Replacing Survey Plans with Fully Digital Cadastral Survey Datasets

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SUMMARY

New Zealand is undertaking major digital transformation activities that will eventually require surveyors to submit digital datasets as the legal record of their cadastral surveys instead of survey plans.

The vision is to achieve a cyclic flow of digital data: from the cadastre to the surveyor to undertake the survey; and the resultant survey data submitted back into the cadastre. This future rests upon cadastral surveyors creating and lodging fully digital cadastral survey datasets as traditional survey plans are unable to meet the evolving needs of data-driven users of the cadastre.

Surveyors will save significant effort through no longer being required to prepare and lodge a survey plan. Information in the form of intelligent data enables cadastral survey data to be validated internally and against the data already held in the cadastre.

New Zealand has developed a prototype tool that enables a user to visualise a cadastral survey dataset as a survey plan in a browser. It provides powerful interactive tools that enable the user to explore the data that is not possible with a fixed image plan.

New Zealand has been working with colleagues in Australia to develop a standard model for 3D cadastral survey data and its exchange. The model is currently being exercised and tested for 2D cadastral survey data using the JSON encoding format. This will enable further engagement with survey software suppliers to enable them to enhance their software to import and export standardised datasets for lodging in the cadastre.

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INTRODUCTION

New Zealand started a major transformation of its cadastral survey system with the launch of Landonline in 2000. Surveyors and other users were then able to interact with the cadastre online and almost all of the information was in digital form. The system includes business rules that validate the datasets lodged by surveyors using the 'intelligent' data.

The current system and regulations require surveyors to lodge not only digital data but also a survey plan that represents that same data in the form a 'fixed' image. As well as duplicating the information, this traditional way of presenting the survey information does not meet the evolving needs of data-driven surveyors and other users of the cadastre.

In 2025 Land Information New Zealand (LINZ) completed the first stage of the redevelopment of Landonline that moved all the external applications to more-modern browser-based versions. The current phase is migrating to a new database and housing the system more robustly in the cloud.

In the next planned phase of the enhancement program, the Surveyor-General and LINZ have committed to developing a new regime whereby surveyors will lodge a cadastral survey dataset (CSD) without a traditional survey plan. Instead, a browser-based application will render that dataset as a 'digitally visualised survey plan'.

PREPARATION OF THE CADASTRAL SURVEY DATASET

The Cadastral Survey Act 2002 was promulgated while the original Landonline system was being developed. The Act specifies the lodgement of digital cadastral datasets and does not refer directly to survey plans.

As a transition to that goal, the Surveyor-General's Rules for Cadastral Survey (ie. regulations) require the lodgement of a survey plan as the primary legal record. But they also require most of the information to be presented as digital data (other than height-related data). Landonline provides tools that enable surveyors to comply with these requirements through a capture application and uploading of data exported from survey software using LandXML. It also provides a 'Plan Generation' tool that enables surveyors to semi-automatically generate the fixed image plans (including diagrams) from the data in the CSD (see Figure 1). Additional text can be added manually.

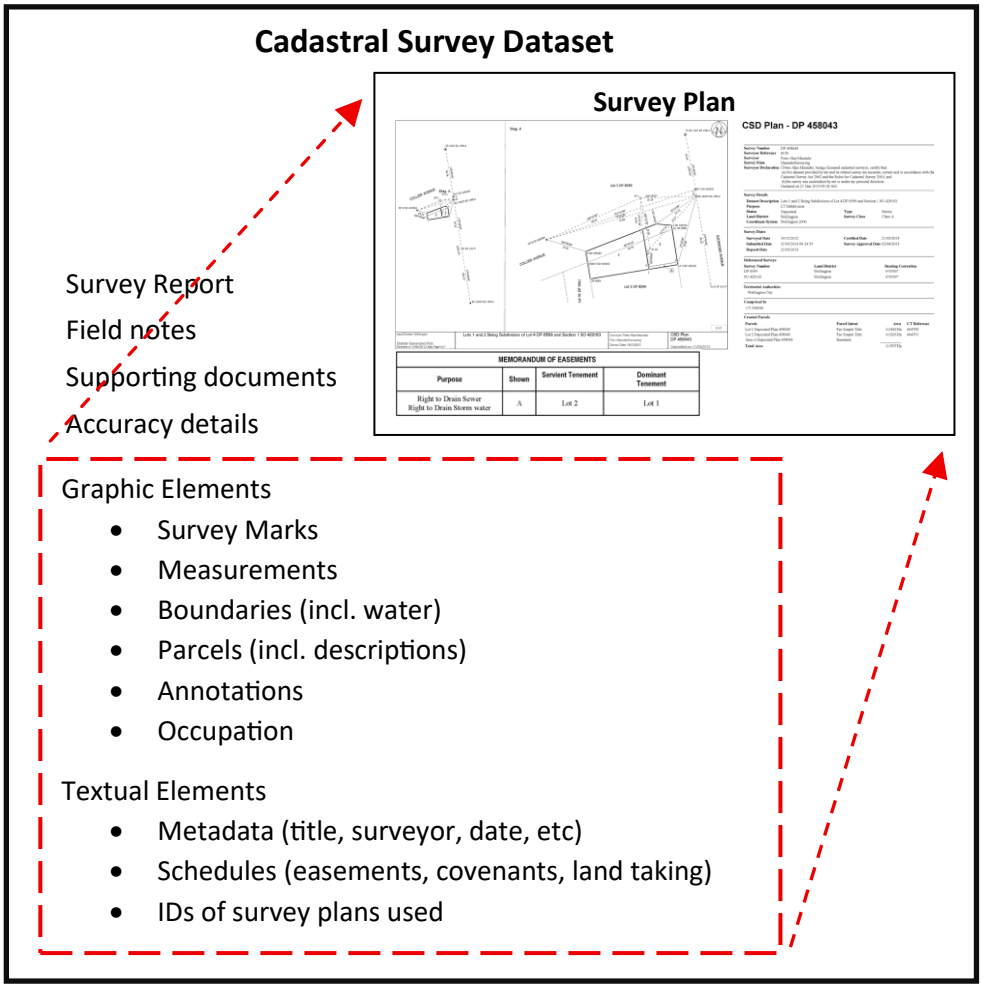

Figure 1 Contents of a Digital Cadastral Survey Dataset

Having the data in digital form offers significant benefits. This comes from data flowing from the cadastre, into modern surveying technology which digitally adds new data that is subsequently processed through survey software for lodging in the cadastre. The efficient flow of that information into the cadastre produces higher quality data through the reuse of data already recorded in the authoritative cadastre, the minimisation of human errors and the application of business rules to validate the data, including against the Rules. It also enables major efficiency gains through the semi-automatic integration of the data into the cadastre without the need for additional capture.

One of the most significant benefits of the digital cadastre is through the free availability of the survey-accurate digital map of the parcel boundaries. This 'base map' was initially established through back capture of existing survey plans and is constantly enhanced with the measurement-based data from new cadastral surveys. It is used for multiple purposes and is

highly valued by every local government, as well as government agencies, utility managers, real-estate agents, and resource managers.

PROTOTYPE CADASTRAL SURVEY DATASET VIEWER

Significant improvements in digital depiction technology have enabled LINZ to progress with the concept of replacing static survey plan images with a CSD visualisation solution. The Digitally Visualised Survey Plan (DVSP) solution requires all of the data that is to be displayed to be in digital form.

Currently in a prototype stage, functionality was released to a pilot pool of surveyors to test the proposed solution in real world circumstances. Surveyors were asked to use it to generate CSD packages for surveys that were currently underway and then share them with conveyancing practitioners to understand if this solution would meet the core needs of the cadastre and the tenure system.

The DVSP prototype automatically renders the CSD package which is currently a ZIP file. It includes a JSON file with spatial and aspatial data bundled with supplementary supporting information in document formats.

The CSD package is dropped into a browser interface which is enabled to visually render the survey in a format controlled by LINZ. This rendering provides a range of benefits and features designed to meet the needs of core customers groups such as surveyors and conveyancing solicitors. These include:

- graphical views customised for different users - surveyors and those involved in the titling and conveyancing processes
- embedded structured data can be spatially interrogated and displayed graphically and in tabular form with interactive highlighting
- smart data visualisation allowing for filtering at different scales, multiple searching options, layer controls, text clash algorithms, and overlays of topographic or aerial photographic context information
- portability - files are shareable and can be viewed with ubiquitous web browser capability; works on different devices including survey sensor controller systems

Standard features including spatial zooming, scrolling, layer controls, filtering and data selection provide an intuitive method to interpret the CSD. When combined with drill down options, interactive tabular and text data identification the DVSP offers a substantively enhanced ‘survey plan’ to support users of the cadastre.

Figure 2 shows an example of a diagram sheet of a survey plan produced by a surveyor using the current Plan Generation functionality. Figure 3 shows part of the same CSD automatically rendered as a DVSP.

CSD packages can be created as required by the surveyor up until submission to LINZ. The ability to automatically generate and view different versions of a CSD package will be a significant improvement on the current system as it will eliminate the plan drafting rework typically required when data is added or adjusted. Once 'Approved as to Survey' the CSD would become part of the integrated cadastre from which users would be able to obtain the authoritative CSD package. It would be able to be shared and viewed by anyone through a mainstream web browser using the DVSP tool.

Basic printing is enabled through the creation of PDF screen views as required by a user.

LEGAL BASIS FOR LODGING OF A CADASTRAL SURVEY DATASET

In New Zealand the CSD, which includes the 'traditional' survey plan, is the legal record that identifies the parcels of land and their boundaries. Once approved by LINZ it is typically used to undertake some form of legal property transaction, such as for creation of new titles, acquisition for public works, proclamation for government purposes such as Reserve, or for sale of Crown lands.

It is therefore critical to the property rights system that the replacement of traditional survey plans with fully digital cadastral survey datasets and a tool for visualising them is robust, legal, and enduring.

The primary users of cadastral survey datasets are surveyors, lawyers (who undertake the property transactions, local government (who are responsible for planning and resource management), and officials who administer land.

For these users to trust the new regime it is critical that all the information in the dataset is able to be visualised without missing any details and that the information is clear and unambiguous. The traditional method of meeting this requirement is to include detailed diagrams on the survey plan, with prescribed symbology. Digital visualisation needs to meet this requirement by managing text and symbol collisions in a manner that is intuitive to the user.

A further requirement is that the dataset that is lodged and certified by the licensed cadastral surveyor must persist forever in that legal form in the cadastre and is not subject to subsequent changes by LINZ. The national digital parcel map is a separate representation of the boundaries that is adjusted to depict the current positions of parcels in terms of the semi-dynamic datum (which manages tectonic movement).

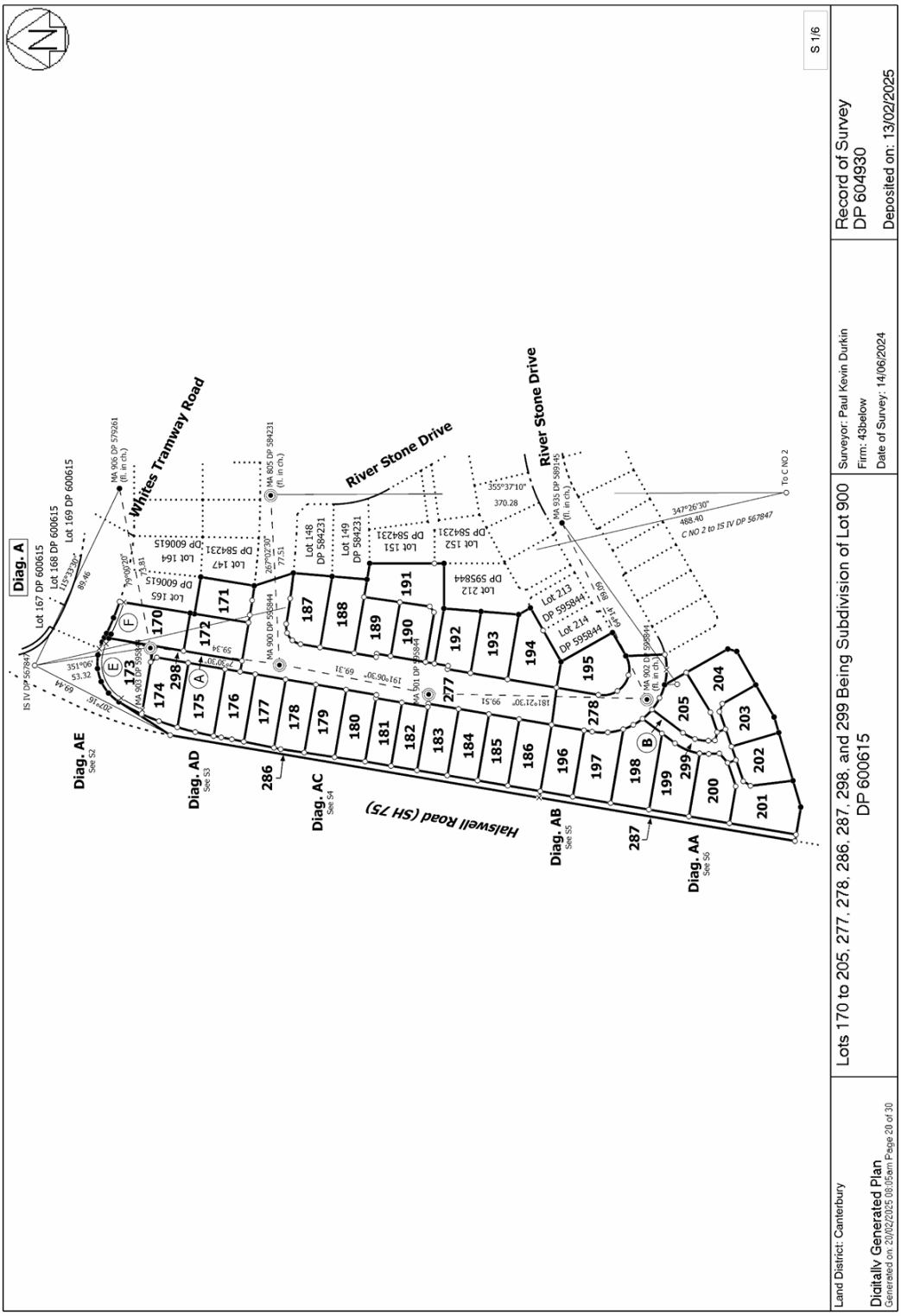

Figure 2 – A sheet from a current Survey Plan generated by surveyor using the Landonline PlanGen System

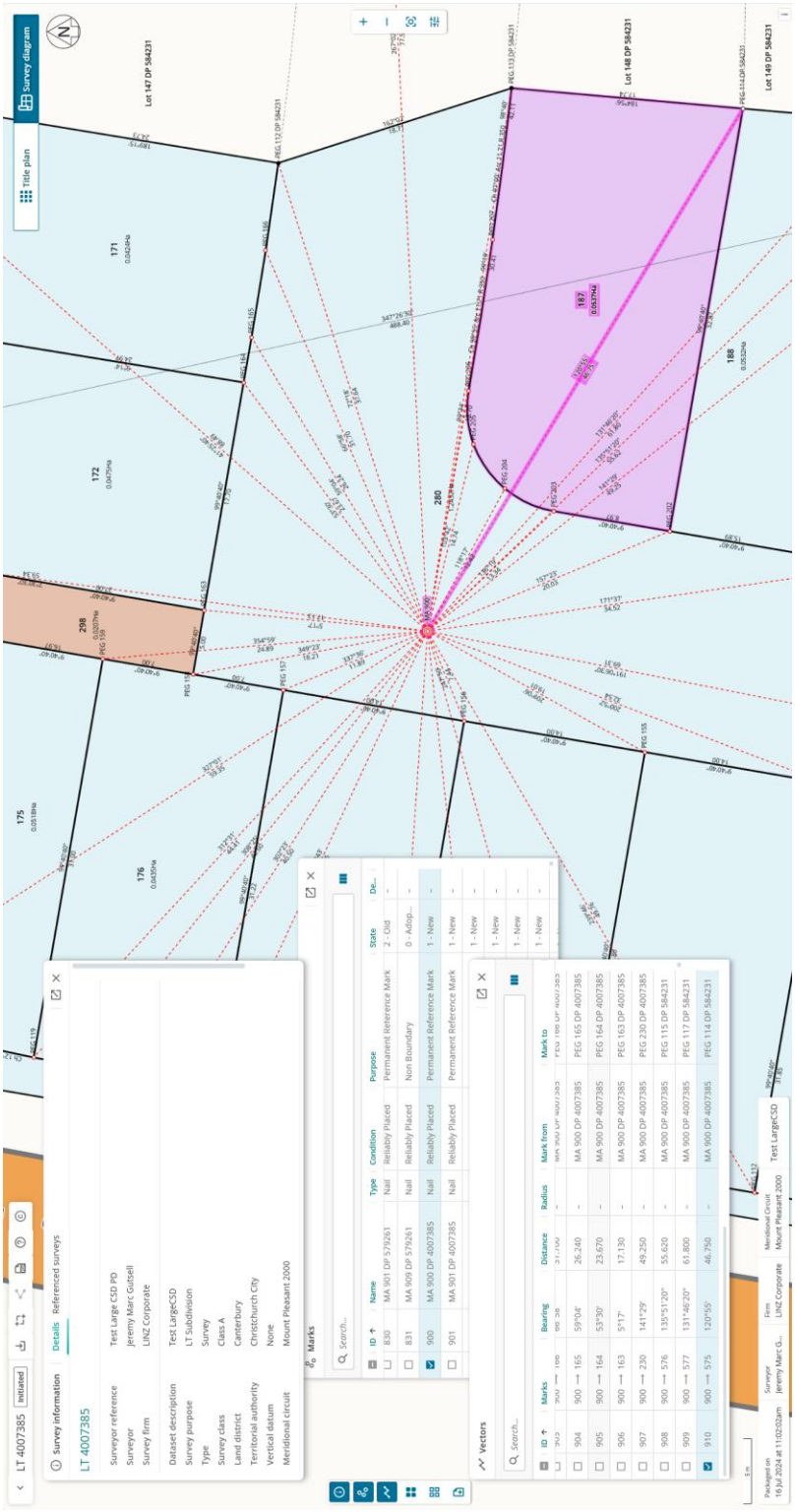

Figure 3 – Example of a Digitally Visualised Survey Plan

Implementation of the new regime will require the Surveyor-General to promulgate new Rules that require surveyors to lodge data that is equivalent to the information that they have been required to depict on a survey plan. That depiction requirement will instead be specified in a formal standard that LINZ will be required to apply in the tool for digitally visualising the CSD.

STAKEHOLDER ENGAGEMENT AND IMPLEMENTATION

The prototype tool for visualising CSD is available on the LINZ website along with some sample CSD packages. LINZ invited stakeholders to provide feedback on the proposal along with any concerns. Providing a working prototype was essential to support this engagement process, as it would otherwise be too difficult for stakeholders to understand and assess this generational change to the cadastral survey system and how the new regime might work.

While the Landonline Plan Generation functionality provides a relatively efficient means of producing the survey plan, the proposed solution would completely remove the need to prepare the plan. This saving offers significant benefits to surveyors preparing CSDs for lodgement with LINZ.

Most stakeholders thought that digitally visualised plans would present opportunities to improve efficiency, increase accuracy and reduce costs to both businesses and clients. However, surveyor professional bodies also reported that about a third of their members did not support the proposal.

LINZ is committed to addressing these concerns, particularly through further engagement with surveyors. This will include direct involvement in the further development of the visualisation tool and related products. They will also be consulted in the development of the related Rules.

The new regime will be introduced progressively through the same transition approach that has proven successful with previous changes. This involves enabling use of the new regime while the existing systems continue to be available. Surveyors can then choose if they want to trial the new regime, while any issues and problems can be addressed knowing that the existing systems remain available to use if necessary. Once the new regime is proven and accepted by stakeholders its use would be made mandatory.

This work is currently planned to commence in 2027 and is expected to take several years to complete.

3D CADASTRAL SURVEY DATA MODEL

While New Zealand has used LandXML for over 20 years, it has had limited adoption in Australia. For the future exchange of cadastral survey data LandXML has some significant restrictions including that it is not a fully recognised international standard, is not designed

specifically for cadastral data, and is not enabled for 3D objects. Australian and New Zealand cadastral jurisdictions are addressing this issue through their collaboration body, the Intergovernmental Committee of Surveying and Mapping (ICSM) and its Cadastral Working Group (CWG).

CWG has developed a prototype 3D Cadastral Survey Data Model (3D CSDM) exchange standard in advance of jurisdictions implementing 3D data-oriented objects in their cadastres. With the help of an external supplier, the first phase of work encompassed the development of a harmonised data model to represent the needs of the nine jurisdictions involved and a recommendation of exchange encoding format. The multi-tier data model is based on international standards, and the encoding uses the more-modern JSON format.

The second phase expanded the model structure to provide jurisdictionally specific content implemented through profiles and delivered sample parsing code that exercised the model.

The model utilises accepted international standards and ontologies for components which are ubiquitous such as for survey observations, measurement sensors and reference frames.

As this solution matures through testing and implementation, ICSM aims for the standard to be taken up by international standards organisations with appropriate governance, management and maintenance capabilities to ensure it meets the needs of all users.

ICSM recognises the vital role that survey software providers play in supporting the digitisation of cadastral surveying and the cadastre itself. Jurisdictions are now looking to engage with them to implement the 3D CSDM and JSON encoding framework. Jurisdictional prototyping of solutions that exercises the framework is essential to enable providers to develop compatible solutions that support the digitisation of the cadastral survey cycle. Initial prototyping will focus on the 2D components of the model, as the majority of cadastral surveys are only defined in the horizontal.

The JSON file in New Zealand's CSD package currently employs a data model based on Landonline. LINZ is planning to implement the 2D elements of the 3D CSDM into the DVSP solution in 2027. More broadly, New Zealand is looking to use the 3D CSDM and the JSON encoding as the foundation for the exchange of cadastral survey data for multiple purposes, not just visualisation. These would include the validation of CSDs and supporting interoperability for other uses of cadastral survey data.

3D FUTURE

A key aspect of the ICSM CWG work has been to build a cadastral foundation for the future which supports the development of a 3D digital cadastre. All Australian and New Zealand jurisdictions currently provide for the 3rd dimension through the submission of static diagrams to represent 3D rights, restrictions and responsibilities. However, there is no representation of the height elements in digital form.

Users' expectations are no longer satisfied by this approach. The capability of technology coupled with the wider utilisation of cadastral information as a reference frame, demands a data driven approach for the future.

A core outcome of the early CWG work undertaken on this programme identified:

> "The major conclusion reached is that there is a key gap in the standards landscape around common approaches for 3D Feature and Geometry, particularly with respect to basic topology support required." [1]

Consequently, completion of the 3D components of the current 3D CDSM is pending the development of the appropriate standards which will be incorporated in a future iteration. The modular approach in the development of the model supports this expectation, and LINZ expects that a future 3D enabled DVSP will provide a far superior outcome for the digital representation of 3D cadastral elements compared to diagrams on the current survey plans.

CONCLUSION

The value of high-quality cadastral survey data is rapidly increasing with further movement into the digital age. The ability of modern technology to process and present the data in a much more user-oriented way is enabling major changes to the traditional 'paper-based' way or presenting surveys in the form of a survey plan.

To truly realise this value, New Zealand will be progressively moving toward receiving digital cadastral survey datasets rather than the survey plan. It will only be then that the efficiencies and effectiveness of a fully digital cadastral survey system will be realised to the benefit of all.

New Zealand is committed to the standardised solution that is being adopted by Australian and New Zealand jurisdictions through ICSM. Wide adoption of the internationally based standard by jurisdictions and survey software vendors may eventually see it being more widely accepted for the exchange of cadastral survey data.

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BIOGRAPHICAL NOTES

Anselm Haanen has been the Surveyor-General at Toitū Te Whenua Land Information New Zealand since 2018. He was previously the Deputy Surveyor-General. He holds a Master of Surveying degree from the University of Otago and has worked in various technical capacities since joining the department in 1978. He was heavily involved in the development of Landonline, New Zealand's automated survey and title system, and helped develop New Zealand's Cadastre 2034 strategy

Jeff Needham is Deputy Surveyor General at Toitū Te Whenua Land Information New Zealand (LINZ) and is the Business Owner for the redevelopment of the Landonline system. His background includes 25 years in private consulting focused on Land Development, Infrastructure and digital information technologies. He was the surveying profession's Stakeholder Representative in the original development of Landonline between 1999 and 2003. Jeff is a Fellow and past President of Surveying and Spatial NZ and is the Product Owner for the ICSM 3D Cadastral Survey Data Model Programme.

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