages 3 and 4 are expected to take up to 4 weeks for each organisation to complete their tasks. These delays are significant and are considered onerous for a conveyance process which may have other factors (mortgage funds and human) requiring speed to close the transaction.

Stages 1 and 2 (Table 7) are exactly the same as in table 6 and can take up to 2 weeks to complete. Stage 3 is a new process for adjoining owners to agree a boundary which is then marked and surveyed by the surveyor. Stage 4 is again a new process to register boundaries as conclusive which includes a new PRA task to validate the accuracy of the survey submitted.

There will be a cost for registering boundaries as conclusive and this will be borne substantially by landowners. Sperling (2008) suggested that incentives are needed to encourage landowners to choose option B such as:

- Extending the State guarantee already provided for title to boundaries registered as conclusive;
- Providing a partial reduction in stamp duty for the purchaser when boundaries are registered as conclusive.

The benefits of registering boundaries as conclusive include (Williamson, 1981 & Enemark, 2005):

- To provide landholders and their mortgage providers increased security of tenure by reducing risks associated with title documents and thereby enhancing the security provided by registration;
- To define and physically mark boundaries on the ground using boundary monuments to assist in resolving any existing or future boundary disputes;
- To provide reliable boundary information for subdivision and land transfer processes;
- To build a cadastral inventory for a country of accurate spatial parcels for land;
- To ensure that the spatial definition of parcels in the PRA database would be precise and compatible with the development of a national land management system in the future.

Table 6 Tasks required to regularise ownership records for non-conclusive boundaries.

Stage	Register boundary as non-conclusive	Time
Property Line Survey	o Discussion with client & site visit o Prior research and investigation o Purchase OSi & PRA maps (vector form preferred) o Field preparation o Survey of Property Line (office prep + survey) o Map plotting o Report of Property Line Survey (section 8.4)	2/3 days
Map Correlation and Analysis	o Map correlation using best fit methodology o Coordinate listings of PRA & OSi boundaries o Area Computations o Preparation of report	1/2 days
Regularisation of Ownership Records (A - OSi)	o Reporting discrepancy to OSi o Initial checking of reported discrepancy by OSi in-house o OSi reviser to re-survey boundary(s) to validate results of property line survey o Rectification of OSi map by OSi and geometry tagged re accuracy of ground survey (not to be shifted subsequently using aerial photography)	4 weeks
Regularisation of Ownership Records (B - PRA) – (monthly?)	o Solicitor reports OSi update to PRA and supplies: ▪ Consent of adjoining owners ▪ Deed of rectification o OSi report new update to PRA on monthly basis? o PRA rectify boundaries on PRA index map & re-issue PRA Filed Plan	4 weeks

Table 7 Tasks required to regularise ownership records for conclusive boundaries.

Stage	Register boundary as conclusive	Time
Property Line Survey	o Same tasks as in table 6	2/3 days
Map Correlation and Analysis	o Same tasks as in table 6	1/2 days
Agree and mark conclusive boundary	o Site meeting with adjoining owner's surveyor o Current PRA boundary indicated with pegs by surveyor o Owners move pegs & agree new boundary o Boundary demarcation and surveying of monuments o Owners sign boundary agreement in association with solicitors o Preparation of boundary map + descriptions of monuments o Agreement & information sent to solicitor for registration of boundary as conclusive (includes registration fee)	2 days
Registration of Conclusive Boundary	o Solicitor to check and submit documentation to PRA o PRA to validate conclusive boundary o PRA to register conclusive boundary	4 weeks

The cost of each of these options is quite similar, though the delays in option A resulting from rectifying the OSi and PRA maps make this option less desirable. Additionally the benefits accruing from adopting option B are significant, so for a similar cost a substantially better result is acquired. There is also a major additional benefit for subsequent boundary surveys. Once the survey is done once correctly, then subsequent surveys should be less onerous, and take the form of checking the records and the boundary monuments to ensure all is as it should be.

It is also important to distinguish that boundary location and boundary treatment are two separate tasks. The surveyor's task is to determine and accurately record the location of the boundary. However, the boundary treatment may require the services of a solicitor and an engineer along with the surveyor as the best way to deal with the boundary feature issue, once the location of the properties has been determined or agreed.

13 ELECTRONIC SUBMISSION OF BOUNDARY SURVEYS

The IIS Commission on Land Registration and the PRA established a sub-group in autumn 2007 to define and pilot electronic submission of mapping for registration purposes. A description of the current PRA requirements for electronic submission of digital mapping is supplied in Appendix K.

The digital map is to be in .DWG format (in model space) on the ITM coordinate reference system and spatial information is to use standard layers and colours where:

- The colour RED is restricted for Property Registration Authority information;

- The colour BLACK is restricted fro Ordnance Survey Ireland information;
- Information for the Property Registration Authority should be supplied in a layer named LR_PLAN_NEW. This layer can contain:
  - boundary lines supplied as polylines (continuous line style) rather than polygons
  - Property numbers and road names supplied as text
- Other information may be included in the file (such as title block or additional survey information) using any other colour other than RED or BLACK.

The electronic submission of digital mapping assists the Property Registration Authority gain in-house efficiencies when processing this data for inclusion in the PRA map. However, surveyors also need the PRA to supply ITM Filed Plans in digital vector format prior to a boundary survey being conducted to enhance production efficiencies in the private surveying firms.

The process for submission is yet to be determined though it is expected it will be via email. Submissions of paper mapping would normally have been carried out through the solicitor so the final process to be adopted has yet to be agreed between the surveyors and solicitors professional bodies.

These developments give rise to a number of quality issues which impact directly on the suitability of the PRA mapping database being compatible with the requirements of ISDI, INSPIRE and EULIS, including:

- PRA Data Model — It would be beneficial if a detailed data model was prepared for the PRA digital mapping database and examine this model in relation to the 'Core Cadastral Domain Model' (van Oosterom *et al.*, 2006) already accepted as a reference for the development of a data model for cadastral parcels for INSPIRE
- Quality Model — It would be beneficial if a detailed quality model was developed for the PRA digital mapping database in order to:
  - describe how the PRA data model conforms to ISO quality elements, sub-elements, and outline how data quality is measured and managed (Ivanova, 2006)
  - describe the quality requirements for the PRA map
- Quality Assurance — Need to outline the system of QA procedures operated by the PRA and to develop a corresponding system for the surveying firms (using software) to confirm that quality standards have been achieved before the map is electronically submitted. Two versions may be needed, one each for non-conclusive and conclusive boundaries. This has

already been successfully achieved in a number of European countries.

14 STATUTORY DECLARATIONS / DECLARATIONS OF IDENTITY

Declarations of Identity should be signed before a Peace Commissioner or Commissioner for oaths in accordance with the Statutory Declaration Act (Oireachtas, 1938). Declarations of Identity are required from surveyors to certify their findings and judgements having set out properties within a development scheme, or carried out a boundary survey of a property, or examined maps and documents relating to a transaction. These declarations are used to document the surveyor's professional judgements prior to property transfers or property developments.

Surveyors should request their solicitors to prepare the draft declaration. Surveyors are advised to be particularly careful of all statements made in these declarations. It is on the basis of these declarations that transactions proceed and finance is exchanged, so they constitute a risk to survey firms and their professional indemnity insurance. Qualifications should not be overstated, as they may be challenged, and if found to be incorrect, could cast doubt on the other information included in the declaration.

Surveyors need to be very careful that they only certify facts they know to be true. The solicitor will prepare a draft of the declaration and the surveyor should read this very carefully and suggest amendments as necessary before returning it to the solicitor for completion. The Commission cannot emphasise enough that surveyors should take care in getting the wording of the declaration correct. Under the Statutory Declarations Act 1938, a person who knowingly makes a false or misleading statutory declaration in any material respect is liable on conviction to a fine or imprisonment or both.

15 ENHANCING PROFESSIONAL COMPETENCE OF SURVEYORS

The Commission recommends the development of a third level academic programme to enhance the technical skills and professional competence of surveyors necessary for carrying out boundary surveys and to qualify them as Licensed Boundary Surveyors. The Commission recommends that this programme should be postgraduate level either at Diploma or Master of Science level.

The Commission recommends the modules outlined in table 8 should be considered for inclusion in such a programme.

The proposal to develop a postgraduate qualification in collaboration with a third level institution is likely to take a number of years to implement, so another initiative is required in the shorter term to prepare for issuing licences in 2009. The Commission suggests that this temporary arrangement would require:

- IIS membership at a grade of professional member or Fellow;
- Substantial surveying experience;

- Successful completion of a range of IIS seminars and workshops hosted particularly for applicants for licences. Preliminary proposals on the topics required for these seminars are included in table 9.

Table 8 Modules proposed for post-graduate programme to qualify surveyors as licensed boundary surveyors.

MODULE NAME	MODULE CONTENT
Land Law 1	Theory
Land Law 2	Case studies
Planning Law	Theory & Case studies
Environmental Law	Theory & Case studies
Alternative Dispute Resolution	Arbitration, Adjudication, Mediation & Conciliation
GNSS & CRS	GPS observations and adjustment
Boundary Surveys & CAD	Boundaries, survey practice & map preparation
PRA Mapping Practice	www.landdirect.ie & old and new mapping procedures
Expert Witness & Evidence	Preparation for & presenting evidence in court
Land Management	Land Registration, ISDI, INSPIRE, etc
Research Skills	Technical report writing & research skills
Professional Development	Ethics, Duty of Care, Liability & Professionalism

Table 9 Preliminary proposals on the seminars and workshops required to qualify surveyors as Licensed Boundary Surveyors in the interim.

Seminar Title	Topics Covered
Land Law	Review of land law as it applies to the needs of land registration
Mediation	Roles, responsibilities and survey practice
Boundary Surveys	Prior research, field preparation & Property Line Survey
GPS Surveys	Data Collection and post-processing
Map Correlation	Map correlation & boundary discrepancy map preparation
Conclusive boundaries	Boundary demarcation and recording

16 IMPLEMENTATION OF THESE GUIDELINES

Best practice guidelines are necessary to inform all surveyors of the best methods available to complete certain functions or tasks. However their adoption may be piecemeal and their application may not be uniform. A mechanism is required to ensure these Best Practice Guidelines are implemented in a controlled and uniform manner. Internationally, the one mechanism universally used is licensing of surveyors which controls:

- Who is permitted carry out the boundary survey task;

- The standards applied for the various tasks.

The implementation of the best practice guidelines is considered so important that the Commission recommends that the Irish Institution of Surveyors establishes a register for licensed boundary surveyors in Ireland to ensure the guidelines are implemented correctly. The Commission is cognisant that the State is the licensing authority in many other European countries in this regard. The Commission had a number of discussions with the PRA in this regard, and although the PRA accept the merit of licensing, they stated the PRA have no remit to influence policy in this regard. Therefore, the Commission recommends that the Irish Institution of Surveyors should proceed under its own authority initially, to manage the successful implementation of these guidelines.

16.1 *Register of Licensed Boundary Surveyors*

A register of licensed boundary surveyors will be maintained and administered by the Irish Institution of Surveyors, 36 Dame Street, Dublin 2 (iissecretray@eircom.net, or 01.6774797).

The Institution will begin to take applications from its professional members and fellows during autumn 2008 to register as licensed boundary surveyors. Application forms are available from the IIS secretary.

Surveyors applying to become licensed must agree to following four conditions:

a) Must use these best practice guidelines for their boundary surveys;
b) Must inform the Institution quarterly of all boundary surveys carried out by supplying the information listed in section 16.2;
c) Must agree to allow the Institution carry out an audit of their boundary surveys and supply the Institution with the information necessary to carry out said audit.
d) Must attend training seminars and workshops provided by the Institution specifically for licensed boundary surveyors.

Licensed boundary surveyors must have professional indemnity insurance for carrying out boundary surveys. Minimum cover of €635,000 is currently recommended. The Institution will regularly review the level of cover required.

Licences will be issued on an annual basis, so surveyors must re-apply each year providing proof of PI insurance, agreeing to the conditions already outlined and paying their fees in advance.

16.2 *Record of Boundary Surveys*

Licensed boundary surveyors shall inform the Institution at the end of March, June, September and December each year of all boundary surveys conducted by their practice during the previous quarter.

The IIS shall be supplied with the following information in respect of each boundary survey conducted:

a) Address of the property;

b) PRA folio number for the property:
c) Date of the survey;
d) Name and contact details of the licensed boundary surveyor involved.

The IIS will use this information to record a symbol on the property using Google Earth, which will be accessible only to licensed boundary surveyors via the IIS website (www.irish-surveyors.ie). This will inform licensed boundary surveyors if a boundary survey has been conducted in accordance with these best practice guidelines for an adjacent property, until such time as a similar facility is available via the PRA www.landdirect.ie website.

16.3 *Audit of Boundary Surveys*

Authority for Audit:

Licensed boundary surveyors will confer on the Irish Institution of Surveyors (Licensing Authority) the right to audit all boundary surveys conducted by them in the previous 12 month period.

Audit Panel:

The Irish Institution of Surveyors will establish a panel of auditors from its retired professional members and fellows. Criteria will be drawn up by council and proposed at an AGM which will define the criteria for nominations and the criteria used to choose the panel. Panel members will be compensated for their work, the amount of which will be set by the IIS council. The panel shall be reconstituted every three years.

Audit Methodology:

The audit will be phased in as follows:

- Implementation phase (first 24 months) - to assist licensed boundary surveyors apply the best practice guidelines correctly and uniformly. Difficulties identified during the audits will be highlighted to the licensed boundary surveyor concerned in a 'spirit of assistance' to initially achieve and then maintain the necessary high standard. Specialised training seminars will be specified by the Institution to ensure uniform application of these guidelines;
- Operational phase (after initial 24 months) - disciplinary procedures may be necessary where certain licensed boundary surveyors are identified as continual offenders and fail to rectify their procedures as required. These disciplinary procedures will be set out in the amended versions of the Articles of Association and the Code of Professional Conduct of the Institution currently in preparation.

The panel will predominantly carry out its work in the IIS offices if possible. The panel shall:

a) Prepare a listing of the total numbers of boundary surveys carried out by licensed boundary surveyors during the preceding calendar year;
b) Randomly choose a sample of boundary surveys for auditing;

c) Request information from the licensed boundary surveyors in respect of the boundary surveys selected for audit. Licensed boundary surveyors are encouraged to supply the information required within 14 days according to the template supplied. All information supplied to the audit panel shall be treated as strictly confidential.
d) Carry out the audits as specified below;
e) Prepare and supply audit results for individual licensed boundary surveyors, and recommendations for changes in procedure(s) as necessary;
f) Identify if previous recommendations for procedural change have been applied correctly;
g) Review, document and publish a statistical breakdown of the audit results and provide a comparison with previous years. Audit results will be aggregated to protect identities of individual licensed boundary surveyors and the confidentiality of the individual boundary surveys and the respective owners.

The Audit

It is proposed that the Audit will examine the following:

a) Client:
   - Authorisation to carry out the survey;
   - Identification of the boundary features with the client on site;
   - Incidences where these guidelines were used;
   - Incidences where these guidelines were not used and the reasons why.
b) Survey Control:
   - Survey methodology used;
   - Coordinates computed for stations and their absolute and relative accuracy;
   - Station descriptions diagrams and type of monuments used if appropriate.
c) Boundary Survey
   - Description of survey methodology used and boundaries surveyed;
   - Incidence of surveying both sides of boundaries;
   - Relative accuracy achieved for boundary features;
   - Incidence of registration of boundaries as conclusive;
d) Survey Drawing;
   - Size and scale of map;
   - Grid and coordinates;
   - Features included and how depicted (in accordance with standard format);
   - Certification of Licensed Boundary Surveyor;
e) Rectifications necessary
   - Incidence of rectification of features on OSI maps;
   - Incidence of rectification of areas in PRA folios;
   - Incidence of rectification of boundaries on PRA index map.
   - Lengths of delays resulting from requested rectifications;
   - Difficulties arising from rectifications.
f) Electronic submissions of mapping to PRA

- Any difficulties encountered;
- Suggested changes to submission methodology;

g) Recommendations
- Suggested changes to:
  - Surveying methodologies;
  - Measurement tolerances;
  - Rectification mechanisms;
  - Format or content of boundary map;
  - Methodology used for electronic submissions.

17 CONCLUSIONS AND RECOMMENDATIONS

17.1 *Conclusions*

The widespread public belief that OS mapping is accurate enough to define property boundaries by the PRA is a myth that surveyors and solicitors have to grapple with daily. This system of defining property boundaries in relation to OSi maps was borrowed from the United Kingdom in a different era when Ireland was a post-famine agrarian society and the introduction of land registration was a Crown initiative to give tenant farmers freehold ownership of their farms, to replace the feudal system in operation at that time.

Considering that the value of land and property is so high at present, it seems inappropriate not to define the area and extent of properties much more precisely than is currently practiced. Most countries in the rest of the world have adopted a different system where the land registration map is a cadastre which identifies properties, boundaries and areas by virtue of a good quality boundary survey on the ground by qualified surveyors to defined standards. Ireland is now nearly alone in the western world for continuing to operate a system of non-conclusive boundaries, ever since Canada recently moved towards recording fixed boundaries, and the United Kingdom adopted a system for determining boundaries in 2002. The Commission considers that the current system as operated is no longer appropriate to the needs of Irish society in the 21st century.

The need to significantly improve the standard of PRA mapping is now urgently required due to a range of factors, the most important being:
- Developing an e-Conveyancing system for Ireland - digital systems are renowned for requiring higher standards of data quality to ensure they operate efficiently ;
- Implementing the EU INSPIRE Directive - data harmonisation, even at cadastral parcel level will be one of the priority requirements of this project;
- The extremely high cost of land in Ireland - landowners regularly seek better quality mapping than the PRA can currently supply;
- Exploiting the modern surveying technologies available - why provide a system if it not used for one of the most important surveying functions within a country?

Landowners incorrectly believe that registering their property in the PRA will reliably secure their most valuable asset. Some property professionals even believe that descriptions in lease maps give more confidence than PRA maps. The PRA themselves make a point of stating that the PRA map is only an index map. The following quote is taken directly from the Frequently Asked Questions page of the PRA website. For most property owners this answer is unbelievable. If the PRA cannot supply reliable information on property boundaries to resolve boundary disputes, who can, or more importantly, should the PRA not be in a position to do so?

> *"I have a dispute with my neighbour over where the boundary lies. Can you tell me who is right?* ***No. The Land Registry map is an index map and identifies property, not boundaries. Therefore, we are not in a position to advise."*** *(Property Registration Authority website, accessed on 9/7/2008)*

The Irish land registration system is generally viewed as two separate systems of folios and PRA maps, though directly related. Registrations of title from solicitors are validated by the Land Registry and a State guarantee is provided for this portion of the system which is accepted as reliable and therefore secure. Maps submitted from surveyors are not validated, so a State guarantee is not provided, and the PRA mapping system is widely regarded as unreliable and therefore less secure.

The PRA digital mapping project is addressing some of these mapping concerns and bringing the PRA index map into the 21st century. However, the digital mapping project is changing the position of legal boundaries in what could be viewed as a 'national rectification of boundaries' and the Commission has a number of major concerns, namely:

- The digitising of Irish property boundaries was substantially carried out in India under the auspices of the PRA digital mapping project by moving existing PRA boundaries into coincidence with lines on OSi maps. However, a substantial portion of these same OSi maps were themselves created in India under a separate OSi contract which used aerial photography of a photoscale (1:40000) which is considered to be too high and inappropriate for this use.
- Maps in old title documents held as collateral in banks or mortgage agencies are unlikely to correlate exactly with the new PRA digital maps any longer. The difference between these two PRA maps may give rise to difficulties for mortgage institutions in property re-possessions. The Irish public and mortgage institutions have not been informed of this issue with clarity to date.
- The current PRA digital boundaries are likely to not correspond with the boundaries originally submitted for registration. The legal profession may identify this anomaly during investigations for boundary disputes, and use it as a means of casting doubt on the current PRA map. Rectifications of the mapping should have either the owners consent or be carried out on foot of a judge's order, to be legal according to the Registration of Title Act (Oireachtas, 1964), but neither of these means was utilised during the digital mapping project, so this is potentially the Achilles heel of the project.

Sperling (2008) states that Ireland has one of the best surveying infrastructures in the world and adds that this modern surveying infrastructure is a prerequisite for producing good quality surveys when combined with the adoption of best practice. Irish surveyors now have the technology to survey features to centimetres in a national context using GPS, so they now have the ability to identify discrepancies in less accurate OSi and PRA maps. It would seem foolish therefore, not to exploit this technology to identify and rectify discrepancies during boundary surveys in order to improve the quality and reliability of the PRA mapping system.

There is now a need to develop modern surveying and mapping standards and processes suitable for the digital age and in line with best international practice to ensure this new surveying infrastructure and modern surveying technologies can be exploited for the benefit of landowners and the PRA mapping database.

In the past, additional costs and delays due from rectifications of PRA records were considered prohibitive, so the OSI and the PRA were simply not informed of discrepancies identified in their mapping and the additional risk due to inaccurate records was borne by the landowner. There is now a need to streamline PRA rectification procedures in order to minimise costs and ensure discrepancies in the records are corrected when identified in line with best IT practice. Two such new procedures required in this regard to exploit this highly accurate information from boundary surveys to amend PRA records are:

- A new OSi procedure where discrepancies in OSi maps are reported to OSi to be checked, re-surveyed and corrected as necessary outside their normal map revision cycle;
- A new PRA procedure where OSi corrections are regularly supplied (outside normal update cycles) to the PRA to rectify boundaries.

If these rectification processes were incentivised by waiving registration and/or rectification fees when discrepancies identified, then this might go some way to changing attitudes towards the need for these new procedures.

There is now an increasing need for purchasers to have a competent surveyor check that the maps of properties being offered for sale accurately records the position of the boundaries as occupied on the ground. The main reasons why this has become critical are:

- There is a high probability that boundaries on the new PRA digital maps will not correlate with older PRA paper maps;
- Anecdotal evidence indicates that the positional accuracy of OSi maps has decreased of late, so they should be rigorously checked by surveyors on the ground before being used in property transactions;
- There is a high likelihood (33%) of features on OS maps being outside the accuracy tolerances quoted by Curran and Greenway (2005);

- PRA maps regularly fail to supply landowners with sufficient information on boundaries to adjudicate boundary disputes. This situation needs to be urgently changed.

It cannot be emphasised strongly enough that the proposed boundary surveys are not topographic surveys, where the boundary is just an additional feature. The landowner should walk the boundaries identifying them to the surveyor, and the surveyor will be surveying the current occupation line of the property. The property line map should then be correlated with the PRA map to ensure the position of the boundaries is recorded accurately by the PRA.

The integration of highly accurate information from boundary surveys into the PRA digital map should use a mathematical correlation methodology which fits the less accurate existing PRA map to the more accurate boundary survey. In practice this can be difficult to do, but the PRA in collaboration with the IIS and others need to develop a suitable approach for the situation in Ireland. The real advantage of this methodology is that the legacy mapping in existing databases is gradually upgraded using high accuracy surveys on a continuing basis.

17.2 *Recommendations*

The Commission on Land Registration recommends the following:

Surveyors:

- Surveyors representing landowners on either side of an adjoining boundary should adopt a mediation approach for surveying and mapping by contacting each other to discuss their findings, clarify issues and try to resolve as many of these issues as possible to reduce the incidence of litigation.
- Surveyors should work more closely with solicitors to provide a more comprehensive and enhanced service to landowners for land registration.
- Surveyors should adopt these best practice guidelines when carrying out boundary surveys.

Property Professionals

- PRA maps are not as reliable as many people believe. Solicitors and auctioneers should advise clients of the need for care, so that boundaries are checked and correctly registered.
- Solicitors should advise landowners of the need to regularise their ownership records and outline the benefits of the two options available:
  - To correct discrepancies identified on OSi and PRA maps;
  - To register new boundaries as conclusive to enhance the security of their asset.

Property Registration Authority:

- Copies of the PRA maps currently available on paper as PRA filed plans should be made available to surveyors in vector format to facilitate production efficiencies in private surveying firms.
- Property line maps (as defined by these best practice guidelines) submitted for registration should be associated with the folio on the public record in addition to the existing filed plan for clarity and to ensure this additional information is available for further dealings on the folio.
- PRA rectification procedures should be weighted towards encouraging owners to correct discrepancies identified in the PRA map and the PRA should be given sufficient resources to minimise delays when rectifying the register.
- Boundaries registered as conclusive should be distinguishable on the PRA map.
- New procedures should be developed and implemented for the following:
    - to accept revised OSi mapping, outside the normal scheduled revision cycles, in order to rectify discrepancies identified on PRA maps.
    - to validate the accuracy of boundaries submitted for registration as conclusive.
    - to fit less accurate PRA maps to higher accuracy surveys in line with best principles for surveying, rather than the reverse as is the current situation.
- Detailed information on boundaries registered as conclusive should be made available on the public record.

Ordnance Survey Ireland:

- A new procedure is already available for surveyors to report discrepancies on OSi maps to OSi, and for OSi to confirm these discrepancies and rectify the OSi maps outside the normal scheduled revision cycles for the mapping.
- Boundaries resurveyed on the ground by OSi field revisers should be tagged with metadata relating to the accuracy of the survey, so that the boundary cannot be subsequently moved by less accurate survey methods (i.e. photogrammetry) without first evaluating the accuracy issue.
- The determination of the accuracy of OSi maps should be carried out by an independent organisation according to defined scientific criteria.

The Irish Institution of Surveyors:

- Should establish a register of Licensed Boundary Surveyors from January 2009.
- Should provide a range of seminars and workshops during autumn ’08 and spring ’09 to assist applicants for licences to implement these best practice guidelines correctly.
- Should establish a panel during 2009 to carry out audits of boundary surveys
- Should work in collaboration with a third level institution to develop and deliver a post-graduate programme to quality Licensed Boundary Surveyors
- Should continue to work with the PRA towards the successful implementation of a totally digital mapping system for boundary surveys in Ireland

Third Level Education:

- A post-graduate programme should be developed and offered to qualify surveyors and engineers for licences to carry out boundary surveys.
- Research is required to determine the incidence and identify the causes of boundary disputes in Ireland.

Legislators:

- The resolution of all boundary disputes should, where possible, require that the boundary in question be registered as a conclusive boundary. This will ensure that disputes do not re-occur.
- The registration of boundaries as conclusive should require the demarcation of the boundary with boundary monuments in line with international best practice.
- Once a boundary is registered as conclusive, it should not be possible for it to revert to a non-conclusive state, similar to the requirement that once a parcel is registered in Land Registry it cannot subsequently revert to the Registry of Deeds.
- The prescribed conditions outlined in the Land Registration Rules 148 to 151 for registration of boundaries as conclusive need to be amended for the digital era, such as:
  - Making it illegal to move boundary monuments;
  - Outlining the priority between the location of boundary monuments on the ground and the record of their location (coordinates and location diagrams) recorded in the PRA

The State:

- Incentives should be provided to encourage landowners to rectify discrepancies identified in the PRA map, such as reductions in fees and prioritised procedures.
- Incentives should be provided to encourage landowners to register boundaries as conclusive, such as:
  - Providing a State guarantee for boundaries registered as conclusive;
  - Providing a partial reduction in stamp duty for the purchaser when boundaries are registered as conclusive.
- The government should consider the introduction of a licensing system for surveyors to carry out boundary surveys to defined standards of accuracy, especially where boundaries are to be registered as conclusive.
- The government should address the significant responsibility gap between the Property Registration Authority and Ordnance Survey Ireland with respect to the PRA mapping system. Other countries have resolved this problem by assigned Ministerial responsibility across government departments or merging multiple national agencies into one organisation.

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APPENDIX A

TYPES OF FEATURES USED TO DEFINE BOUNDARIES IN IRELAND

TYPES OF FEATURES USED TO DEFINE BOUNDARIES

1. WALLS

a. ***Brick wall***

Description: Wall built using bricks of 8.5 x 10 x 21.5 cms in size, normally using the 10 cms side as the wall width. Usually red in colour though may have various hues.

OSi Maps: Depicted as a single line representing the centreline of the feature.

Advice: Measure both sides to derive the centreline.

b. ***Block wall***

Description: Wall built using concrete blocks of 4 x 9 x 18 inches in size normally using the 4 inch (10 cm) side as the wall width. Usually grey in colour, but may be painted, plastered, or pebble-dashed.

OSi Maps: Depicted as a single line representing the centreline of the feature.

Advice: Measure both sides to derive the centreline.

c. ***Cut Stone wall***

Description: Wall built using cut stone of any type, which may be of various widths and heights. Constructed in modern times using a backing wall of concrete blocks supporting a facing wall of cut stone.

OSi Maps: Depicted as a single line representing the centreline of the feature.

Advice: Measure both sides to derive the centreline. Older versions may not have a consistent width and may not be vertical.

d. ***Uncut Stone wall***

Description: Wall built using uncut stone of any type, which may be of various widths and heights. These are normally old walls which may have a plastered surface.

OSi Maps: Depicted as a single line representing the centreline of the feature.

Advice: Measure both sides to derive the centreline. Generally do not have a consistent width and may not be vertical.

e. ***Retaining wall***

Description: Retaining wall of uncut stone with an earth bank and fence above.

OSi Maps: Depicted as a single line representing the centreline of the bank and fence feature.

Advice: Line of the retaining wall may not be straight and wall may slope inwards towards the bank. Measure base of wall, both sides of bank and fence on bank, and create a height profile to assist description. The ownership of this boundary feature should extend to the toe or face of the retaining wall to protect the land on the higher side.

2. RAILINGS

a. ***Old railing***

Description: Many types available mostly manually produced by blacksmiths of larger and more solid construction than newer railings.

OSi Maps: Depicted as a single line representing the centreline of the feature.

Advice: Railing may not be vertical, so measure as close to base as possible.

b. ***New railing***

Description: Normally placed on top of wall (brick, block or stone) to extend height of the boundary feature but not restrict light into the property.

OSi Maps: Depicted as a single line representing the centreline of the feature.

Advice: Railing may not be vertical, so measure both sides at base of wall to derive the centreline of feature.

c. **Railing of suspicious Vintage**

Description: Some newer railings especially in urban renewal schemes use castings created for their mock heritage value. Welding indicates newer vintage.

OSI Maps: May not be included on map if considered non-permanent. If included will be depicted as a single line representing the centreline of the feature.

Advice: Railing may not be vertical, so measure as close to base as possible.

3 FENCES

a. ***Concrete Post & Wire***

Description: Normally concrete posts 4 inches (10cms) square set in concrete base, spaced 3 to 5 metres apart with 3 strands of wire. Type of construction and presence of tensioners indicate age.

OSi Map: May not be included if considered to be non-permanent. If included will be depicted as a single line representing the centreline of the feature.

Advice: Posts may not be vertical, so measure as close to base as possible.

b. ***Concrete Post & Wood Panel***

Description: Normally concrete post 4 inches (10cms) square spaced 6 ft 1 Inch (1.86m) apart with 6 ft x 6 ft wood panels.

OSi Map: Depicted as a single line representing centreline of the feature.

Advice: Posts may not be vertical, so measure as close to base as possible.

c. ***Palisade Fence***

Description: Normally metal post set in concrete base, spaced 10 ft (3.05m) apart with 10 ft x 6 ft metal sections bolted between the metal posts.

OSi Map: Depicted as a single line representing centreline of the feature.

Advice: Posts may not be vertical, so measure as close to base as possible. If built upon a concrete base measure both sides to derive the centreline.

d. ***Typical Land Commission Fence***

Description: Normally an earth bank with dense whitethorn hedge on top. Usually erected in straight lines and not normally on pre World War 1 OSi maps. Were used to sub-divide old estates between local farmers.

OSi Map: Depicted as a single line representing centreline of the feature.

Advice: Measure both sides of bank and root of hedge to derive centreline.

e. ***Stock proof Fence***

Description: Normally wooden posts driven into the ground and spaced approximately 3 to 5 metres apart with a number of strands of barbed wire and chain-link wire up to approximately 1 metre in height.

OSi Map: Depicted as a single line representing centreline of the feature if considered to be a permanent feature

Advice: Posts may not be vertical, so measure as close to base as possible.

f. ***Sod and stone Fence***

Description: Normally stone wall interlaced with sods and can be overgrown in appearance. Normally it is 1 to 2 metres in width and 1 to 1.5 metres in heights.

OSi Map: Depicted as a single line representing centreline of the feature

Advice: Measure both sides of feature as well as the centreline.

Photo supplied later

4 BANKS

a. ***Earth bank***

Description: Bank of earth normally 1 to 2 metres wide and 0.5 to 1 metre high.

OSi Maps: Depicted as a single line representing centreline of the feature

Advice: Bank may be old and trampled in places, so measure both sides and include a height profile to assist description. Where a section of the bank is exposed in a profile it should be used as an aid to determine the centre of the feature as opposed to the centre of bank.

b. ***In a Demesne***

Description: Bank of earth usually 1 to 2 metres in width and approximately 1 metre in height. It may not be used any longer as a boundary within a demesne.

OSi Map: Depicted as a single line representing centreline of the feature.

Advice: Measure base of both sides and points on centreline to assist derivation of centreline of feature.

c. ***Stone bank***

Description: Bank of uncut stone usually 1 to 3 metres in width and approximately 1 metre in height which can become disturbed and overgrown with age.

OSi Map: Depicted as a single line representing centreline of the feature.

Advice: Measure base of both sides and points on centreline to assist derivation of centreline of feature.

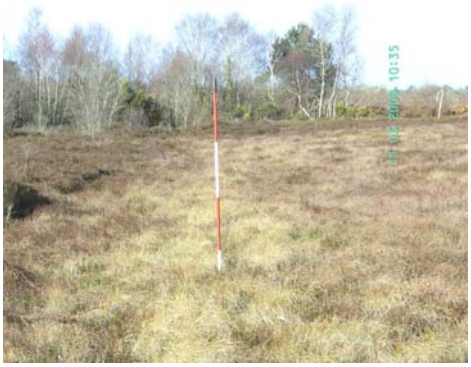
5 DRAINS

Single drains

Description: Drains dug in the past to remove excess water from bog to permit cutting turf. Normally straight and discolouration of vegetation or slight dip in height of vegetation can indicate presence. Very useful detail in bog because little else.

OSi Map: Depicted as a single line representing centreline of the feature.

Advice: Place series of ranging poles to indicate centreline of drain before taking measurements.



6 DITCHES

A drain is always a cutting to drain the land. However a ditch can be either a drain (a cutting) or a bank (earth bank). Consequently surveyors need to be extremely careful with this feature due to the different interpretations in different localities. Some old OSi or PRA maps may have annotations which may be of assistance, but surveyors are best advised to talk to local farmers to identify the custom in the locality.

a. ***Single***

Description: Similar to single drain or earth bank. Normally it is 1 to 2 metres in width and approximately 1 to 1.5 metre in height (or depth) which can become disturbed and overgrown with age.

OSi Map: Depicted as a single line representing centreline of the feature.

Photo supplied later

Advice: Measure base of both sides and points on centreline to assist derivation of centreline of feature.

b. ***Double***

Description: Bank of earth which may be several metres in width and several metres in height which can become overgrown with age. May have been a 'bothairín' across a bog in the past.

OSi Map: Depicted as a double line representing centreline of the hedgerows on either side of the feature.

Photo supplied later

Advice: Measure the root of the hedge on both sides. A profile, if available, can be very useful to present the characteristics of the feature.

7 OTHER

a. ***Moat***

Description: Mainly stone retaining wall 2 to 3 metres in height with fence on top usually found on external boundary of old demesne. Moat normally used as a drain and edge of external sloping bank may not be well defined.

OSi map: Depicted as a double feature representing the wall and the top of the sloping bank.

Advice: Measure along top of wall and top of drain, and if possible supply a profile to present its characteristic shape.

b. ***Ha-ha***

Description: Retaining wall of cut stone 2 to 3 metres in height between lawn of Victorian house and fields in a parkland setting.

OSi Map: Depicted as a single line representing centreline of the feature.

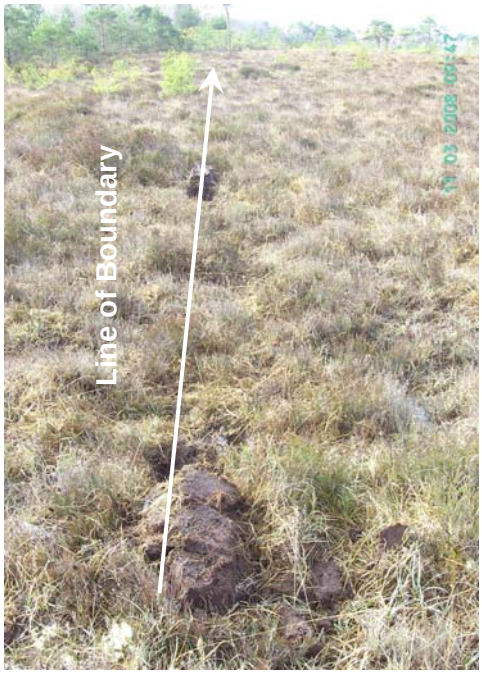
Advice: Wall may be sloping inwards to take the pressure and is of unknown width. Should measure along the base and the top of the wall and also along the centreline of the top of wall.

c. ***Lock spit***

Description: Trenches dug normally 3 feet in length and 6 inches deep in the direction of a boundary over boggy ground.

OSi map: Depicted as a single line representing the centreline of boundary with annotation 'lock spit' included.

Advice: Place series of ranging poles along the centreline before taking measurements.



APPENDIX B

SAMPLE CONTRACT TO AGREE SPECIFICATION FOR BOUNDARY SURVEY

STANDARD QUOTATION FOR BOUNDARY SURVEYS

Surveyor's Name: _____

Address: _____

Agrees to carry out a boundary survey at the property located at:

Address: _____

On the authorisation of:

Client's Name: _____

Address: _____

Client's Solicitor's Name: _____

Address: _____

The boundary survey should be carried out in accordance with the Irish Institution of Surveyors' Best Practice Guidelines for Boundary Surveys, and should include the following features:

FEATURES	CRITERIA
Property Boundary	Identifying types of boundary feature, location where features change & annotations for line of property boundary
Buildings	Footprint of all permanent buildings + building areas + ground floor levels
Areas	Supplied for land part & road part in hectares (3 decimal places)
Access & Driveway	Entranceway, gate pillars and edge of hard surface on property
Roadway	Approximately 25 to 50m on either side of property
Extra Features	Old hard detail included on old OSi maps such as facades of adjoining buildings, fence junctions, entranceways, etc.
Special Instructions (as specified)	

The professional fee for this boundary survey is € _____ excluding VAT at 21%

Signed: _____ Date: _____

Licensed Boundary Surveyor

Signed: _____ Date: _____

Acceptance by Client

It is important to outline the phasing nature of boundary surveys including a) property line survey, b) map correlation and analysis, c) record regularisation or registration of boundaries as conclusive.

Boundary Surveyors licensed by the Irish Institution of Surveyors are required to use the Best Practice Guidelines published by the Institution, have Professional Indemnity Insurance, comply with a Code of Professional Conduct, and are their boundary surveys are audited annually by the Institution for compliance with the guidelines.

APPENDIX C

ARCHIVES OF LEGACY MAPPING AND AERIAL PHOTOGRAPHS

Older versions of OSi maps (available from OSi unless stated otherwise)

OSi legacy mapping (large scale)

SCALE	EDITION	PERIOD	COVERAGE	CRS
6”	First edition *	1825 to 1844	National	Cassini
6”	Second edition	circa 1890 to 1918	National	Cassini
6”	Revisions	circa 1930s period	occasional	Cassini
25”	First edition	1887 to 1916	National - less uplands, bogs & offshore islands	Cassini
25”	Revisions	1930s to 1990s	Occasional in early decades and also in parts of Counties Meath, Dublin, Kildare, Laois, & Carlow	Cassini
1:2500	First edition	Early 1970s to late 1990s	Parts of Counties Louth, Offaly, Kilkenny, Wexford, Waterford, Tipperary, Limerick, Cork, Kerry, Clare & Galway	Irish Grid 1975 realisation (IG75)

* Available from the National Archives in Bishop Street, Dublin

Aerial Photography

A number of archives of aerial photography are available in Ireland, including

- Aer Corps, Department of Defence - occasional images for the 1940s to early 1970s at various photo scales;
- Ordnance Survey Ireland
  - Multiple versions of most urban areas between the late 1960s and the present at a photo scale of circa 1:5000;
  - Occasional images of rural areas between the late 1960s and the present at various photo scales;
  - National coverage at a photo scale of 1:40000 in Black & White for 1995 (also available in orthophoto format);
  - National coverage at a photo scale of 1:40000 in colour for 2000 (also available in orthophoto format);
  - National coverage at a photo scale of 1:40000 in colour for 2005/2006 (also available in orthophoto format);

- **MapFlow Ltd**. - Colour orthophotos available for 31 urban areas on the IG75 CRS at a spatial resolution of 0.2m, cut into tiles of 48Ha compatible with the OSi index for the 1:1000 map tiles. These orthophotos were derived from aerial photography flown at 5000ft (photoscale of 1:10000).

	1998	2000	2001	2004	2005	2006	2007
Arklow	✓						
Athlone	✓						
Carlow	✓						
Clonmel				✓			
Cork		✓				✓	
Cobh				✓			
Drogheda	✓						
Dublin			✓		✓		
Dundalk	✓						
Enniscorthy				✓			
Fermoy				✓			
Galway	✓						✓
Greystones		✓					
Kildare	✓						
Kilkenny	✓						
Killarney	✓						
Kinsale				✓			
Limerick	✓						✓
Mallow				✓			
Maynooth		✓					
Mullingar	✓						
Naas		✓					
Navan	✓						
Newbridge	✓	✓					
Portlaoise	✓						
Skerries		✓					
Sligo	✓						
Tralee	✓						
Waterford	✓						
Wexford	✓						
Youghal				✓			

- **BKS Surveys Ltd**. - Colour orthomaps are available for counties and urban areas on the IG75 CRS cut into tiles of 800m x 600m (48Hectares) compatible with the OSi index for the 1:1000 map tiles. The spatial resolution of these orthomaps is 0.2m.

	2005	2006	2007	2008
Counties				
Dublin City Council	✓			✓
Dun Laoghaire Rathdown	✓			
Fingal	✓			✓
South Dublin	✓			✓
Waterford				✓
Wexford				✓
Towns				
Athlone			✓	
Ballincollig		✓		
Blarney		✓		
Castleblaney			✓	
Carrickmacross			✓	
Carrigaline		✓		
Clones			✓	
Clontibret			✓	
Cork City		✓		
Cobh		✓		
Crosshaven		✓		
Drogheda			✓	
Dundalk			✓	
Enniscorthy			✓	
Galway City			✓	
Glanmire		✓		
Limerick City			✓	
Middleton		✓		
Monaghan			✓	
Mountmellick			✓	
Mullingar			✓	
Portlaoise			✓	
Ringaskiddy		✓		
Tralee			✓	
Waterford City				✓
Wexford				✓

APPENDIX D

LOCATION DIAGRAMS OF SURVEY CONTROL STATIONS

PROJECT NAME: Boundary survey of:
The **********, *******town, Co. Wexford

CONTROL STATION NO.: 1

CO-ORDINATES:

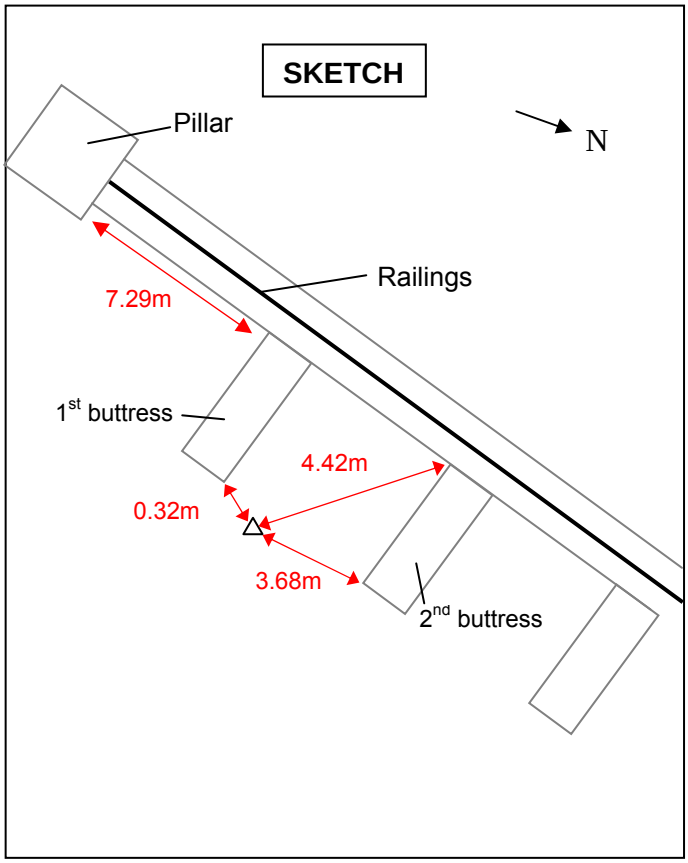
ETRF89 / WGS84

Latitude:	53^0 17' 10.79612" N
Longitude:	6^0 23' 21.20049" W
Ellipsoidal Ht:	147.586

ITM

Easting:	727496.357
Northing:	727436.899
Orthometric Ht: (OSGM02)	92.223 (MSL @ Malin Head)

STATION DESCRIPTION: Dome headed survey nail with washer on the paved area inside the railings at the front of the property.



Company: **John Smith & Sons Surveys Ltd,**
Address: 27 Main Street, Enniscorthy, Co Wexford
Contact Details: Tel: 0504.###### Email: info@johnsmithandsons.ie

APPENDIX E

PROPERTY LINE MAP

Property Line Map

Property Owner:	Mrs ******* **********
Property Address:	*******town, Gorey, Co. Wexford
Folio Number:	WX ###### F
Property Areas:	Land Part = 0.245 Ha Road Part = 0.011 Ha

LEGEND

- Survey Control Points
- Boundary Features
- Buildings
- Property boundary on the Ground
- Driveway

BOUNDARY ABBREVIATIONS

CR = Centre of Road or River
CS = Centre of Stream
CW = Centre of Wall
CF = Centre of Fence
FW = Face of Wall
FF = Face of Fence
RH = Root of Hedge

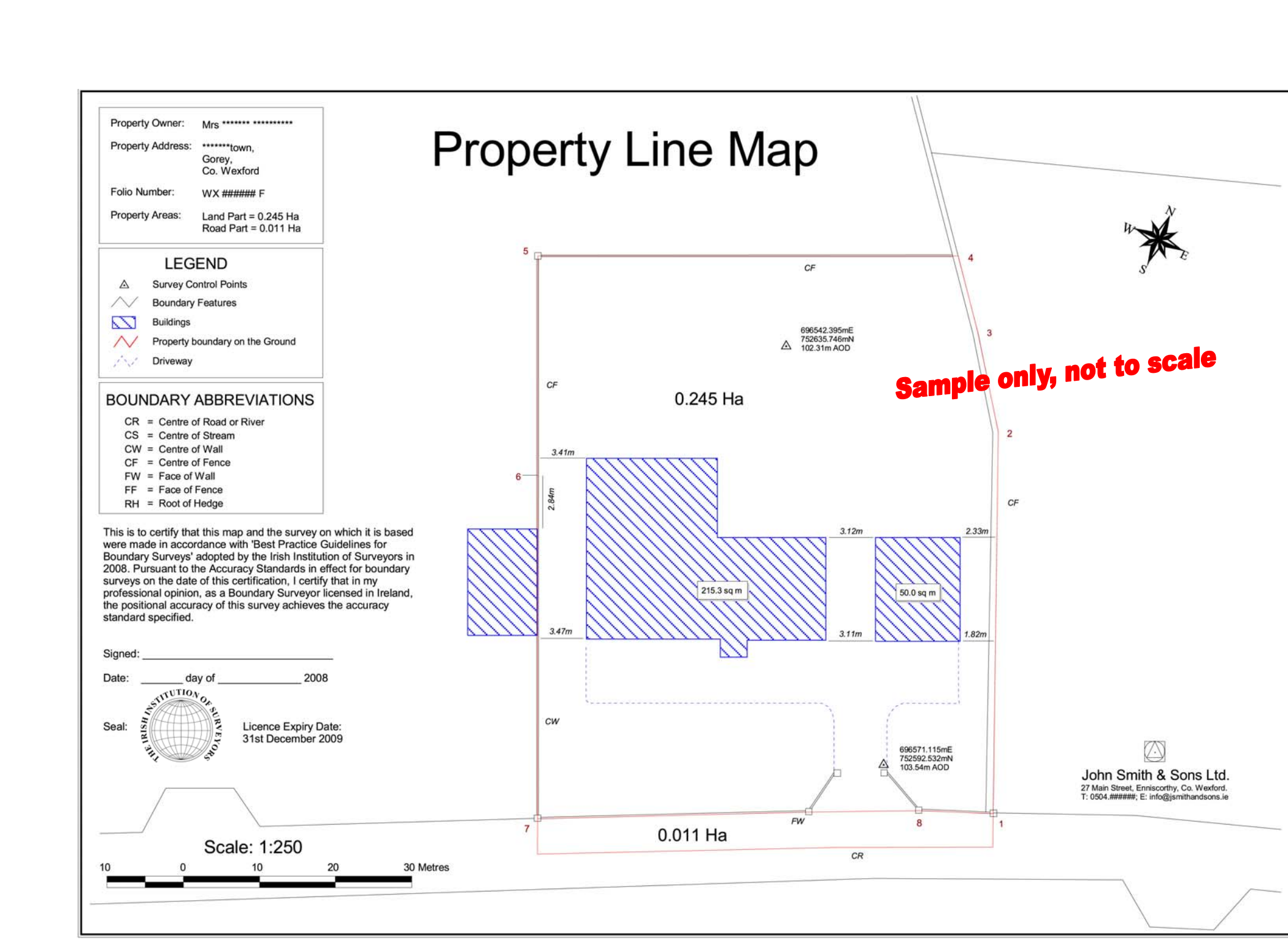
This is to certify that this map and the survey on which it is based were made in accordance with 'Best Practice Guidelines for Boundary Surveys' adopted by the Irish Institution of Surveyors in 2008. Pursuant to the Accuracy Standards in effect for boundary surveys on the date of this certification, I certify that in my professional opinion, as a Boundary Surveyor licensed in Ireland, the positional accuracy of this survey achieves the accuracy standard specified.

Signed: _____

Date: _____ day of _____ 2008

Seal:

Licence Expiry Date:
31st December 2009



Scale: 1:250

10 0 10 20 30 Metres

John Smith & Sons Ltd.
27 Main Street, Enniscorthy, Co. Wexford.
T: 0504.######; E: info@jsmithandsons.ie

List of coordinates of Property Line as Occupied on the Ground

	ITM				
Point No	**Eastings**	**Northings**	**Height (MSL)**	**Typical Description**	**Digital Images**
1	696571.115	752592.532	103.4	Eastern edge of end pillar of wall in line with top of bank and root of hedge	5 & 6
2	696571.115	752592.532	102.2	Turning point of line of root of hedge	7
3	696571.115	752592.532	101.6	Turning point of line of root of hedge	8
4	696571.115	752592.532	101.3	Concrete post on top of bank on line of root of hedge	9 & 10
5	696571.115	752592.532	101.8	Concrete post at fence corner	11
6	696571.115	752592.532	101.8	Pillar at start of wall and end of fence	12
7	696571.115	752592.532	104.1	Western edge of end pillar of wall in line party wall with adjoining property	13
8	696571.115	752592.532	103.8	South eastern corner of eastern pillar of external pillars of gateway	14

Description of Boundary Features

Feature Type Concrete block wall
Capping Yes ❑ No ❑
Rendered Yes ❑ No ❑
In map Indicated 1 through 8 to 7
Height 1.5m
Boundary Face of wall to public road

Photo of Feature

Feature Type Concrete block wall
Capping Yes ❑ No ❑
Rendered Yes ❑ No ❑
In map Indicated 7 to 6
Height 2.0m
Boundary Centre of wall

Photo of Feature

Feature Type Concrete post & wood panel fence
In map Indicated 6 to 5
Height 2.0m
Boundary Centre of fence

Photo of Feature

Feature Type	Concrete post & wire fence
Wire	3 strands barbed wire
In map	Indicated 5 to 4
Height	1.5m
Boundary	Centre of fence

Photo of Feature

Feature Type	Hedge and ditch
In map	Indicated 4 through 3, and 2 to 1
Earth bank	On East side of feature width = 1.8m Height = 0.9m
Hedge	Hawthorn Height = ~ 4m
Ditch	On West side of feature Width = 2.4m Depth = 1.3m
Boundary	Edge of opposite side of ditch

Photo of Feature

APPENDIX F

BOUNDARY DISCREPANCIES MAP

Boundary Discrepancies Map

Property Owner:	Mrs ****** ********
Property Address:	******town, Gorey, Co. Wexford.
Folio Number :	WX ###### F
Encroachment Areas	C = 0.0013Ha D = 0.0038Ha E = 0.0006Ha

LEGEND

- Boundary Features
- Buildings
- Boundary as defined by PRA map
- Driveway
- Area of land oinside the title as defined by the PRA map and occupied on the ground - indicated 'G'
- Area of land outside the title as defined by the PRA map, but occupied on the ground - indicated 'R'
- Area of land inside the title as defined by the PRA map, but not occupied on the ground, indicated 'O'
- Discrepancy between area of land as defined by the PRA map, and original lodged instrument map, indicated 'B'
- A - B: Encroachment of eaves of neighbour's garage along line of A - B of circa 0.2 m. Wall of garage built flush with boundary wall on neighbour's property, so foundations not assumed to encroach.

This is to certify that this map and the survey on which it is based were made in accordance with 'Best Practice Guidelines for Boundary Surveys' adopted by the Irish Institution of Surveyors in 2008. Pursuant to the Accuracy Standards in effect for boundary surveys on the date of this certification, I certify that in my professional opinion, as a Boundary Surveyor licensed in Ireland, the positional accuracy of this survey achieves the accuracy standard specified.

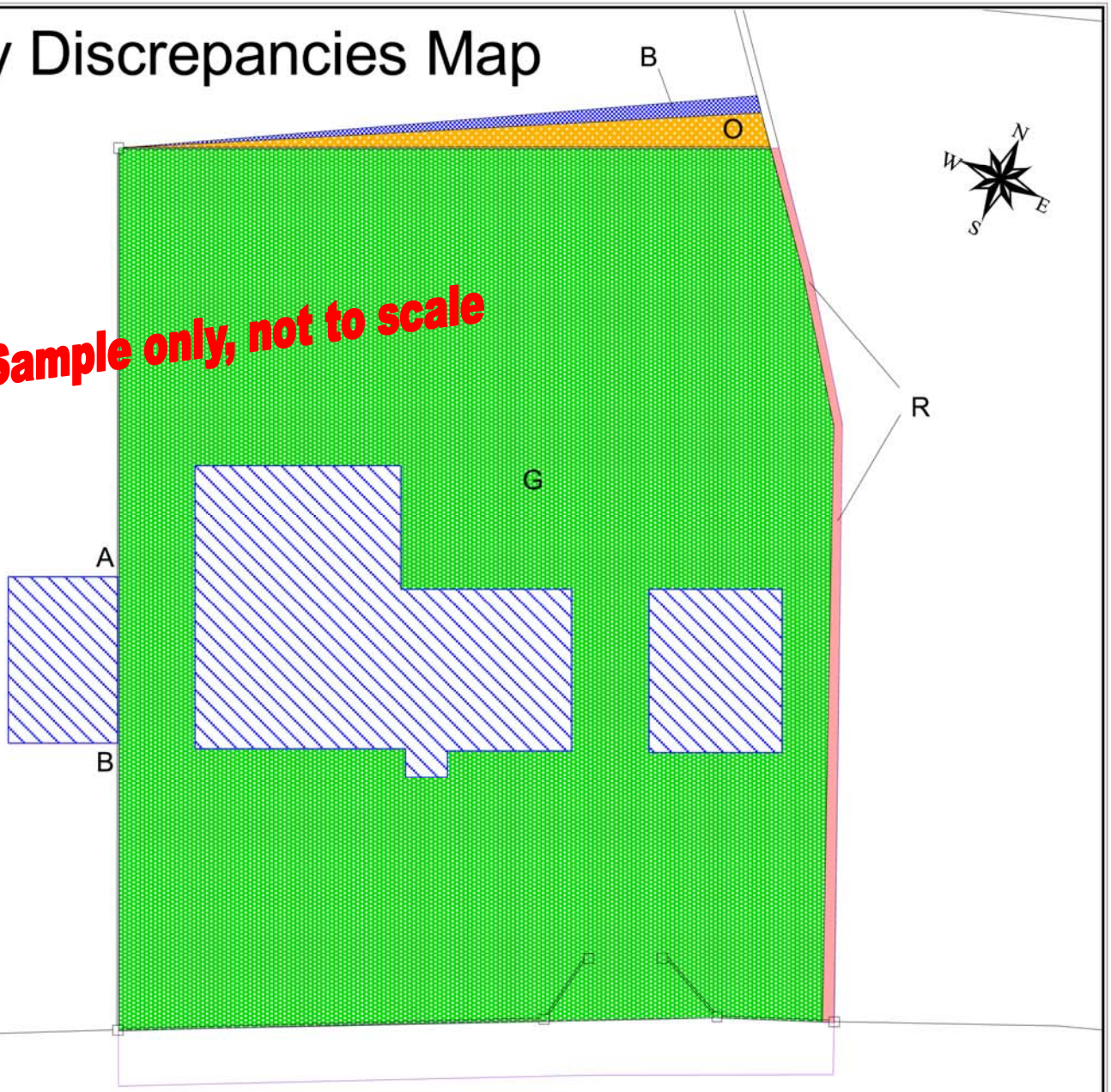
Signed: _____

Date: _____ day of _____ 2008

Seal: THE IRISH INSTITUTION OF SURVEYORS

Licence Expiry Date:
31st December 2009

John Smith & Sons Ltd.
27 Main Street, Enniscorthy, Co. Wexford.
T: 0504.######; E: info@jsmithandsons.ie



Scale: 1:200

10 0 10 20 30 Metres

List of Coordinates of Property Boundary as registered in PRA records

	PRA Boundary		Property Line as Occupied	
	ITM Coordinates		ITM Coordinates	
Point No	Eastings	Northings	Difference in Eastings	Difference in Northings
1a	696571.115	752592.532	+2.74	+0.47
2a	696571.115	752592.532	+2.56	-0.09
3a	696571.115	752592.532	+2.62	+0.36
4a	696571.115	752592.532	+2.37	+0.44
5a	696571.115	752592.532	-0.23	+0.05
6a	696571.115	752592.532	-0.08	+0.16
7a	696571.115	752592.532	+0.17	+0.29
8a	696571.115	752592.532	-0.32	+0.46

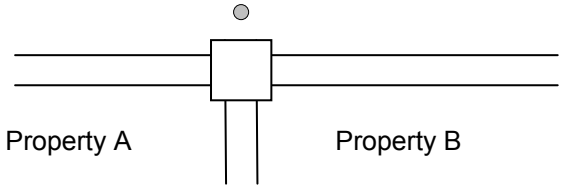
APPENDIX G

BOUNDARY MONUMENTS

Boundary Monuments

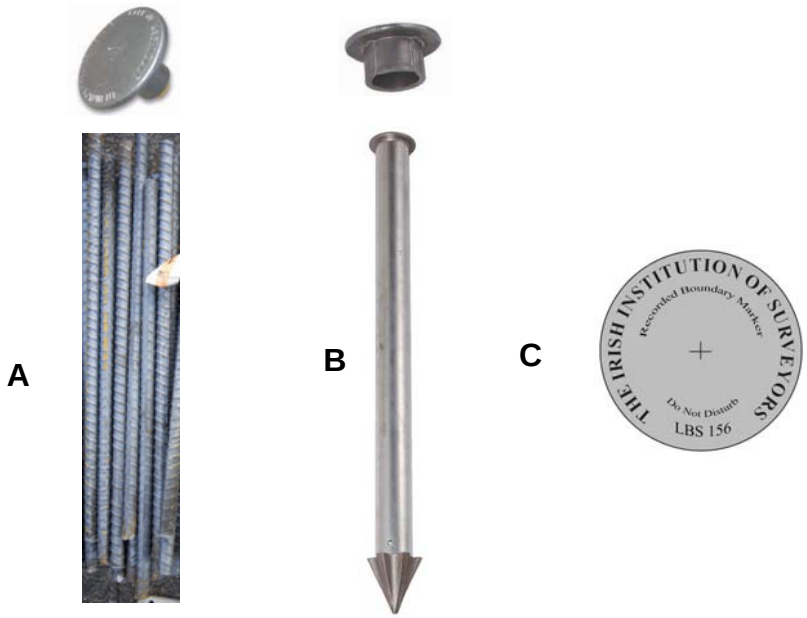
All boundaries registered as conclusive should be demarcated with boundary monuments on the ground. If it not possible to mark the exact point then the monument should be offset from the boundary and buried 100 to 200mms below the surface. All offset dimensions and orientations should be accurately recorded.

For corners of properties fronting the public road where boundary walls are already built the boundary monument should be offset 0.25m on the footpath and recessed to minimise any trip risk.



Suggestions for boundary monuments on soft ground include:

a) Rebar topped with a circular cap (available in aluminium or bronze) fitted with a plastic sleeve to give a tight fit onto the rebar (A below).
b) 'Drive-in aluminium' monuments (available in a range of sizes) with a 3¼ inch cap (B below).



Examples of boundary monuments available

The intention is that the caps would generally be in plain view and contain the licence number of the Licensed Boundary Surveyor, thus linking the monument to the surveyor and its coordinates for posterity. Therefore, surveyors should be extra careful in

computing coordinates for boundary monuments from a professional pride point of view.

APPENDIX H

PROPOSED TEMPLATE FOR BOUNDARY AGREEMENTS BETWEEN ADJOINING OWNERS TO REGISTER BOUNDARIES AS CONCLUSIVE

BOUNDARY AGREEMENT

THIS AGREEMENT made the day of 2008 between (***here insert name and address of first property owner)*** (hereinafter called "the First Owner") which expression shall where the context so admits or requires include his Executors, Administrators, Assigns and Transferees of the First Part and ***(here insert the name and address of the second owner)*** (hereinafter called "the Second Owner") which expression shall where the context so admits or requires include his/her Executors, Administrators, Assigns and Transferees of the Second Part.

WHEREAS:

A. Definitions

In this Indenture:-

(i) "The Plans"	means the plans or plans annexed thereto.
(ii) "The First Owner's Lands"	means the lands known as ***(here inset the address and folio number of the First Owner's Lands"***
(iii)"The Second Owner's Lands"	***(here insert the description and folio number of the Second Owner's lands.***

B. The First Owner and the Second Owner have mutually agreed to enter into this Boundary Agreement for the purposes of conclusively identifying the common boundary between their respective properties as more clearly delineated on the map annexed hereto and thereon marked with the letters ***(here insert appropriate letters for each common boundary i.e. a, b, c, etc.)***

C. The First Owner and the Second Owner hereby agree and consent to the registration of this document in the Land Registry as constituting a conclusive definition of the boundaries between their respective properties.

NOW THIS INDENTURE WITNESSETH as follows:-

1. The First Owner and the Second Owner hereby agree for all purposes that the boundaries between the properties referred to at paragraph A(i) and A(ii) hereof shall be conclusively and definitely defined by the anchor/monuments referred to on the map attached hereto along the line marked (***here insert appropriate letters a, b, c, etc.)*** which said map we have endorsed our names upon prior to the signing hereof by way of verification. We acknowledge and agree that the correct boundary line is the line drawn along the said letters marked ***(here insert marked letters, a, b, c, etc.)*** on the map attached for its entire length.

2. The first and second owners hereby confirm, acknowledge and agree the co-ordinates referred to in the schedule hereto identify the letters referred to in paragraph one hereof and are conclusive to define the boundary to which they relate.

3. ***(this paragraph to be included where the boundary consists of a topographical feature or a party structure)*** the parties hereto hereby acknowledge and agree that the ***(describe structure e.g. wall/wooden fence)*** is a party structure. (Party structure maybe referred to by reference to letters).

4. The parties hereto consent to the registration of this Boundary Agreement as a burden upon the lands and folios referred to herein.

IN WITNESS WHEREOF the parties hereof have hereunto set their hands and affixed their seals the day and year first above written.

SCHEDULE

Coordinate A = (insert relevant coordinate)

Coordinate B = (Ditto etc

SIGNED, SEALED AND DELIVERED

By (Name of first owner)

In the presence of:-

SIGNED, SEALED AND DELIVERED

By (Name of second owner)

In the presence of:-

Dated this day of 2008.

APPENDIX J

PROPOSED TEMPLATE FOR DECLARATIONS OF IDENTITY WHEN REQUESTING THE PROPERTY REGISTRATION AUTHORITY TO RECTIFY THE REGISTER

PROPERTY REGISTRATION AUTHORITY

LAND REGISTRY

Declaration of Identity

County **Folio**

Re: Registration of Property at (here insert postal address of property)

I, (name of Declarant) aged 18 years and upwards of (here insert address of Declarant) a member of the firm of (here insert name of Chartered Surveyors) do solemnly and sincerely declare as follows:-

1. I am retained by (here insert name of client and property owner) and am familiar with the property referred to at paragraph 2 hereof.

2. This Declaration relates to the property known as (here insert postal address of property) being the property comprised in and described by Folio (here insert the folio number) of the Register of Freeholders/Leaseholders County (here insert relevant County) hereinafter called "the Property".

3. The attached survey drawing number (here insert number of drawing) upon which marked with the letter "A" I have signed my name prior to the swearing hereof, is a factual representation of the physical boundaries of the property.

4. The survey is prepared in accordance with IIS "Best Practice Guide-lines" and I certify that the area which is enclosed by the polygon and outlined by a red verge line, measures (here insert area in hectares).

5. That the attached list of ITM co-ordinates, upon which marked with the letter "B" I have signed my name prior to the swearing hereof, which runs along the centre line of the boundary feature, runs along the centre line of the boundary feature except where otherwise stated.

6. Each segment of the boundary is referenced and labelled.

7. That the owner of the property wishes to secure and defend the property by means of the factual records. I am of the opinion, and have assured the owner, that the survey is factually correct within a tolerance of plus/minus (here insert margin) mm.

8. When the maps and records for the property abutting the property referred to at paragraph 2 hereof were examined, some areas of paper encroachment on to the property were identified. These are marked on a second copy of the survey drawing which is attached and upon which marked with the letter "C", I have signed my name prior to the swearing hereof and I respectfully make application that The Property Registration Records be amended to reflect the reality on the ground following my survey of the property.

9. In order to assist the officials of the Property Registration Authority, I have marked the survey drawing to show the location of the two GPS control stations which I established, near the property. The ITM co-ordinates for these two stations are as follows:

    Station A
    Station B

10. I make this Declaration having carried out a detailed survey of the property in accordance with IIS "Best Practice Guide-lines" and having inspected the most recent Property Registration Authority maps available in respect of the property.

I make this solemn Declaration conscientiously believing the same to be true from facts within my own knowledge and pursuant to the provisions of the Statutory Declarations Act, 1936, and for the benefit and satisfaction of the owner and the Property Registration Authority.

DECLARED before me this day of
2008 by the said
IIS Licensed Boundary Surveyor who is
Personally known to me at

In the County of

_____
Commissioner for Oaths/Practising Solicitor

APPENDIX K

ELECTRONIC SUBMISSION OF DIGITAL MAPPING TO THE PROPERTY REGISTRATION AUTHORITY

Required Structure of CAD Files for Registration Purposes
PRA Appendix 7

CAD files submitted to Property Registration Authority containing digitised boundary geometry for a Registration must conform to the following requirements:

1 **File must be in .DWG format**. DXF files generated by non-AutoCAD cannot be accepted as the content of the resulting DWG file cannot be guaranteed consistent with applicant expectations.

2 **The CAD file must be emailed to scheme_maps@prai.ie as a single file.** Any referenced geometric data must be bound into the file and any references to images must be removed from the file before it is submitted to Property Registration Authority.

3 **Geometry must be in ITM Co-ordinates.** All geometry and annotation in the CAD file must be referenced to Irish Transverse Mercator (ITM) co-ordinates.

4 **Data must be structured in standard layers and colours.** The data relating to the proposed registration in the CAD file must be structured into Property Registration Authority standard layers ("LR_" prefix) and must conform to the Property Registration Authority standard colour convention to facilitate unambiguous interpretation of the data. Data on non-standard layers will be considered to be reference material only and will not be interpreted by Property Registration Authority.

5 **Line Style must be Continuous.** Only Continuous Line Style to be used for Plan boundary lines.

6 **Annotation must be clear and unambiguous.** The size and style of annotation text must be such that it is clear and unambiguous when viewing the complete area of the registration to which it applies. On large schemes this means that individual plan annotations are clear when viewing a single plan area and its environs.

7 **Lines must completely enclose Plan areas.** The lines representing a boundary for a Plan area must be complete and must not leave any gaps in the boundary. Holes in a Plan area must be similarly enclosed by lines.

Property Registration Authority Standard Layers and Colours

See examples of DWG & Layer Properties Manager in Figs 1, 2, and 3

A CAD file submitted as part of an application to Property Registration Authority must conform to the following Layer and Colour standard for details which are directly related to the proposed registration. Other geometry and annotation details can be included in the file but this must not be contained on the Property Registration Authority standard layers.

Layers and Colours:

LR_PLAN_NEW (Red)
Used for proposed Plan area boundaries which are not already on the Register and any annotation relating to the proposed Plan registration

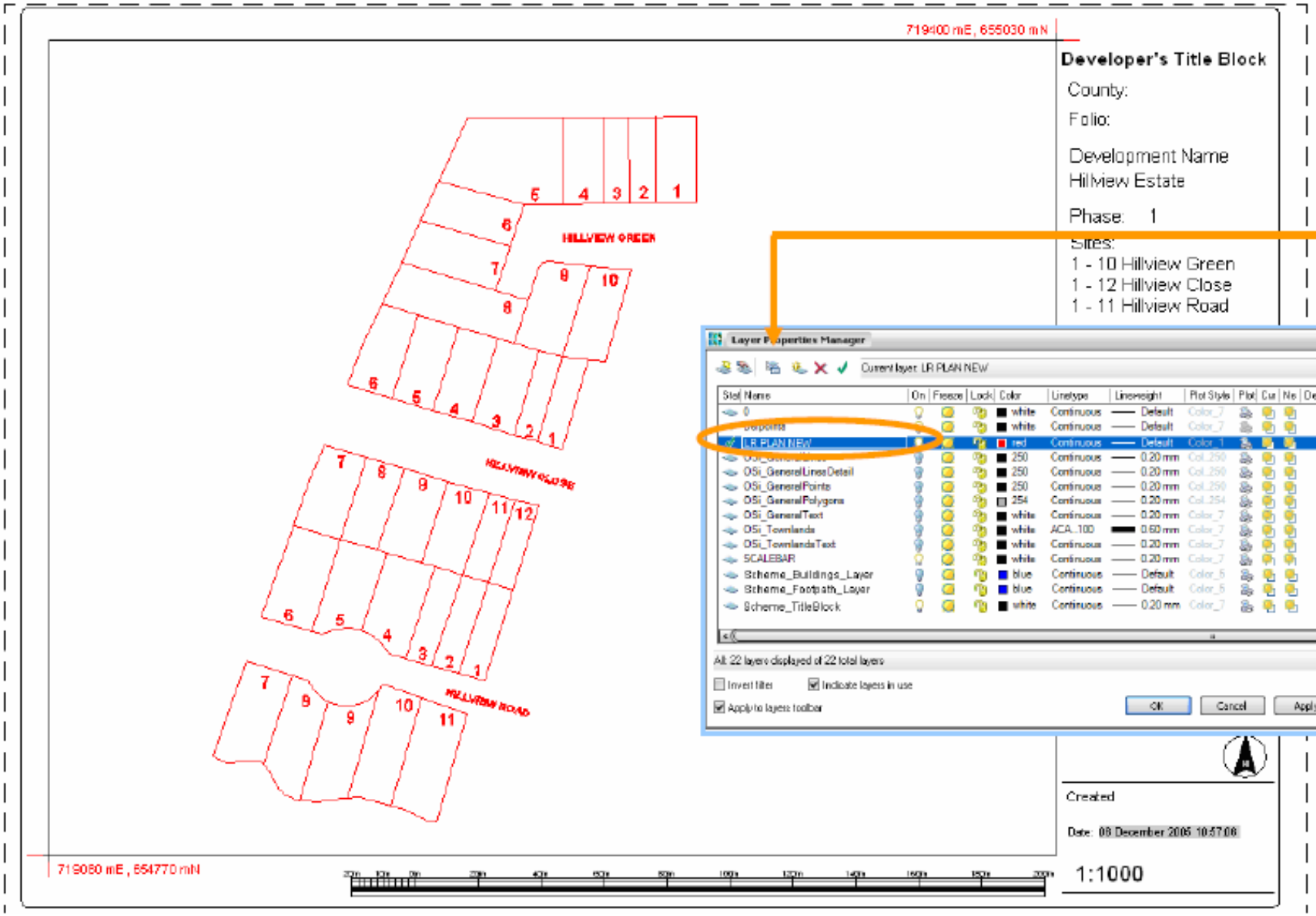
All other layers **Colour optional –**

Please do not use Red (LR) or Black (OSi)

Other geometries and annotation may be included in the CAD file for reference purposes or for presentation. This information will not be used by Property Registration Authority in processing the application. The applicant must ensure that all geometric and annotation information pertinent to the processing of the application is included on the Property Registration Authority standard layer listed above.

APPENDIX 7
Required Structure of CAD Files for Registration Purposes

Fig. 1

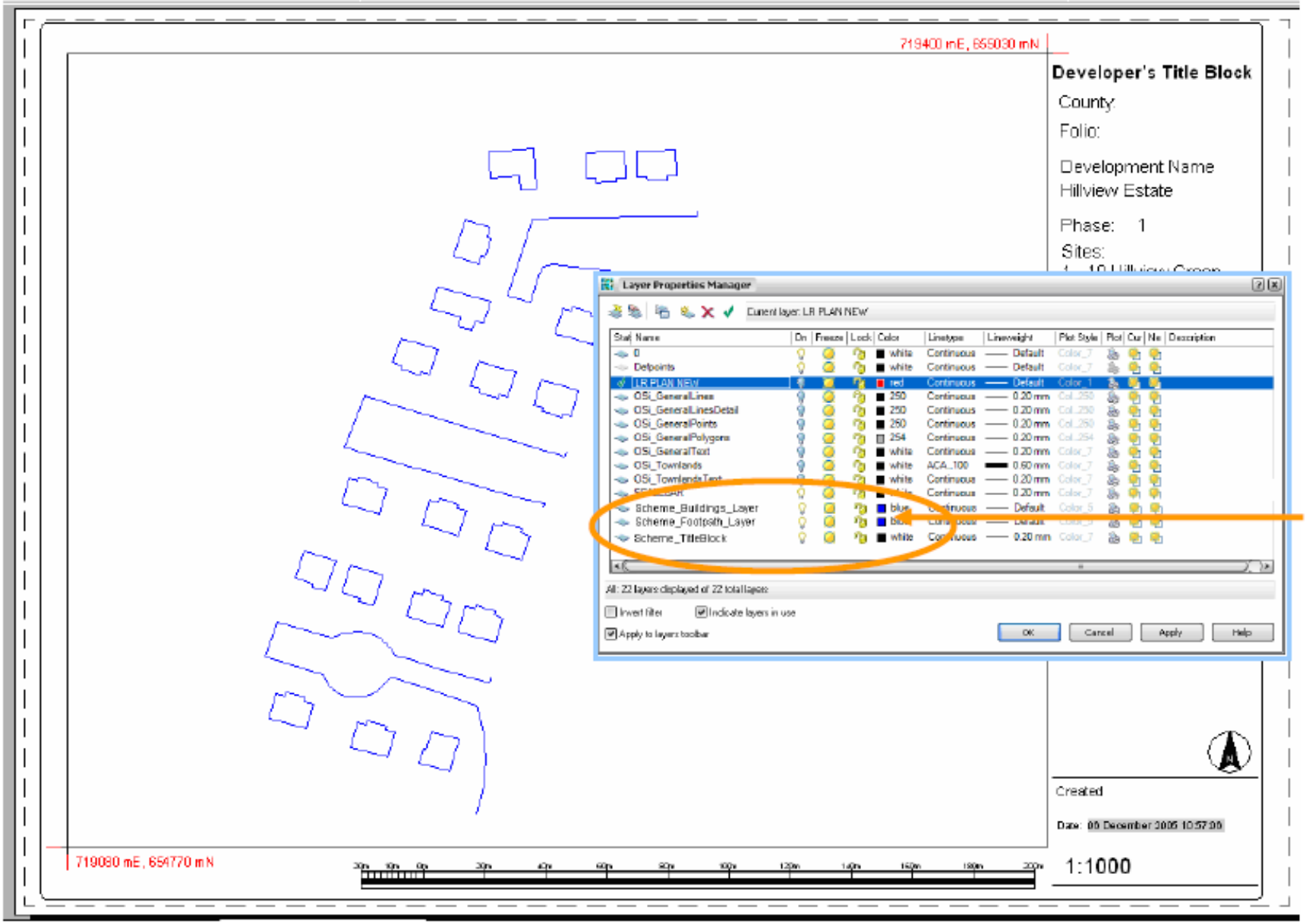


LR_PLAN_NEW
New polylines to form the properties should be digitised on this layer only
Site Numbers and **Road Names** should also be placed on this level.

*See **example** in **Fig.1** and* **Layer Properties Manager**

APPENDIX 7
Required Structure of CAD Files for Registration Purposes

Fig. 2



Scheme layer(s).

Other Geometry such as buildings or footpaths that might be considered relevant to the development scheme can be digitised on one or more scheme layers.

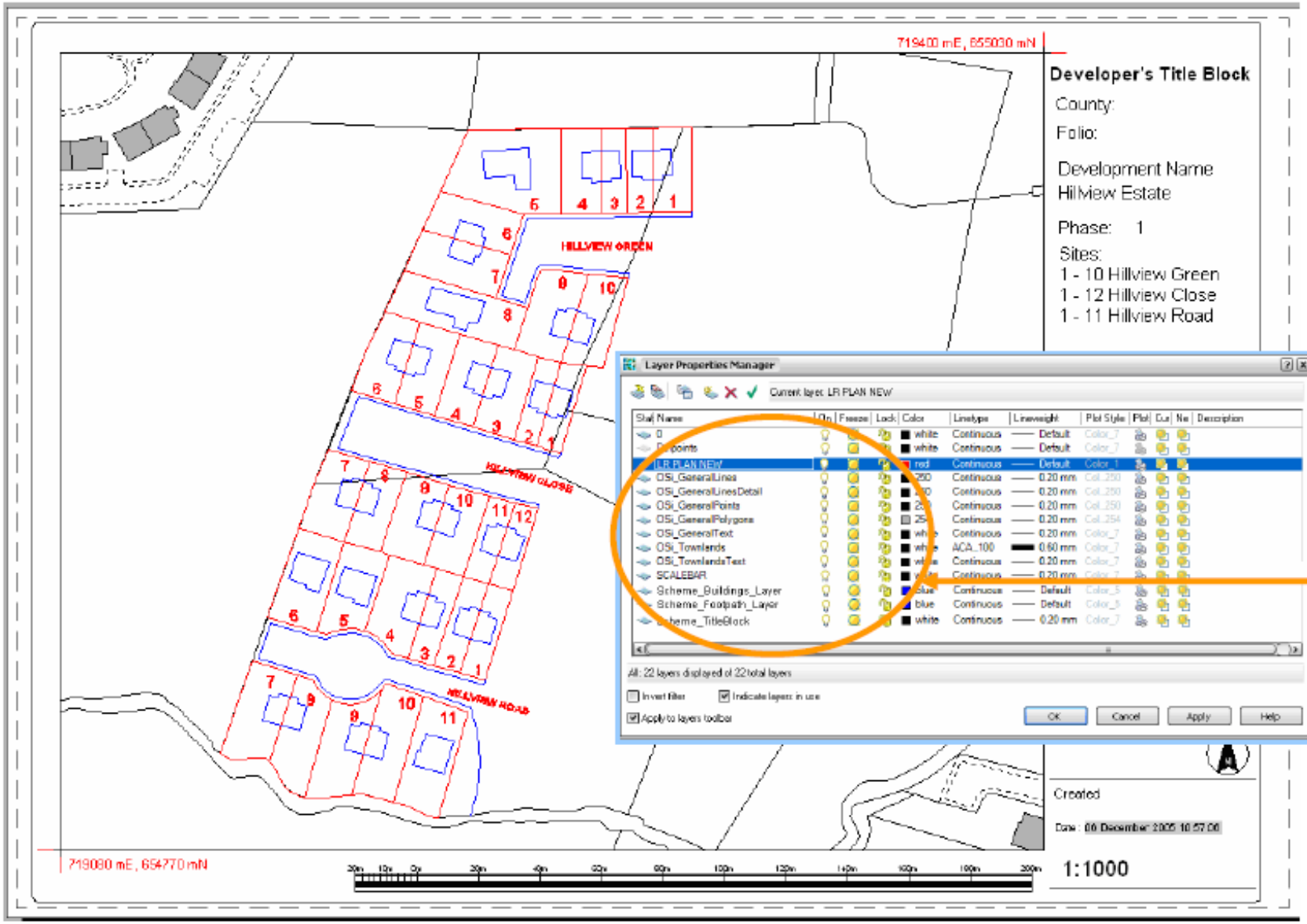
Colour is optional, but do not use Red or Black as those colours should be reserved for **LR** and **OSi** layers.

Blue has been used in this example

*See **example** in **Fig 2** and* **Layer Properties Manager**

APPENDIX 7
Required Structure of CAD Files for Registration Purposes

Fig. 3



Hard Copy of Scheme

LR_PLAN_NEW Layer
OSi Layers
Scheme Layers.

Hard copy of scheme map should be generated with **LR_PLAN_NEW** and **OSi** layers turned on.

Scheme layer(s) is optional
It is up to the lodging party to decide whether to include **other geometry.**

If including other scheme geometry then **scheme** layers should be turned on for printing purposes.

*See **example** in **Fig. 3** and* **Layer Properties Manager**