SURVEYING + SPATIAL

March 2016
Issue 85

Connected Community Machine Control on the M2PP Expressway

GIS – a tool for surveyors

Mobile 3D Mapping – a hydrographic first in NZ

NZIS

www.surveyors.org.nz

Trimble R2
GNSS Receiver

- Achieve sub-metre to centimetre level positioning accuracy
- Pair with professional or consumer mobile devices for easy data collection
- Start collecting data fast with a quick setup and one-button operation
- Integrate with proven Trimble Geospatial software for a complete field-to-office solution
- Get highly-accurate positions in real-time wherever you are with a range of correction sources

VERSATILITY IN THE FIELD. FLEXIBILITY FOR YOUR WORKFLOW.

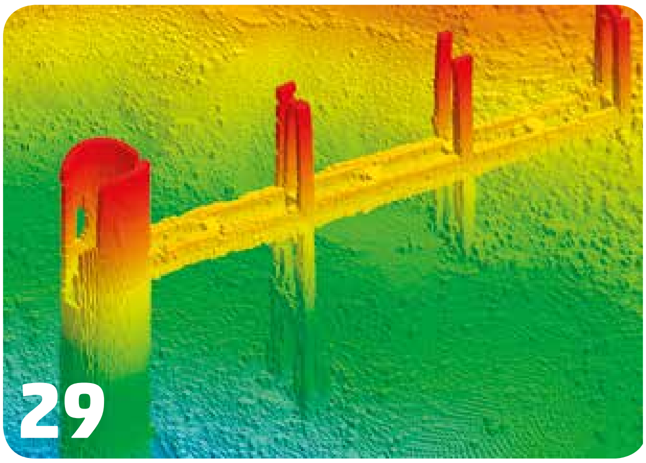
Whether you're a surveyor who requires centimetre accuracy or a GIS professional who needs sub-metre accuracy, the Trimble® R2 GNSS receiver gives you the flexibility to choose a solution based on the accuracy and GNSS performance level that suits your application.

The compact, durable Trimble R2 can be paired with a Trimble handheld or personal smart device. Plus, enjoy a simple and fast one-button start up so you can begin collecting data straight away. Select from a range of correction sources, including Trimble RTX™ services, for accurate, real-time data just about anywhere.

To find out how the versatile Trimble R2 can bring flexibility to your workflows, visit Trimble.com/R2forGIS or Trimble.com/R2forSurvey

GEOSYSTEMS *Future Thinking*
www.geosystems.co.nz | 0800 GEOSYS

Trimble
Authorised Distribution Partner



SURVEYING + SPATIAL

MARCH 2016 ISSUE 85

COVER IMAGE:
Peat removal on the MacKays to Peka Peka Expressway. See page 6 for more details.
Credit: Mark Coote

ARTICLES

6 Mackays to Peka Peka – Using Trimble Connected Community

11 FIG Working Week 2016 in Christchurch

12 GIS: a Tool for Surveyors – Survey & GIS Integration

15 International Boundary Making – The crème de la crème of cadastral surveying

19 Vehicle Speed and Curve Risk Modelling for Road Safety

22 Archie Bogle's Brothers Honoured in Waipukurau

29 Mobile 3D Mapping – A Hydrographic First in NZ

37 Getting It Sorted – GIS at SCIRT: The Start of a Legacy

REGULAR FEATURES

2 Editorial

3 Surveyor-General

4 Professional Stream News

24 Technology

26 BCB Commentary

35 Legal Column

42 Perspective

44 University Happenings

NZIS New Zealand Institute of Surveyors Te Rōpū Kairūri o Aotearoa

ISSUE 85 MARCH 2016

SURVEYING+SPATIAL

A publication of the New Zealand Institute of Surveyors – Te Rōpū Kairūri o Aotearoa

ISSN 2382-1604

www.surveyors.org.nz

EDITOR

Diane Moriarty

survey.editor@yahoo.co.nz

Correspondence relating to literary items in *Surveying+Spatial* may be addressed to the editor. Papers, articles and letters to the editor, suitable for publication, are welcome. Papers published in *Surveying+Spatial* are not refereed. All correspondence relating to business aspects, including subscriptions, should be addressed to:

The Chief Executive
New Zealand Institute of Surveyors
PO Box 5304
Lambton Quay
Wellington 6145
New Zealand
Phone: 04 471 1774
Fax: 04 471 1907
Web address: www.surveyors.org.nz
Email: nzis@surveyors.org.nz

Distributed free to members of NZIS.

Published in March, June, September and December by NZIS.

DESIGN & PRINT MANAGEMENT

KPMDesign – www.kpmdesign.co.nz
info@kpm.co.nz

TO ADVERTISE

Email: nzis@surveyors.org.nz
or contact Jan Lawrence +64 4 471 1774

Our Year to Shine

Diane Moriarty

Hello and happy New Year! I trust you are all back into the swing of things after a relaxing summer break.

It is an exciting year for the NZIS and its members as we get set to welcome the biggest gathering of spatial professionals in the world at the annual FIG working week from 2-6 May. To be hosted in Christchurch – a city that has seen so much tragedy but also a city that has shown resilience and innovation to rise from the ashes and rebuild itself. A lot of lessons have been learnt along the way and this is our time to share these with the rest of the world. If you have not registered yet, get in quick and secure your spot. This type of event does not come around every year. It should also be seen as a great opportunity for NZIS Young Professionals (YP). The Auckland Branch of the NZIS has recognised this by providing sponsorship of $1000 for one lucky YP in the Auckland region to attend the conference. The NZIS Board have also agreed to support YP nationally and funds have been allocated to branches.

There is plenty of change afoot in the coming year with legislation under review and national policy statements proposed. Submissions on the RMA Legislation Amendment Bill 2015 are still open until 14 March 2016 and it is recommended that members have an active role in the submission process. The Ministry for the Environment is also proposing the development of a National Policy Statement on Urban Development (NPS). With the intention of the NPS to ensure that regional and district plans provide adequate development capacity for business and housing, enabling urban areas to grow and change in response to the needs of their communities. Public consultation on a draft NPS is expected to take place in mid 2016. Lastly, the feedback period for the Canterbury Properties and Related Matters Bill is now closed and it will be interesting to see the findings on these submissions in the report due out in May. Mick Strack provides a commentary on the proposed bill in his column on Page 26.

This month's magazine has a bit of a GIS theme, with a number of articles covering this topic. The article on Page 12 may be of particular interest to many surveying companies. It tells of how BTW Company uses GIS as a tool for their surveying, engineering and energy departments. The GIS team acts as the 'glue' between all the other departments by storing and managing data as well as providing independent GIS services to external clients. This article is a good example of how the surveying and GIS professions can work together and in turn, improve efficiencies within existing companies and add to the list of services on offer to clients.

I hope you enjoy this edition.

Editor's Correction: Figure 4 on page 26 of Issue 84 (Dec 2015) was displayed incorrectly. For the correct figure please refer to the online publication at http://www.surveyors.org.nz/Attachment?Action=Download&Attachment_id=2182

SURVEYOR-GENERAL

Land Information New Zealand
Toitū te whenua

A Global View

Mark G. Dyer

Kia ora koutou.

There is no doubt that surveying and spatial science is global – the earth is not flat, and even a local project will consider relevant reference frames. Our profession seeks to solve common problems, address challenges, and to seize opportunities that occur at local, national, and global levels.

For instance, successful land economies require efficient and effective property rights systems. While urban development is often viewed as a locally directed function, at the same time it contributes to national prosperity and how we compete in what is increasingly a global market.

Another example is our response to climate change and how we act to counter the existing trend. As we engineer our built environment to build resilience in the face of issues such as flooding, we need to work with others to understand matters such as rainfall intensity in catchments. These are of course influenced by weather patterns and changes in our oceans. Policy informs and directs our responses at a global, national and local level.

We should all be aware of international commitments such as the United Nations Sustainable Development Goals as ultimately, our value as a profession, is in how well we serve society. To do this well we need an understanding of the issues facing the communities in which we live, work and play, and to view these along with national drivers and the broader international context.

To be in the best position to seize opportunities to add value requires that we build our capability, leverage the available technologies, and have a broad understanding of how others are responding to these common problems. This helps us to be innovative and effective.

A rare opportunity is available to us all to attend FIG2016 to be held in Christchurch in May. The topic of 'Recovery from Disaster' is reflective of a common challenge facing us here in New Zealand and internationally. Of course different countries have and will face different disasters and, as uncomfortable as it is, we need to be prepared for the future by learning from past events to ensure our communities are well equipped to respond and recover. We all have much to learn and we are fortunate that we have colleagues prepared to share for our collective benefit.

I commend this conference to you and strongly encourage you to attend. It will be a fantastic event.

For those working in the Canterbury region and involved in cadastral surveying you should be aware of the work being undertaken to assist the Canterbury rebuild and, in particular, the rebuild of the cadastre. This is a priority for Government and for LINZ and of course for me. The cadastre is fundamental to how we organise ourselves as a society and we need to continually invest in it to make the cadastre as effective in its function as possible.

To this end I have commenced a review of the Rules for Cadastral Surveying and you will hear more about this as the year progresses.

In the meantime I look forward to seeing you at FIG 2016. I and other LINZ staff members will be on the LINZ stand in the exhibition hall and happy to have a chat and answer any questions you may have.

Ngā mihi,
Mark Dyer

Cadastral

The Cadastral Stream has been busy behind the scenes over the last few months. We have appointed the members of the Cadastral Survey Act Review working group who are now working on this, especially around the area of Section 52. This group is chaired by Colin McElwain. The Cadastral Stream has also been working closely with National Office and members of the Canterbury Branch with the submissions lodged on behalf of the NZIS members for the Canterbury Property Boundaries and Related Matters Bill and the Greater Christchurch Regeneration Bill.

The Cadastral Stream are hoping to organise some CPD events in the coming year, but to date are not sure what format these will be in (webinar or seminar). We have a few potential topics in mind, but if you believe we should look to organise around a particular topic, please forward your thoughts to *mattr@cheal.co.nz*.

Engineering Surveying

The New Year has arrived and brought with it a raft of small to mid-sized construction projects. Survey companies have been inundated with site topographical surveys, subdivision development and infrastructure projects of all shapes and sizes. The cranes appearing on the Auckland skyline are a strong indication that high-rise development is back in full swing with a few 30+ level buildings underway and a couple of 50's on the horizon. Together with the announcement of $2.5b worth of funding for the city rail link, the need for quality engineering surveying expertise is sure to grow.

The engineering surveying leadership group is making steady progress towards creating a pathway that will allow engineering surveyors to have their skill and experience professionally recognised by the NZIS. There is a growing need for engineering surveyors to become professionally registered in order to adhere to council and client standards when signing off as-built plans, certifications and setting out correctness.

If any stream members have news from any of the projects going on around the country at the moment, please feel free to get in touch via the engineering stream email on the NZIS website.

Hydrography

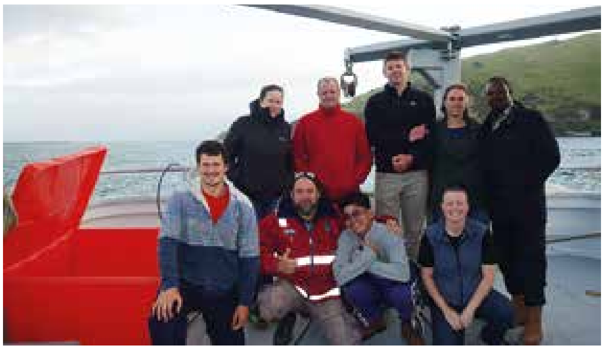
NZR AHS webinar and annual seminar

The NZ Region of the Australasian Hydrographic Society is hosting a webinar titled "Developments in the use of AUV's for Hydrography" on 7th March. Presented by Hydroid Inc., this is a great chance to learn more about the technology used in exploring our underwater environments.

In addition, the annual NZR AHS seminar is currently being planned. The theme will follow that set by the IHO for World Hydrography Day 2016 "Hydrography – the key to well-managed seas and waterways".

Please visit the NZR AHS website for more details on the webinar and seminar: *http://www.hydrographicsociety.org.nz/*

International partnership brings the world to study hydrography at Otago



Attendees at the hydrograph paper SURV562. Photo A.Holt.

In December, the School of Surveying, in partnership with the Hydrographic Academy of the Marine Learning Alliance (Plymouth, UK) offered their inaugural Southern Hemisphere practical hydrographic paper (SURV562). Attending the truly international course were students from NZ, Australia, Hong Kong, Ghana, Germany and The Netherlands, and instructors from the UK and NZ.

During their time at Otago students undertook a variety land and vessel-based surveying measurements and calculations, including an overnight voyage. We were very lucky to receive generous support from IX SURVEY, Fugro BTW Ltd and GNS Science who provided equipment for this.

For more information on the paper or the MLA please visit: *https://www.mla-uk.com/*; *http://www.otago.ac.nz/surveying*; or email *emily.tidey@otago.ac.nz*

Hydro at FIG 2016

Looking forward to seeing you all in Christchurch in May – with a Commission 4 vessel excursion sounding exciting!

Emily Tidey, Hydrography Stream Council representative

Land Development and Urban Design

Moving forward into a new year, 2016 brings some interesting events of note to members of the LDUD stream including FIG working week in May, RMA Legislation Amendment Bill, and possible input into a proposal for the

St Kilda – eco subdivision in Cambridge

development of a National Policy Statement on Urban Development. Members will be encouraged to get involved in the submission process as these are important subjects given the strong growth that is occurring throughout NZ and in particular Auckland. Most of our members are well aware of the unwieldy and expensive processes to obtain Resource Consent for multi lot subdivisions.

From a local perspective Cambridge is enjoying the benefits of the new Cambridge bypass section of the Waikato Expressway. The unparalleled residential growth between the town and the new expressway is putting pressure on Local Council to fast forward major infrastructure projects, which has been a major impediment to future development in the past. The cost of this infrastructure has also resulted in current Development Contribution levels rising to approximately $40k per Lot.

The award winning St Kilda development in Cambridge (which is on the Northern side of the bypass) is also growing rapidly and has moved into construction of Stage 4 of the 5 stages planned. This is an eco-subdivision with stringent covenants and large wetland areas for stormwater treatment and retention.

Link to summary of main points in Resource Management Act reform:

https://www.mfe.govt.nz/sites/default/files/media/RMA/second-phase-rm-reform.pdf

Link to NZ Property Council submission on a National Policy Statement on Urban Development:

http://www.propertynz.co.nz/media/wysiwyg/pdf/NPS_on_Urban_Development_Submission.pdf

Link to St Kilda Development website:

www.stkildacambridge.co.nz/

Positioning and Measurement

Technical Seminar on Reference Frames in Practice

The NZIS Positioning Stream is pleased to be working with FIG and other international partners on a technical seminar on Reference Frames in Practice. The seminar is designed for surveyors and spatial professionals who want to maintain and enhance their knowledge of 3D and vertical geodetic datums (or reference frames) and how best to use them. The two-day seminar will be held immediately before the FIG Working Week in Christchurch, on Sunday 1 and Monday 2 May 2016. Speakers include a number of prominent geodesists and geodetic surveyors from around the world, including Japan, the United States and Australia. There is also a strong New Zealand focus, with presenters from LINZ and University of Otago. The seminar starts with a half-day revision of key concepts of 3D and vertical datums, before focussing on topics such as the use of deformation models, geodetic infrastructure and geodetic software. Further details are available at *http://www.fig.net/fig2016/commission5.htm*. Registration for the seminar is via the FIG website *http://www.fig.net/fig2016/registration.htm*. If you would like more information, please contact Nic Donnelly at *ndonnelly@linz.govt.nz*

Spatial

As to be expected we've had little activity in the Spatial stream over the Christmas/New Year period however discussions have been ongoing around the certification landscape for spatial professionals, and spatial professional identity as a whole, such as what it means to be a "Spatial Professional" and what professional competencies do we uphold.

The inaugural New Zealand Geospatial Research Conference (NZGRC) was held in Christchurch at the University of Canterbury from 7th-9th December, incorporating what was previously SIRC, the Spatial Information Research Conference that had been held at the University of Otago in previous years (this year with an expanded scope). The conference was supported by NZIS and included presenters from academia, local and central government and industry as well as the Cooperative Research Centre for Spatial Information (CRCSI), and a panel discussion in which NZIS Chief Executive Hadyn Smith took part. The conference will be held every two years as a communication forum for academia, industry and government to share geospatial innovation and research.

A Women in Spatial (WIS) planning day for 2016 was held, and a number of new WiS events have been planned for 2016 in Wellington, Auckland and Christchurch.

The New Zealand Spatial Excellence Awards were held on 19th November 2015 at Te Papa, Wellington, continuing the excellent event inaugurated in 2014 and showcasing the talent of the geospatial industry in New Zealand. Another hugely successful event partnering with NZIS.

Looking forward to seeing you all in May at FIG Working Week in Christchurch!

Greg Byrom, Spatial Stream Council representative

MACKAYS TO PEKA PEKA

Using Trimble Connected Community

Will Newall, Survey Manager, MacKays to Peka Peka Alliance

Introduction

Mackays to Peka Peka (M2PP) is a new section of expressway currently being constructed on the Kapiti Coast. It runs from the northern side of Paekakariki up to Peka Peka, just north of Waikanae. This forms part of the Wellington Airport to Levin corridor, which is one of New Zealand Transport Agency's (NZTA) Roads of National Significance (RONS) projects.

The project is an 18km long expressway, consisting of 18 structures, an end to end cycleway, and a number of connections to local roads. More importantly, there is four million cubic metres of earth to move, in order to complete the project. Of that four million, there is over 800,000 cubic metres of peat to be dealt with. M2PP is being constructed by an Alliance consisting of Fletcher, Beca, Higgins and NZTA. As an alliance model, there is significant emphasis on the reduction of cost, increases in efficiency, and elevating safety performance. Due to the huge amount of material to move on M2PP, earthworks immediately became a focus for the alliance.

Earthworks and Survey

Being an 18km linear expressway project, using GNSS was an obvious choice for much of the survey duties. Goodmans, the earthworks contractor, has been a long-standing user of Trimble machine control. Consequently, they knew as much as the Alliance; that using GNSS-based machine control could prove to be a huge asset. However, traditional radio-based correction streams could provide coverage issues on such a long project. Having utilised internet-based corrections to great effect in the past for general survey work, cell coverage was tested along the entire length of the expressway. With virtually no black-spots, this appeared to be a viable method for delivery of corrections, for both machine control and the survey crews.

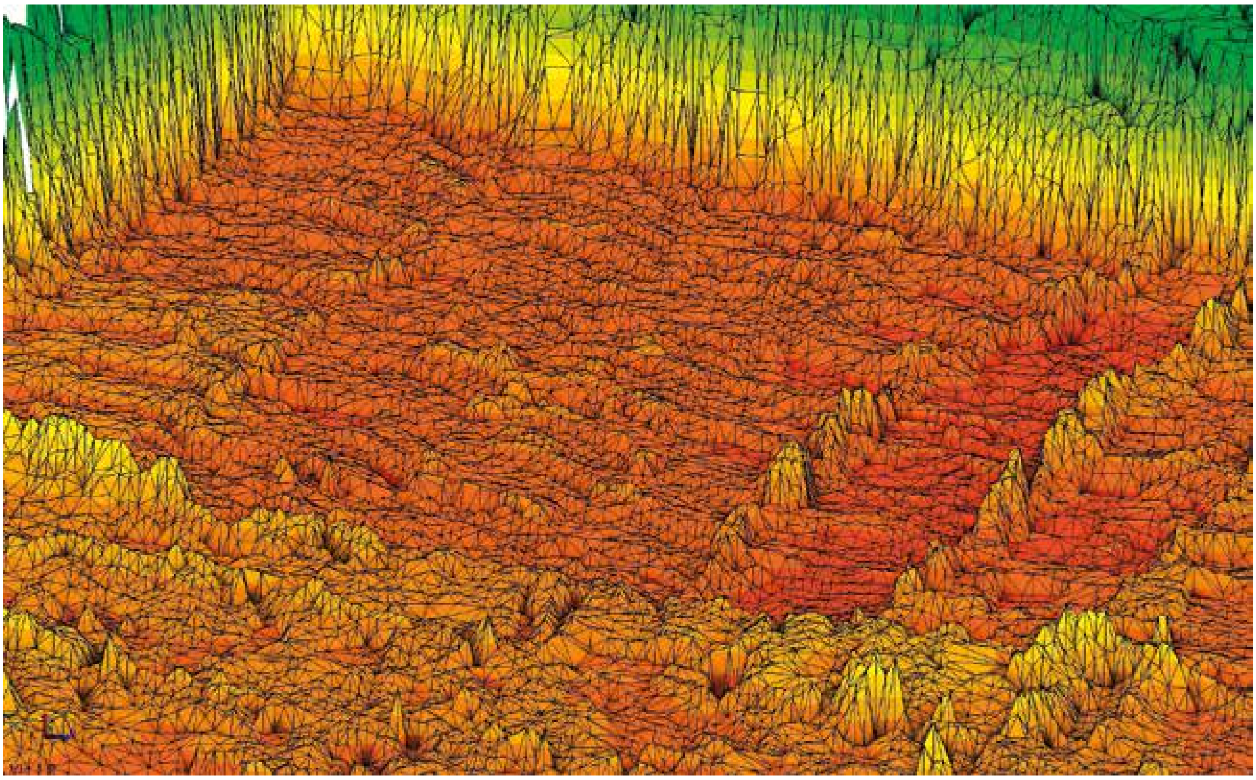
So, the decision was made to use GNSS-based machine control, with corrections provided over the internet. What was required was something to tie this together into a coherent system.

Trimble Connected Community

Trimble Connected Community (TCC) was introduced at this stage. In the simplest terms, this is an all-encompassing cloud-based system for running an entire survey and machine control fleet. All GNSS units effectively have a unique “log-in” to the system, and as such can pass data both to and from the cloud. This means that all units in the field have constant access to corrections, as long as they have cell coverage. From a cost perspective, adding a machine control-specific modem is relatively cheap. Therefore, older existing systems could be easily upgraded. At this point, options for base stations were examined. The alliance wanted full control over the base units, locations, and data. Therefore, using an external source for corrections was discounted. A network solution was also discounted due to the extra cost and complexity of running a large number of bases over a wide geographical area. Therefore, single base solutions were chosen. Particularly as the project had been divided into three 6km-long “zones” and three base stations were installed along the alignment. These were observed overnight with static data, and post-processed together to provide a tight network. This effectively gave each zone its own base. Due to the proximity of each base to its respective zone, the PPM error was reduced to a maximum of 5mm. This, complete with the standard specification of the Trimble survey equipment at 8mm and 15mm, provides an excellent backbone for survey infrastructure. A separate site calibration was completed for each zone. However, all combinations of base and calibration were tested to ensure consistency along the length of the project. As part of TCC, CMRx as a corrections format was chosen. This has proved to be extremely reliable, due to its compact nature. It has given the project very consistent and reliable results in the field. Survey marks observed with GNSS through TCC are regularly checked using digital levels to ensure this consistency continues.

What’s new?

Machine control using GNSS is nothing new. However, as mentioned previously, TCC allows data to flow both to and from the GNSS units in the field. This, complete with one other brand new addition, has proved invaluable. What separates this system from what has been used in the past, is the ability for the machine control to measure and record survey data as the machines go about their daily work. For example, M2PP has 14 excavators fitted with machine control. The system is configured such, that whenever the bucket of the excavator is retracting towards the cab (effectively digging) survey information is being recorded from the edge of the bucket. This data is then passed automatically to the Cloud. A surface of that data, using a number of different criteria to filter the data, can then be easily downloaded. Therefore, in the example shown below, the bottom, or lowest pass of the excavation can be obtained without the requirement of an actual surveyor on site.



3D Excavation v1

This methodology also works on the six bulldozers and three graders currently on site. These machines are setup to record survey data when the machine is moving forwards. Using a combination of these different machine types enables M2PP to automatically survey excavations, trimmed slopes, and long stretches of expressway subgrade. The surface density provides triangle nodes at roughly 300mm intervals. Therefore, the resulting surfaces provide very accurate representations, suitable for volumetric analysis, and completion of quality analysis and handover.

What does this mean for M2PP?

In this image, the bottom of the excavation is required for volume analysis.

Peat Excavation

The excavation is five metres deep, under approximately three metres of dirty water. Using normal survey methods, this would be a difficult survey to complete in an accurate and safe manner. Using machine control with TCC, the lowest part of the excavation was accurately surveyed without having to send a surveyor into an unsafe environment, even though the operator couldn't see through the water. This has therefore delivered on the Alliance requirements of efficiency and safety. Obviously this technology has had an immense impact on the project.

Data Transfer

As well as the measured data directly from the machine blades being a revelation, data transfer in general is now a far simpler, more easily managed affair. All of the survey controllers, predominantly Trimble TSC3 units, can pass data to and from TCC remotely. For example, when a design file is created in the office, the controllers on which the design is required can be easily chosen, and the file synchronised quickly to TCC, tagged for those units to download. The surveyor in the field then simply synchronises their unit and the data is downloaded automatically for them in the correct file location and format. In a similar way, observed data in the field can be synchronised immediately back to the office for analysis. This has provided M2PP with the ability to manage data in a far more efficient manner. As well as managing who is using what data, it eliminates the always "forgotten" designs that are needed when going out to the field. Previously, a "forgotten" design may have led to a 25km round trip to deliver it to site on a pen drive. Now it only takes a couple of minutes to synchronise. In a similar way, design files can be quickly sent out to machine control enabled plant, through TCC. If a particular machine is missing a file it can be sent out through TCC and automatically downloaded to the machine control box in a matter of minutes. What makes this even better is superseded or revised design files can be remotely deleted from the machines, ensuring the operators are only using the correct design information.

Benefits to the Project

Minimal Setout

Stakes are set out to show the extent of earthworks, as a first stage in a new work area. Once this is done, machine control effectively takes over and no more stakes are required. The image on the next page shows a typical work zone on M2PP.

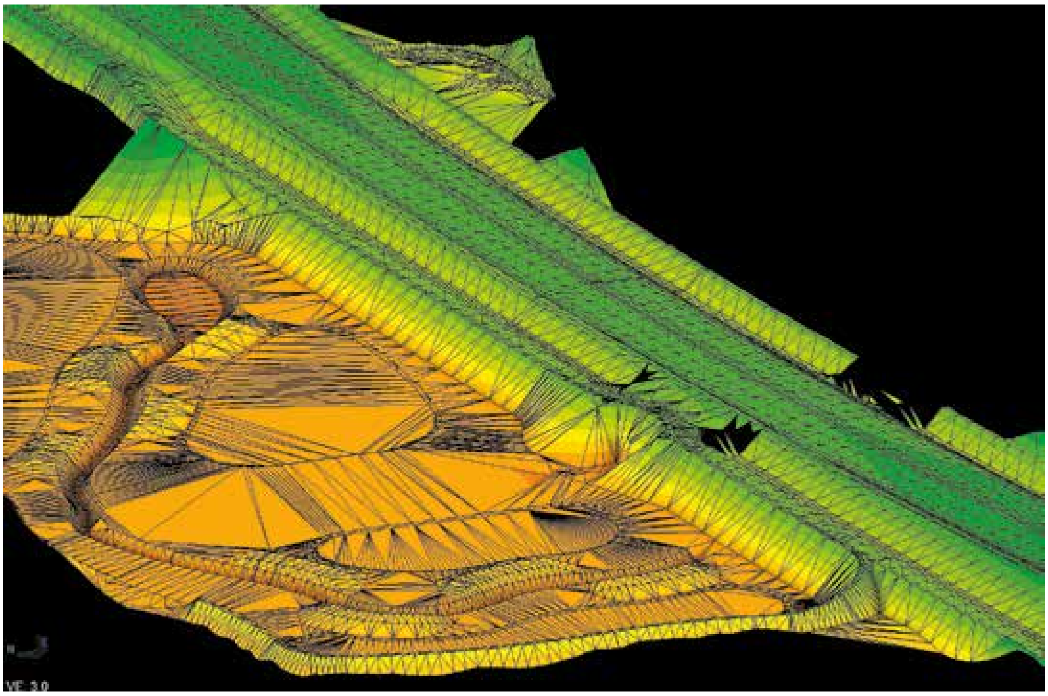
The design cross-section of the expressway is often reasonably complex, with swales and wetlands as well as the alignment itself. The wetland in the image above was constructed accurately without a single stake.

Reduction in re-work/Increase in efficiency

The machine operators are working far more efficiently than at any time in the past. They don't need to wait for stakes and they don't knock any stakes out as there are none. The operator no longer needs to step out of the cab, look at the stakes and think about how they are going to complete the job. They effectively just get on with it. This simple fact has led to an increase in productivity of over an hour a day, across every machine. In addition to this, the 3D design is on the machine control all of the time. Therefore, the design can be constructed far more efficiently.

Increased Safety

As with the previously shown image of the excavator digging in dirty water, safety has been hugely improved on M2PP. There is no need to send surveyors into those potentially dangerous areas. It has also reduced the amount of potential danger on the alignment and batters, as the machines measure much of the surface, eliminating the requirement for the surveyors to be there.



3D Design v1

Data and data transfer

As illustrated, the ability for machines to measure themselves has been a revelation. That fact, complete with the ease and speed of transferring and managing data, has played a huge part in increasing efficiencies on M2PP. As an addition to this, base stations and machine control boxes can be dialled into remotely, to change settings or trouble-shoot if required. It is also possible to transmit multiple base station streams from the same bases, providing correction formats such as RTCMv3 for other equipment brands.

Clearer claims process

All parties relevant to earthworks volumes agreed at the beginning of the project that measured machine control data was the best data format to agree volume claims. Therefore, there have been no disagreements on M2PP regarding the volume of material that has been excavated.

Cost Saving

The efficiencies gained on M2PP have obviously provided significant cost savings with estimated savings at over $8 million. That figure doesn't include the effective elimination of rework, or the potential savings from safety incidents

Conclusion

It is worth stating that utilising a system such as TCC does not eliminate the requirement for survey professionals. On the contrary, it requires surveyors with skill and experience to operate the system effectively. What is does mean is the construction surveyors core roles are changing from "bashing stakes" to managing 3D data. It illustrates how the surveyor's role is always evolving as technologies develop. However, those core skills that all surveyors need are required just as much now as they ever have been.

A Truly International Event for Christchurch

FIG WORKING WEEK 2016

With a theme of 'Recovery from Disaster', Christchurch is an ideal venue for an international event where delegates can see a city in action as it recovers and rebuilds after a sequence of earthquakes. In May this year, up to a 1000 delegates will be arriving in Christchurch to attend the International Federation of Surveyors (FIG) Working Week being co-hosted with the New Zealand Institute of Surveyors (NZIS).

Iconic Christchurch cathedral damaged by earthquakes

FIG was formed in Paris in 1878 and organises an international event every year; this year is New Zealand's turn with NZIS jointly hosting the event in Addington.

"This is only the fourth time since its inception that FIG has held an international event of this size in the Southern Hemisphere" says Simon Ironside, NZIS's Co-Conference Director. "We're very excited to be co-hosts and believe the city's experience – and how surveying and spatial professionals proved to be key actors in making an important contribution to improve, simplify and to shorten the disaster mitigation, rehabilitation and reconstruction phase – will be relevant for any city in a similar situation."

The working weeks are a chance for not only our members, but all surveying and spatial professionals within many disciplines to come together to hear about the latest developments and to network with their peers. It brings together a diverse range of scientists, policy- and decision-makers, students, and stakeholders. These disciplines include land surveying, engineering, positioning and measurement, hydrography, remote sensing, photogrammetry, spatial information, cartography, construction and real estate.

The main aim of the event is to allow delegates to develop and strengthen their skills, knowledge base and sector network. It also offers an unrivaled opportunity to discover how others are doing things and for the community to share knowledge and experiences. The Working Week also allows the ten technical FIG Commissions to meet and discuss issues and topics.

The tentative programme has been released and it is shaping up to be a brilliant week says Mr Ironside. "We have received around 400 papers of which 60 have undergone the double-blinded peer-review process and been graded on relevance, originality, breadth, completeness and clarity."

The programme will be underpinned by invited high-level presentations in three plenary sessions covering topics within the overall theme 'Recovery from Disaster'. "We have nine powerful keynote speakers, including the Minister of Canterbury Recovery, the Hon. Gerry Brownlee, who will set the stage on knowledge sharing and cover best practices, trends and case studies."

Registration is open for the working week and the organisers are expecting a truly international gathering. For added interest, a special New Zealand rugby experience is offered to the first 200 registrations to attend the 'Reds' versus 'Crusaders' rugby game and a special international rate has been negotiated with Air NZ for international travellers.

For more details about the FIG 2016 Working Week visit *http://www.fig.net/fig2016/*

FIG | FIG Working Week Christchurch New Zealand 2–6 May 2016 | NZIS

Recovery from disaster

GIS – A TOOL FOR SURVEYORS

Survey & GIS Integration

Jacob Hechter, GIS Manager, BTW Company

Introduction

More spatial information than ever before is now available to New Zealand companies. Geographic Information Systems (GIS) provides a means to view, query and analyse spatial data using computerised maps. In the past few years, improvements in web-enabled GIS viewers have allowed for mapping to be extended to non-GIS specialists to assist with decision making and visualisation. BTW Company is a case study on how GIS integration assists with data management and allows users to make informed decisions using digital maps.

BTW Company in New Plymouth is a company employing 60 people from various disciplines. We specialise in Land Surveying, Engineering, Planning, Environmental Science and Land Access Services. The company also employs GIS analysts and developers charged with creating, managing and serving spatial information. Because of the multi-disciplinary nature of the company, multiple departments will be involved on an individual job. This creates a unique set of challenges. When multiple departments access job data, pertinent information can easily be lost or duplicated when stored and referenced in a decentralised file structure. This has partially been solved by strict adherence to document management. However, we have found that a large portion of data created is spatial in nature.

Because of the spatial nature of much of the data created at BTW Company, the GIS Department acts as the 'glue' between departments; storing, and managing data which can then be served back to the company in the form of maps – both digital and printed.

Managing data through maps allows for several advantages. Mapping data allows the user to place data in perspective within the broader environment. For example, viewing the location of a survey point in relation to a topographic overlay or aerial photo allows the user to make better decisions regarding access if the map shows the area to be steep or overgrown. Managing data through maps also creates a rich environment for querying information. Attribute data and linked tables are embedded in mapped features providing a wealth of information. For example, locations of previous jobs can be symbolised in a web map. When the user clicks on the point, attached information is shown, such as job history, client contact details and the nature of work undertaken.

BTW GIS Structure

BTW Company employs a GIS department, composed of two GIS Analysts and one GIS Developer. The GIS Analysts are responsible for creating and maintaining spatial data. Spatial data, composed of points, lines and polygons, is derived from spreadsheets, aerial photography and anecdotal evidence. Spatial data can also be sourced from outside parties, such as District and Regional Councils and Government Agencies. The GIS developer is responsible for creating and maintaining infrastructure used for serving spatial data, administering data access across the internal network and the internet and configuring web viewer user interfaces.

The BTW Company GIS Network consists mainly of inter-connected components. In addition to providing data for printed maps, the GIS network draws from various Sturctured Query Language (SQL) databases and external web services to provide a comprehensive set of spatial data. Government agencies such as Land Information New Zealand (LINZ), QEII Trust, LandCare Research and Census Bureau regularly produce data which can be mapped, layered and integrated into meaningful maps.

All employees access GIS data using an internal web viewer called "MapDog." MapDog is a JavaScript-based web viewer configured from the publicly available Configurable Map Viewer (CMV). Users can turn layers on and off, query features, search for features, draw and print PDFs. This functionality has enabled much of the staff to do mapping tasks previously done by trained GIS Analysts. MapDog contains spatial data from all of the different departments within BTW Company – Cadastral Surveying, Planning, Energy Surveying and Environmental Science. Layers can be turned on and off depending on the task at hand. Easily accessible spatial information allows users to explore the relationships between different datasets. MapDog leverages map services created using ESRI ArcGIS Server and Desktop GIS software. A map service provides web access to the content of geographic datasets. GIS web viewers are composed of assembled map services. Figure 1 below shows the architecture of the MapDog viewer.

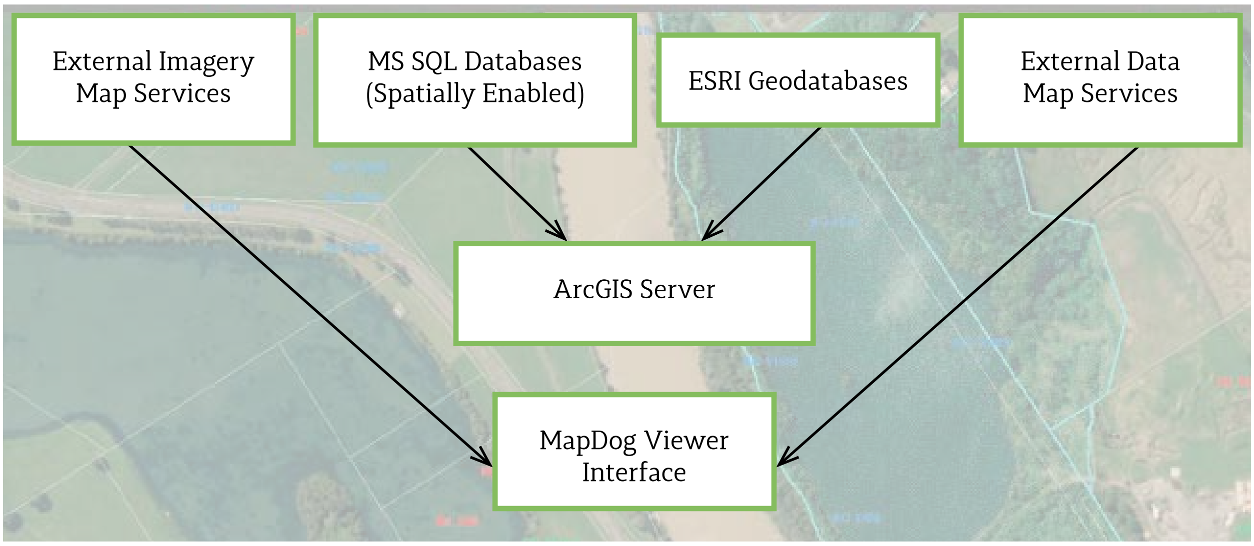


Figure 1: MapDog architecture showing the integration of different types of spatial data.

MapDog operates as a central hub for spatial data. In a company the size of BTW Company, there is potential for data to be duplicated. By centralising spatial data, users can be confident that they are viewing and querying the most up-to-date information. All GIS work is written to the live central database. Good decision making requires that there is no ambiguity regarding currency or accuracy of data. Figure 2 below shows the MapDog user interface.

Figure 2: MapDog User Interface showing Layers pane, Cadastral survey plans and DOC conservation areas.

MapDog as a Surveying Tool

Since its release, the Cadastral Surveying department has become dependent on the MapDog viewer for a variety of tasks. Pricing, calculating and undertaking surveying jobs is dependent on the conditions in the field – both current and historical. The GIS department has worked hard to make sure that the Cadastral Surveying team has quick access to critical information to aid in decision-making for all parts of the surveying process.

Locations of past jobs provide the Cadastral Surveying team with vital information on where work has been done in the past. Job locations are symbolised as red and green points (red for closed/inactive jobs, green for open/active jobs). By clicking on the points, the user can see when the job was completed, which team member was in charge of the job and the nature of the work done. Pre-job research time is reduced because Surveyors can pinpoint exactly which old job is most pertinent to new work required; allowing for the re-use of pre-established survey control. Landowners and neighbours can also be determined by accessing the old job files as well as any hazards or constraints on the area (e.g. slippery, steep slopes).

Cadastral data, updated weekly through SQL scripts, has been sourced from LINZ. This data includes parcel boundaries, boundary marks, addresses, road alignment, easements and landowner details. Up-to-date cadastral data is vital for planning and executing cadastral surveying jobs. Within the MapDog application, users can search cadastral data based on a variety of attributes and criteria. Once the required data is located, the user can extract data from an area of interest to use in CAD software for creating scheme plans.

In recent months, local councils have made water reticulation data available through external map services. MapDog is able to consume and display external map services directly. Users are able to query individual reticulation features. Attributes attached to each feature are produced directly by the council engineers and GIS professionals, so accuracy is assured. This is a great improvement. Surveyors can identify and locate water supply, stormwater and sewer infrastructure before accessing work sites. Figure 3 below shows an overlay of cadastral data and New Plymouth District Council (NPDC) water reticulation data. Water supply is displayed in blue, stormwater in green and wastewater in red.

Figure 3: Cadastral Boundaries and NPDC water reticulation data.

The MapDog web viewer also allows Surveyors to perform tasks that used to be assigned to the GIS team. Printing simple maps of areas of interest with overlaid data and text and line annotation is easily done using custom printing templates. Simple GIS maps can be produced and distributed to clients directly from the MapDog viewer. MapDog has enabled our cadastral surveying team to more easily access data which can assist in researching and completing and survey jobs by granting easy access to spatial information and simple map production.

What's Next

BTW Company's capacity for serving spatial data is always growing. As the company expands and the work streams become more diverse, different types of data can be added to the MapDog webviewer. In the past few months BTW Company has become involved in capturing imagery from Unmanned Aerial Vehicles (UAV). Imagery is then projected and ortho-rectified. We are now able to create a patchwork of imagery collected from our UAV and provide current, high resolution imagery overlays which give a better depiction of areas of interest.

Conclusion

GIS web viewer technology has become tightly integrated within the workflows of BTW Company. The MapDog web viewer has proven successful as a central hub of information and a powerful tool for querying data and map production. When packaged and presented in intuitive and simple user interfaces, GIS technology presents a useful tool for map visualisation and decision making.

With Garth Falloon at UN Base, Eritrea

INTERNATIONAL BOUNDARY MAKING

The crème de la crème of cadastral surveying

Rasmus Thirup Beck, freelance journalist, Copenhagen

First published January 2014 in the Danish Surveyors' Organization's magazine *Landinspektøren*

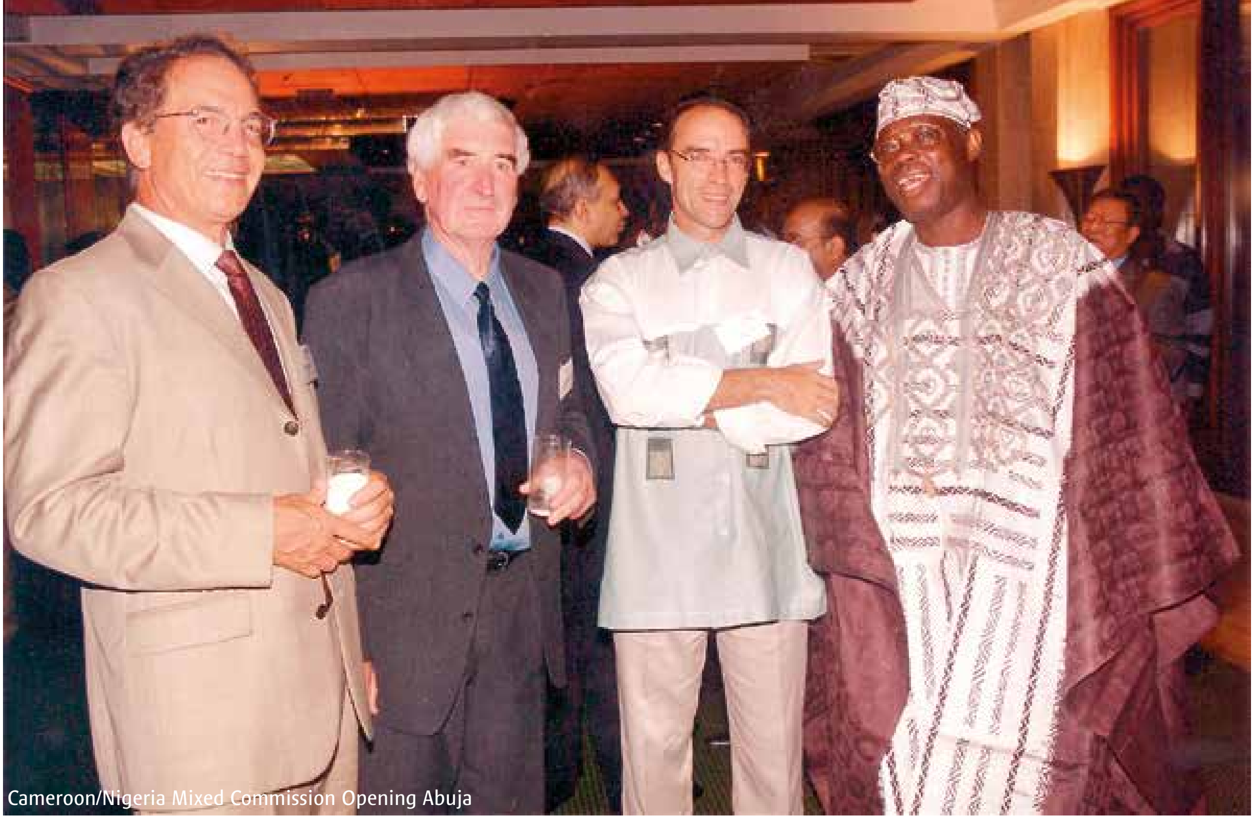
It is extraordinarily politically sensitive – to the degree that you almost need the skills of a diplomat. There must not be a shadow of doubt in your surveys and assessments, as they may mean the difference between war and peace – and the reallocation of assets worth billions. And don't forget about the land mines! Meet New Zealander Bill Robertson, one of the world's most experienced surveyors in the establishment of international boundaries.

It all began somewhat by chance. Impartial surveyors were required to mark the Iraq-Kuwait boundary following the First Gulf War of 1990–1991. The list of candidates was narrowed down to those from countries that had remained neutral during the conflict, of which New Zealand was one. Two qualified surveyors were then to be found from this small selection of countries, and William "Bill" Robertson was chosen. As New Zealand's Surveyor-General he was not only highly regarded, his specialty was cadastral surveying, including the politically charged task of drawing electorate boundaries. The latter played no insignificant role — few things are more political than drawing national boundaries that have recently been the subject of conflict.

"I was used to having politicians hanging over my shoulder and scrutinising my work. During the months when new boundaries are drawn, it is as if every MP knows you", says the 77-year old surveyor over an echoing phone line more than 17,000 kilometres away.

And it is particularly the meticulous monitoring of those involved, but also a whole range of other factors that leads to Bill Robertson – he prefers to be called Bill – calling international boundary-making the 'crème de la crème' of cadastral surveying:

"It is very telling that Iraq hired international experts to scrutinise our surveys. And had they found a single mistake, they could have discredited the rest. You need to be exceptionally careful. Of course, this applies to regular


Cameroon/Nigeria Mixed Commission Opening Abuja

surveying work as well, however, the consequences of not being careful are much more serious in this field", he says and explains further:

"Even if survey maps are not impossible to read for laymen or even other professionals, the boundaries on them represent some very important rights and entitlements. A domestic property survey, for example, is about title, and the further up you go, the more important the rights and entitlements become. When we then get to national boundaries, there are a whole range of rights involved – extremely important rights that affect people's finances, standard of living and even security. That's why the drawing of international boundaries is at the top of the cadastral surveying pyramid."

Delimitation and demarcation

The Kuwait-Iraq survey established Bill Robertson internationally, and institutions such as the United Nations and the World Bank now knew who he was. He had just completed his eight years as the Surveyor-General of New Zealand, and his professional life was so flexible that he was able to accept several of the rare opportunities to survey disputed international borders.

His next assignment came with his appointment as a special consultant to the Eritrea-Ethiopia Boundary Commission, which was active from 2001 to 2007. He was subsequently senior consultant to the so-called Cameroon-Nigeria Mixed Commission, which is still in progress. In 2009 he was appointed as an independent expert to the Sudan Tribunal which was tasked with reviewing a previous survey of the then internal Abyei boundary between what is today the two independent states of North [sic] Sudan and South Sudan. And finally he has just recently finished work re-surveying the Kuwait-Saudi Arabia boundary – one which has not been the subject of an outright conflict.

In other words, he has a wealth of experience surveying boundaries, something he has written about and given talks on to the International Federation of Surveyors (FIG) and is happy to share with *Landinspektøren* magazine.

The first thing to remember is that you work with boundaries in two ways: delimination [sic], which means to determine boundaries on a map, and demarcation, which is the concrete marking of boundaries in the field. What you work on in a particular commission is determined by the treaty usually issued by the International Court of Justice, the UN's judicial branch, following negotiation between the two parties.

The Kuwait-Iraq work was thus defined by its name: "The Iraq/Kuwait Boundary Demarcation Commission", meaning that the boundary was to be demarcated. The same applied to Cameroon-Nigeria, while both the Eritrea-Ethiopia Commission and the Sudan tribunal dictated delimination [sic].The latter often involves interpreting historical maps and documents and then drawing the most reasonable boundary line on a map. The assessment you need to make here is not what is fair, but what historical information is the most credible:

"In many ways the surveyors have to undertake what resembles detective or research work. We have to assess the historical material at hand and use it to determine the fairest delimitation."

This is no easy task, as there are huge differences between historical maps, and the definitions found in historical documents are often very vague. Eritrea, for example, thought that the border with Ethiopia should be where the Kunama tribal land ended, and in Sudan they agreed that the border should follow the 1903 Dinka tribal land boundary.

"So the question is simply: where was it?" Robertson says.

In the case of Eritrea-Ethiopia the commission chose a new approach. Over three sessions they asked the two parties to send in their arguments for where they thought the boundary should be. First an initial submission, then a response to the other party's submission and then a concluding response.

"This process undoubtedly took much longer to complete, but I have to say that it was an excellent process and it made it much easier to implement what had been agreed. Both parties had ownership. There were disputes concerning several hundred metres, but in most cases they were nevertheless able to find compromises and reach a decision in the field", Robertson says.

In contrast, the three other disputed borders were characterised by entrenched attitudes and very little desire to compromise:

"The surveyor normally works in an environment where the two parties to the survey are in agreement, or at least do not interfere. In this case (where the survey is preceded by a dispute – Editor) the surveyor needs to adapt according to the parties' requirements, needs and level of involvement."

For example, you need to be prepared to be accused of bias and accept observers that monitor your work like they did in the case of Eritrea-Ethiopia, and that your work will be thoroughly checked, as in the example of Iraq-Kuwait.

Overall, you need to be very aware of your conduct towards the two parties and their representatives.

"This is also important when you are a general surveyor meeting with a client, but in these cases things such as propriety, appearance and formal address become even more important. As a general rule, personal comments are completely inappropriate. You have to be professional. In normal business dealings there is room for a joke, for example, but here you must simply refrain – in particular if you have a wacky Kiwi sense of humour", he says and laughs.

Danger on the ground

If the boundary is to be marked on the ground, the rules you need to follow are very strict, but you can still encounter practical problems in the field. Rivers might have been renamed, points of reference might have disappeared or have been built over, and geographical information such as tidal boundaries may be so ambiguous that you need to find other ways.

"The challenge with working with demarcation lies in observing the extremely strict information of the delimitation – even if it contains obvious contradictions. You have no authority to change it, even if it would be the fairest solution", he explains.

In the Kuwait-Iraq case, the delimination [sic] stemmed from old, vague maps of the Ottoman Empire and the Sultanate of Kuwait which had been formalised in the Treaty of Lausanne following World War 1. The delimination [sic] text, for example, merely described a boundary running through the Wadi Al-Batin depression to a sign approximately one mile south of the village of Safwan and then continuing in a straight line to where the tidal flows of the Khors meet in the Persian Gulf.

"We then had to determine the lowest point of the depression, which became the boundary. We had to find the sign, or someone who could tell us where the sign had been. And then we had to determine where the Khor tidal flows — which today are a mystery — might be."

They were actually successful in finding the sign, but not the mysterious tidal flows and had to consult with the two parties via the International Court of Justice (ICT), and through diplomatic correspondence were able to identify a point that both parties could accept.

When you find yourself in the field in the Middle East or Africa, your own personal safety also becomes a chal-


MI8 Helicopter

With Vince Belgrave, Kenyan Regiment Base, Afambo, Eritrea

lenge. Both the Eritrea-Ethiopia border and, in particular, the Kuwait-Iraq border, were littered with thousands of land mines and unexploded bombs. "This is, of course, an important factor, but I have been lucky to work closely with the exceptionally competent UN mine clearance staff, who made us feel safe", he says.

There are other dangers such as uncontrolled guerrilla troops and aggressive hippos when crossing rivers in boats. "This makes things interesting, and it all becomes a bit of an experience", says Bill Robertson humbly.

Peacemaker

He is equally humble when it comes to the results of his surveys. He writes in his scientific article for the FIG that all four cases have resulted in significant trust-building, meaning that the two parties involved felt more secure as neighbours following the delimination [sic] or demarcation.

"I don't like drawing attention to myself. The work we undertake is huge and I am but a small part of it. But I have to say, it is very rewarding work", he says simply.

He also readily admits that there are few surveyors worldwide who, like him, have been involved in the drawing of international boundaries that have been the subject of conflict and which are often settled after prolonged disputes. He also wants to tell us about one of his best experiences in the field — one of many. It took place at the end of the work marking the Kuwait-Iraq boundary. Everyone involved had gathered for a farewell dinner, when suddenly one of the most powerful men in the world, the then Secretary General of the UN, Boutros Boutros-Ghali, appeared and shook everyone's hand, including Robertson's.

"It was great. He also held a short speech in which he described our surveying work as perfect and praised us for completing it on time and within budget. In reality, it might have been the last two things he was most happy about, but that's something we'll never know", he says and laughs.

Acknowledgements

I wish to acknowledge the very good work done by many New Zealand surveyors, cartographers and photogrammetrists on international boundary work over the last 25 years on all the boundaries referred to in this interview. Vince Belgrave has provided good references to this in his article on the Iraq-Kuwait Boundary Maintenance Project in the June 2015 issue of this Journal. For the Eritrea/Ethiopia boundary project Vince was Chief Surveyor, Garth Falloon Assistant Chief Surveyor, with other field work by Jeremy Simonsen and Josie Fitzgerald. Vince Belgrave was also a senior consultant to the Sudan Arbitration Tribunal, Project Manager for the Kuwait/Saudi Arabia boundary project and also provided training to the field teams on the Cameroon/Nigeria Boundary.

This article was first published in the Danish Surveyors' Organization's magazine Landinspektøren *and written by Rasmus Thirup Beck, freelance journalist, Copenhagen.*

This interview has been undertaken by long distance telephone and there is some loss through the double translation. For the precise meaning of technical terms and detail of techniques the reader is refereed to FIG Publication 59, International Boundary Making FIG Commission 1, Professional Standards and Practice, Editor Haim Sebro, Copenhagen, Denmark, December. 2013.

BILL ROBERTSON – A BRIEF BIOGRAPHY

In addition to his involvement in five international boundary surveying projects (Iraq-Kuwait, Eritrea-Ethiopia, Cameroon-Nigeria, Sudan-South Sudan and Kuwait-Saudi Arabia) and his ongoing work as an independent consultant for the World Bank, the UN, FAO and NZAID, the New Zealand surveyor William 'Bill' Robertson is a man with an extensive CV.

First of all, he has served as both the Director General and Surveyor-General at Land Information New Zealand. He is also a former President of the New Zealand Planning Institute and the Commonwealth Association of Planners and is today a fellow at the New Zealand Institute of Surveyors.

He holds an honorary doctorate in surveying from the University of Melbourne and is also an adjunct professor at Otago University and the University of Newcastle. He originally studied urban planning at Auckland University and also has a master's degree in public policy from Victoria University, Wellington.

He has sat on numerous boards and is today a board member at Terralink, New Zealand's largest property and land information company.

And finally, he can also boast of being an Officer of the New Zealand Order of Merit for his contribution to surveying, and he has had a mountain in Antarctica named after him for his contribution toward surveying and mapping in Antarctica.

Vehicle Speed and Curve Risk Modelling for Road Safety

Dale Harris, Senior Consultant, Interpret Geospatial Solutions

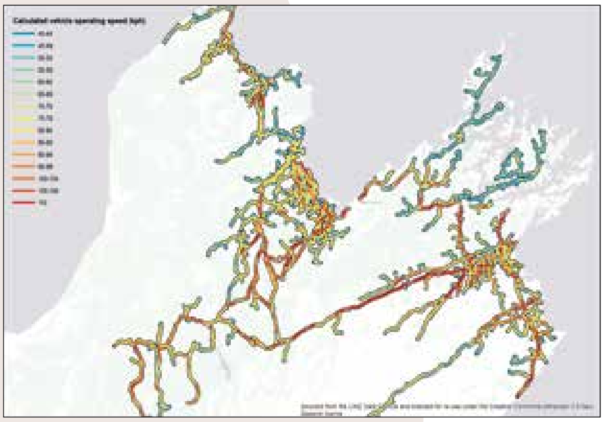
ONGOING IMPROVEMENTS TO NEW ZEALAND'S ROADS AND VEHICLE FLEETS HAS SEEN A GRADUAL REDUCTION IN THE NUMBER OF FATAL AND SERIOUS ROAD CRASHES OVER THE LAST 20 TO 30 YEARS.

A number of geospatial tools are available to help road managers identify high risk roads and prioritise safety projects. These tools are usually reactive in nature – relying on crash history data to highlight blackspots and crash trends. As the most dangerous intersections and hazardous corridors are identified and improved, there is an increasing role for smart spatial applications to identify the next problem area that may not be immediately apparent from looking at crash histories. A particularly challenging area is low volume rural roads, where crashes tend to be random and sporadic in nature.

Investment in road safety programmes is a high priority for the New Zealand government. The focus for this investment is delivering the best 'bang-for-buck' – identifying and prioritising road safety projects that will deliver greatest value in terms of the lives saved and injuries prevented.

Working with Interpret Geospatial Solutions, the New Zealand Transport Agency sought to develop a spatial road safety risk assessment methodology specifically targeting low volume rural roads. This methodology was developed as part of a 'safe system signature project', as identified in the government's Safer Journeys Action Plan 2013-2015. Signature projects are multi-agency pilot projects that provide a platform for developing or trialling innovative road safety approaches. This particular project focused on the Eastern Bay of Plenty region (Whakatane, Kawerau and Opotiki districts).

The New Zealand Transport Agency had two key requirements for the development of the methodology. First, it had to be developed using



Screenshot of the Top of the South showing vehicle operating speeds

the existing available knowledge of the road network (including spatial data and attributes). Second, it had to be cost-effective so that could readily be applied across a large area.

Calculating curve risk using road geometry

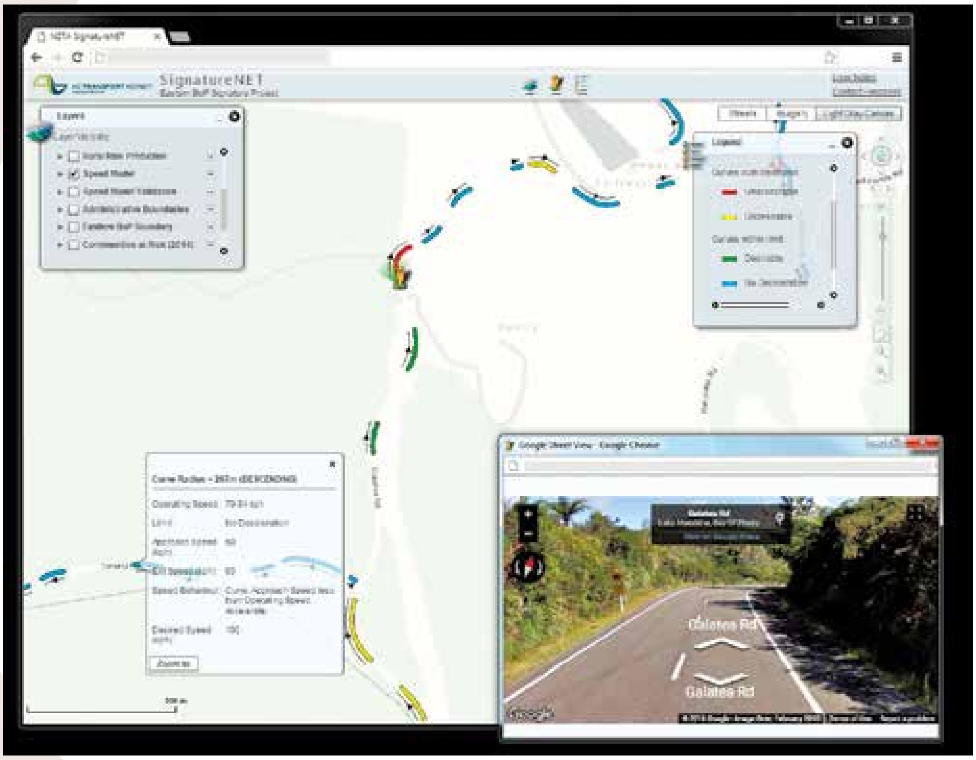
The Eastern Bay of Plenty is characterised by a relatively low volume road network. Due to the remote nature of these roads, serious crashes tend to occur in locations where there is no known history of high-severity crashes. Across the region, it was also found that approximately 58% of fatal and serious crashes occurred on curves.

The geospatial risk prediction methodology developed for the Eastern Bay of Plenty is based on an engineering methodology (Austroads) that models acceleration on straights and deceleration on curves along a rural road corridor. By comparing approach speeds at curves with the radius (or tightness) of the curve, it is then possible to determine the risk that a driver may lose control while cornering. The methodology can also be used to determine vehicle operating speeds (85th percentile speed) at any particular point on a road network.

This model is designed to be applied manually on relatively short segments of road (ie 10- 25km of network). It requires a traffic engineer to split a road corridor into a series of straights (with known lengths) and curves (with known radii). The engineer would then follow a complicated methodology to identify desired speeds (the maximum speed a driver would adapt to given the general terrain and curvature of the road) and operating speed sections (sections of road with curves of a similar radius). Each element of the road, straight or curve, is then assessed to determine start and end operating speeds using vehicle acceleration or deceleration models.

Curves are categorised by whether the approach speed is appropriate given its radius. Curves where drivers only need slight deceleration are considered "desirable" or within context. Curves where substantial deceleration is required are classified as either "undesirable" (moderate risk) or "unacceptable" (high risk).

With approximately 1500km of rural road, manually implementing the Austroads model across the Eastern Bay of Plenty roads would be both time-consuming and cost-prohibitive. As the inputs to the speed model are available in a spatial format, the model was automated using a geospatial methodology.



Screenshot of the SignatureNET webviewer for performing desktop reviews of curve hazards

Creating a spatial risk assessment methodology

Using existing geospatial analysis techniques and a high quality road centreline, a number of novel geospatial workflows were developed. These included ArcGIS models and Python scripts to identify curves, calculate curve radius, predict vehicle operating speeds along road corridors, and assess curve risk using approach speeds and radius.

To define curves and straights on the centreline, each road corridor was divided into 10m sections and curve radius calculated and averaged over a 30m arc using linear referencing tools. Contiguous sections where the radius is less than 500m and the curve direction is the same were identified as discrete curves.

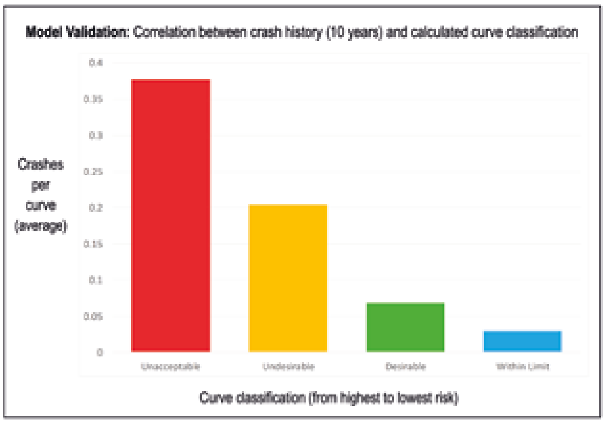
Maximum speeds for particular road sections were modelled by combining the overall terrain and curvature of the road – ranging from flat and straight (110kph) to mountainous and tortuous (75kph). The NZ School of Surveying 15m digital elevation model was used to model terrain variability (ie grade) over long sections of road.

Start speeds for each road was determined by analysing the topology of the road network. Start points that were dead-ends or required turning at an intersection were assigned a low speed, whereas rural roads that were a continuation of an urban road (ie 70kph or less) were assigned an initial speed reflecting the adjoining urban speed limit.

Finally, operating speeds and curve risk was calculated by running a Python script that sequentially evaluated each element of the road, curve or straight, to model vehicle speeds and driver behaviour.

The output curve dataset identified almost 7000 curves across the region. The potential risk of each curve was determined in both directions. A secondary output of the methodology was an operating speed dataset, with speeds also calculated in both directions up to a 10m resolution.

To validate the methodology, ten years of crash data was compared against the location of high risk curves. It was found that two thirds (67%) of loss-of-control crashes occurred on 20% of curves classified as unacceptable or undesirable in at least one direction. This finding suggests that by targeting a small percentage of high risk curves



Results from Eastern Bay of Plenty project. While only 20% of rural curves were classified unacceptable (red) or undesirable (yellow) curves, they accounted for 67% of all loss-of-control crashes between 2003 and 2014.

for further investigation and intervention, local authorities potentially reduce the likelihood of further road crashes in high risk locations.

The final deliverable was an interactive webmap "SignatureNET" that displayed the results of the curve assessment alongside contextual data including administrative boundaries, crash locations and census statistics. The map included Google Street View functionality to allow users to identify site-specific issues and formulate potential intervention responses at a desktop-level.

Applications and future opportunities

Potential applications of the methodology for improving road safety outcomes are numerous. Following the initial Eastern Bay of Plenty project, the methodology was rolled out across the Top of the South (Marlborough, Tasman and Nelson) and the state highway network. The Waikato region is currently being assessed and the methodology is being piloted in New South Wales, Australia.

In addition to being a network-wide screening tool for high risk curves, the operating speed model outputs are also being used for reviewing speed limits. Reducing speed limits is an effective means of reducing the frequency and severity of crashes, however road controlling authorities need to demonstrate that a speed reduction will deliver significant road safety benefits. They also need to determine whether the new limit will be acceptable to the public, for example on roads where operating speeds are already constrained by the terrain. The new methodology enables these agencies to estimate before-and-after operating speeds. When combined with other data, such as traffic volumes, roading agencies can then also estimate potential fatal and serious injury reductions and social costs savings.

Other applications that are currently being investigated include using the methodology to improve corner advisory speed signage and to help roading contractors prioritise skid resistance improvements.

The success of this new methodology has been recognised by winning awards across the road safety, traffic engineering and spatial fields, including the 2015 IPENZ 3M Traffic Safety Innovation Award and the 2015 Supreme Award at the NZ Spatial Excellence Awards.

More information on this project can be accessed here: *http://goo.gl/sz9KQT*

For further information, contact Dale:
Dale Harris
Interpret Geospatial Solutions
03 367 9071
dale.harris@interpret.co.nz

Archie Bogle's brothers honoured in Waipukurau

Compiled by Jan Lawrence, NZIS

Three brothers of the famous and well known surveyor, Archie Bogle have been honoured by having a street named after them in Waipukurau, central Hawkes Bay. Archie was considered to be one of the most widely known and best respected surveyors of his day.

Three of Archie's younger brothers, George, Gilbert and Gordon served in the WW1 armies of New Zealand, Canada and Australia and all three were killed in successive autumns from 1915 to 1917. Archie also served during WWI as a Lieutenant in the New Zealand Expeditionary Force and was a Captain of New Zealand Engineers in the Pacific (mainly Tonga) during WWII.

Their father, James Bogle was the train station master in Waipukurau for 36 years, helping build the railway line between Waipukurau and Napier. To honour the brothers, the street named 'Railway Esplanade' was renamed 'Bogle Brothers Esplanade' on Armistice Day last November.

Archibald Hugh Bogle CBE, FNZIS, or Archie, is a well-known character of the New Zealand survey scene. As a member of NZIS he held all the offices of the institute including editorship of the NZ Surveyor Journal for 38 years and Presidency twice from 1931–33 and 1955–57. Archie also gained the highest NZIS award, the Fulton Medallion (Class A1) for outstanding service to the Institute and his profession. The Bogle Award was also established in Archie's honour for the benefit of promising young surveyors. He was made a Fellow of the Institute in 1948 and in 1959 he received a C.B.E. for his outstanding services to the profession and country.

The Bogle family – Archie standing between his parents

Archie Bogle (right) with a fellow officer in the Field Survey Battalion of the British Expeditionary Force, France 1917

His association with surveying extended over 70 years starting in 1900 when he joined the Department of Lands & Survey as a draughting cadet. He later transferred to Wellington as a Survey Cadet and completed much of his cadetship doing bush work in the Whanganui–Taihape area before establishing himself in private practices.

NZIS published Archie's book 'Links in the chain, Field Surveying in Early New Zealand' in 1975. He wrote the book recording his experiences as a surveyor from youth to middle age about three years before his death in 1972 at the age of 90.

NZIS commissioned a painting of Archie in 1965 from iconic NZ artist Peter McIntyre. The painting was on display at the Otago Survey School for many years until it was returned to National Office in 2011.

References

Bogle, A.H. (1975): *Links in the Chain, Field Surveying in Early NZ*

Hunt, M. (Napier Mail 11/11/2015): *Four Brothers went to war, one returned*

Images all scanned from: Bogle, A.H. (1975): *Links in the Chain, Field Surveying in Early NZ*

Archie Bogle on leave in London during World War I


Our business meetings…
…aren't like meetings in other countries. Relationships matter more than long emails and formal committees. Because of our unique way of doing business you need a training company that teaches your team skills tailored to the Kiwi business psyche.
When you're looking to significantly boost the performance of your sales and marketing don't choose a licenced solution from abroad, choose a company that grew up here and understands just how great it is to work differently. Choose THE Marketing Company.
If you want to be smarter in your sales & marketing call us for a free assessment.
0800 427 627 | THEmarketingcompany.co.nz
NZIS
Diamond Partner
THE MARKETING COMPANY
Make more money in your business.

12d Synergy V3 – Responding to Customer Needs

12d Synergy is 12d Solutions' data management and collaboration software that serves as a central repository for project files created through geospatial design and modelling applications. Designed to be used by all staff – including technical teams, such as surveyors and engineers, as well as administration, marketing and support departments – 12d Synergy enhances productivity for all users, whether they are in the office, at remote sites, or travelling.

With a focus on quickly integrating customer feedback, 12d Solutions releases updates to 12d Synergy customers each calendar quarter, with major releases launched every two years. The next major release is 12d Synergy V3, which will be unveiled at the 12d International Users Conference on July 24 to 26, 2016, in Brisbane for a global release.

"Our customers range from small offices of one to four users, to multi-national companies with hundreds of staff," said Joel Gregory, General Manager, 12d Solutions. "Since our inception, we have differentiated ourselves by encouraging feedback from our customers so we can better understand their business requirements. V3 is testament to that — it contains enhancements to existing function such as master file edit control, version control and advanced search, and introduces new capabilities for surveying companies, contractors and consultants."

For multi-office organisations, 12d Synergy V3 will include a new File Replication Server to provide support for remote sites by storing previously-requested documents locally. This will accelerate access to project files and reduce traffic between the central server and remote sites, therefore reducing bandwidth requirements. V3 will also have optimisation for faster searches and general browsing.

To simplify day-to-day operation for system administrators, 12d Solutions has designed V3 to auto-upgrade, ensuring all users have the most up-to-date version installed. It will also offer flexible permission management, and allow the ability to force user subscription for notifications.

For the user, workflow enhancements include: watch folders to allow submission of documents from external sources, such as scanners and digital cameras; web file drop to allow external users to submit files through a browser environment; integration with external productivity tools such as Workflow Max; and a prompter ('nag screen') for users to check-in data before exiting the software.

12d Synergy also contains a new attribute type, dependent Attribute, which provides a picklist dependent on the value of another picklist; this is akin to having an attribute with a matrix of possible values. Other new features include email conversation tracking and automatic file conversion to automatically convert file formats after check-in.

"With 12d Synergy V3, we continue to address the major challenges faced by surveying businesses, whether they are small businesses or large operations," said Gregory. "The new version will manage the process of storage and retrieval of data, be it in the office or in a remote location with poor connectivity, using the new File Replication Server. It will also provide easy data exchange with third parties over a standard web browser, using the publishing and web drop functionalities. Additionally, V3 will connect to popular software packages such as Abtrac and WorkflowMax."

Scott Williams, Managing Director of Mainland Surveying has been using 12d Synergy since 2013. Scott's experience with the software is documented in the interview below.

Interviewee: Scott Williams, Managing Director, Mainland Surveying


Scott Williams

Why did you select 12d Synergy to support Mainland Surveying's document management?

Scott Williams (SW): We discovered 12d Synergy when we were forming the company in 2013. We knew we had to implement a document management system, but hadn't quite worked out what exactly we needed from it. After considering a variety of options, we evaluated a beta version of 12d Synergy.

Even in its early days, it ticked all the boxes. The key thing was the centralised system. It was able to handle the heavy-duty software we use, including 12d Model, a multi-file piece of software through which we produce a lot of data related to topographical maps, plans, subdivisions and building and infrastructure development. It was also able to deal with email recording, something that I had experienced in previous businesses and considered critical.

How has 12d Synergy impacted the way Mainland operates?

SW: We're a small dynamic business (currently a team of six) and an early adopter of technology and innovation. We use technology to maintain a strategic advantage against our competitors, many of which are much larger companies. 12d Synergy provides a central repository for our reference material, survey data and project documentation, all of which is integrated into the platform.

Using 12d Synergy, all of the project information is captured in the one location. We can check our jobs in and out very easily, enabling a level of transparency across the business, and providing an insight into who is doing what and the status of each project. Having this information readily-available allows us to quickly respond to new client requests and action or update items accurately. Projects are no longer inhibited when someone is travelling, on leave, or attending back-to-back meetings as we can access the full job file with the latest information from anywhere.

12d Synergy has also instilled mobility into our operation. Before the implementation, we were forced to download files onto a portable hard drive and take that with us. We'd have to think about what we needed and wanted, then move those files back and forth between computers. There was the risk of losing the latest version and overwriting more recent files. Then there's the time factor – 12d Model files can be quite large, so shifting those around jeopardised productivity.

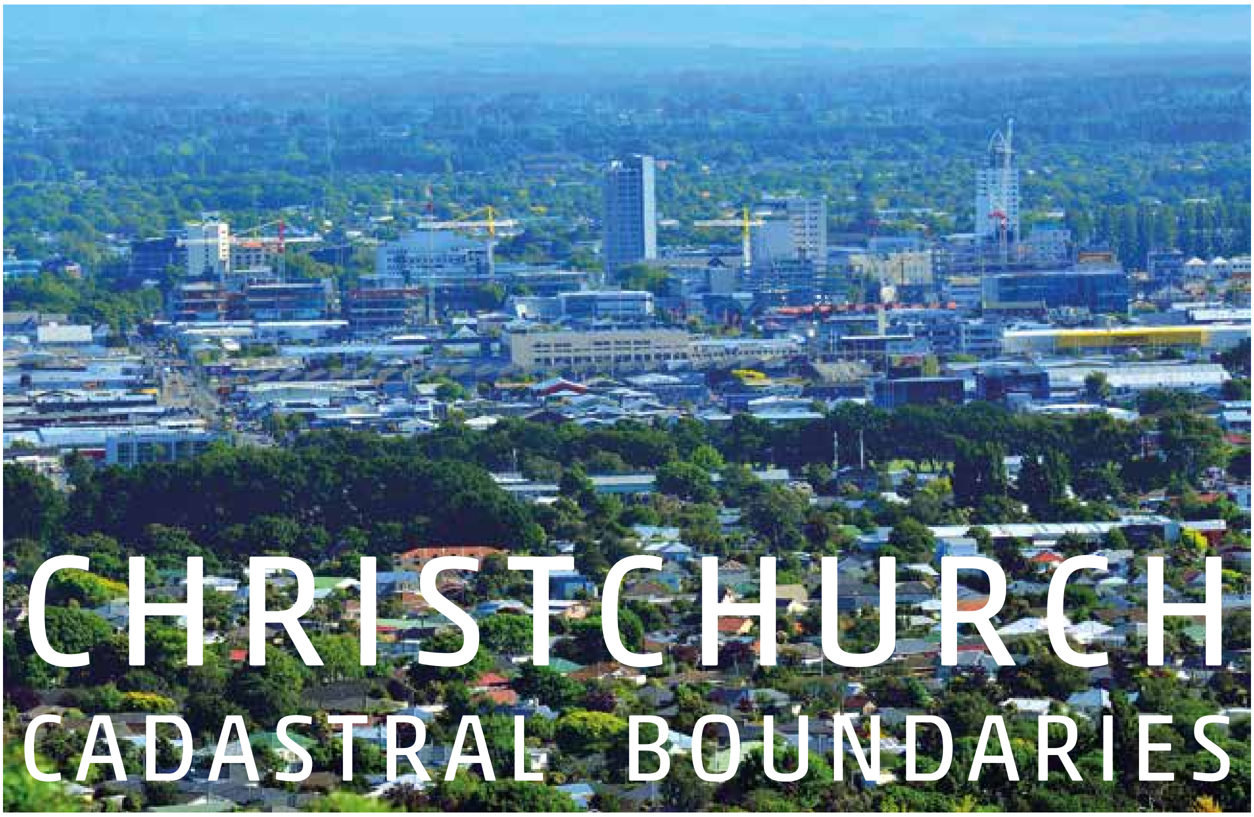
What features do you find the most beneficial and why?

SW: The most beneficial feature, from a day-to-day perspective, has been the email recording link. Each day I receive up to 50 project related emails. 12d Synergy allows us to file those emails very quickly within project folders so they aren't lost and are accessible to everyone working on the project. Once we've made that initial filing, all subsequent sent and received emails are automatically managed and categorised by the software.

We've also experienced reduced pressure on our network since implementing 12d Synergy. It has freed up significant bandwidth. We run a cut down server, so as our business continues to expand, 12d Synergy will future-proof our network once the amount of data flowing through it increases.

As Mainland expands, how do you plan to expand your usage of 12d Synergy?

SW: The 12d Synergy platform is quite comprehensive and there are a number of functionalities of which we intend to take advantage. We're eager to begin using the in-house Dropbox-like function so that our clients can access and pick up selected large data files rather than having to wait for us to send them. We're also starting to implement pre-populated templates, task management and the issue sets. What we've learned in our time using 12d Model is that 12d Solutions is constantly looking to maximise the value we receive from the solution, and similarly, they've closely guided us in our implementation of 12d Synergy to ensure we capitalise on all its features.



CHRISTCHURCH CADASTRAL BOUNDARIES

Mick Strack, National School of Surveying mick.strack@otago.ac.nz

Since the devastating Canterbury earthquakes of September 2010 and February 2011, and the thousands of aftershocks, Christchurch cadastral boundaries have been considerably disrupted. The importance of an accurate and up-to-date cadastre is undisputed – it is required for effective land planning, for establishing and repairing infrastructure, for all spatial reference and GIS purposes, and of course for the protection of private property rights. So how have cadastral problems been dealt with in Christchurch in the five years since the earthquakes?

Rules for Cadastral Survey (CE) 2010

The obvious ground distortions observed subsequent to the earthquakes prompted an early response from LINZ in the form of amendments to the Rules for Cadastral Survey (Canterbury Earthquake) (2010). In the guidelines, boundaries were assigned into five categories according to the nature of the ground movement. The main categories encountered included Category 1 requiring no definitional change (i.e. unaffected by the earthquakes); Category 2 block shift, where boundaries shifted such that they could be redefined relative to surrounding survey control and occupation evidence); Category 4 ground distortion where boundaries could be recalculated, requiring new boundary angles and dimensions; and Category 5 where shallow surface movements (from liquefaction) were likened to landslips or evulsion and boundaries were to be reinstated in some sort of original documentary position. While surveyors were challenged to apply these guidelines, the resolution of boundary position was largely uncontentious in Categories 1-4.

Category 5 boundaries continued to cause difficulties. The shallow surface movement caused by liquifaction shifted all surface structures including boundary pegs, fences and buildings, such that land proprietors continued to occupy all the land defined by those structures. Occupation boundary dimensions were distorted, road alignments were disrupted, and survey marks were difficult to correlate. However, the practical effect of the earthquake-affected boundaries is that property owners continue to assert their property rights over all the land they occupy. This virtually eliminates property disputes between adjoining properties. Disputes arise when a surveyor shows a boundary in a location or alignment that conflicts with the occupation. Any attempt to re-establish those boundaries to pre-earthquake positions was bound to disrupt current occupation and encourage neighbourly conflict, when fences and buildings were apparently no longer within property boundaries.

Surveyor-General's Guidelines 2015

LINZ continued to insist that these boundaries were to be considered in the same context as boundaries subject to landslip, culminating in the Surveyor-General's guidance notes of February 2015. This guidance stated that "Surveyors should not expect legal boundary determinations to align with post earthquake possession (occupation) in areas of shallow surface movement" and "Existing documentary bearings and distances should be retained in boundary marking CSDs".

The proposal dismissed the expertise of practising surveyors to gather all evidence and make appropriate decisions about boundary definition. The proposal undermined good survey practice, especially in applying the long established principles behind the hierarchy of evidence. The legal position that boundaries may move with changes in the land is well established and has served and supported our cadastre for 175 years. The movements in Christchurch are extra-ordinary, but they are not unique and they are likely to be repeated elsewhere in time.

Objecting Submissions 2015

The guidelines came as something of a surprise to Christchurch surveyors both in the content and the way they were announced. It was stated that the guidelines took immediate effect, so they were implemented without any consultation. However, there were widespread objections and 58 submissions. The themes of the feedback included:

1. The proposed guidance will result in conflict between occupation and legal boundaries.
2. Uncertainty of property boundaries has implications that are wider than the surveying profession.
3. All decisions should be made with the landowner in mind. The final solution(s) should minimise any disruption and treat all landowners in an equitable manner.
4. Most responders believe boundaries move with shallow land movement.
5. Occupation is very important evidence when locating boundaries. It is not necessarily disturbed by shallow land movement. Relationships between occupation and monuments should be respected.
6. The traditional hierarchy of evidence should be maintained.
7. Coordinates can provide another layer of evidence when there is an absence of other evidence but should not be used as a basis for definition.
8. There is no Crown guarantee on location, dimension and orientation therefore boundaries can be recalculated (the more or less provisions apply). Dimensions should be retained if they are within survey tolerances.
9. Concerns that the current cadastre is being replaced with a coordinate cadastre.
10. Concerns about liability of surveyors for past and current surveys.
11. Concerns around the costs associated with addressing the issue.

The guidelines were then rather hastily withdrawn, but they had prompted action by Canterbury surveyors to establish more appropriate guidelines.

NZIS/ICS Working Party

A Working Party was established to develop new guidelines and an initial position paper was released in March 2015 that clearly stated that "Boundaries affected by non-linear shallow surface movement need to be recognised as moving with the land surface. This concept acknowledges the reality that all land assets on the parcel (dwelling; utility buildings; fences, driveways, gardens and underground services) would have generally moved in the same way as the physical boundary. The concept of boundaries not moving with the surface of the land is foreign to the landowner and only suits a (currently) legalistic viewpoint, and a questionable view that boundaries are somehow only tied to the underlying bedrock."

In December 2015 the Working Party released (Draft 2 – revision 4) Best Practice Guidelines for Cadastral Surveying in Areas Affected by Ground Movement Caused by Earthquakes. These Guidelines are intended to be an evolving source of information for the re-establishment of Canterbury boundaries over and above the normally expected 'good survey practice' and to be compatible with any future and proposed legislation and rules. The document provides useful advice to surveyors which has wider relevance than just the Canterbury boundary issue. Some of the highlights include:

- Sharing data that is not in the public record will help surveyors determine the best possible boundary solution.
- It is important to look for old marks close to the boundaries to minimise introducing errors from the land movement, but cast the net wide to ensure the effect the definition will have on neighbouring properties can be determined.
- Legal precedent has established that boundary lines of surveyed parcels of land are governed by the position of original pegs placed, even if this conflicts with records and their mathematical relationships.
- If an original survey mark remains firmly and vertically implanted within the immediate ground as it was originally placed, then it's unlikely to be disturbed. This remains the case even if the survey mark (and the immediate land surrounding it) has shifted due to earthquake induced movement.

- Adoptions made from remote undisturbed marks have little weight in defining boundary locations. Mathematical adoptions are to be used [only] when all other sources of evidence are exhausted.

Legislative Intervention: Canterbury Property Boundaries and Related Matters Bill

Concurrently, LINZ was consulting with the government to develop new legislation to incorporate a new understanding of boundary shifts. In 2004, Ballantyne reported to LINZ about boundary movements in earthquake situations including examples in Alaska and California. There, legislation had been used "to equitably re-establish boundaries and to quiet title within the boundaries so established." In another context in South Australia where there are Confused Boundary Areas there is provision that "Fair and equitable occupations are considered prima facie evidence of the confines of the parcels. The definition of an equitable boundary is a subjective matter. Most property owners apparently believe their existing fences mark the limit of their ownership and generally agree to have this reflected in their titles, even if the original dimensions are altered." Ballantyne's conclusion was that similar legislation may be required to support the re-establishment of boundaries to match occupation and the evidence on the ground surface.

As a result of this further consultation, the Canterbury Property Boundaries and Related Matters Bill was introduced to parliament. This Bill states (inter-alia): "The boundaries are deemed to have moved with the movement of land caused by the Canterbury earthquakes (whether the movement was horizontal or vertical, or both), unless the movement was a landslip." This statement is in stark contrast to the SG's earlier guidelines, but responds to the surveyors' feedback.

Commentary

The current apparent agreement amongst all parties (professional surveyors, NZIS, LINZ, Surveyor-General, and the government) comes like a breath of fresh air to practical surveyors working in the Christchurch area.

The agreement now confirms the priority given to the traditional hierarchy of evidence. It confirms that New Zealand has a monumented cadastre (rather than a quasi-coordinate cadastre). It refutes many previous LINZ statements about the need to hold 'documentary' dimensions and position. It allows for a practical survey tolerance between measured and documentary boundaries. It allows for boundaries to shift with land movement and for title dimensions to be recalculated and changed. In all these things, the lessons extend beyond earthquake affected areas. For example, the slow land creep at Moeraki is another example of boundary movement and distortion that needs similar title redefinition resolution.

The philosophy behind the new guidelines is also very worthy. The recommendation that surveyors share data is one that is worthy of wider dissemination. While our justice system is adversarial, the [re-]establishment of boundaries should be cooperative. "One mark of a competent person, secure in his capacity to conduct affairs creditably, is his willingness to cooperate with others in matters of mutual concern." In part, sharing is achieved by assigning a Landonline survey reference as early as practicable. Cooperation and sharing of data will ensure that surveyors working to redefine separate but closely related parcels (e.g. in the same urban block) will reach compatible solutions for adjoining boundaries. It is worth noting that if agreement cannot be reached amongst adjoining owners, the RGL may be directed to issue a new computer register limited as to parcels.

While the Christchurch liquefaction was not necessarily slow or imperceptible in its progress, it did nevertheless leave surface features (fences, structures, gardens) largely intact. Landslips, on the other hand, can be distinguished by their destruction of surface features. The acknowledgement that shallow surface movements carry legal boundaries with them reinforces the principles of boundary shifts due to 'slow gradual and imperceptible' movements such as is applied to ambulatory natural boundaries.

While we can be justly proud of the traditions, completeness and accuracy of our cadastral records, we must remember that boundaries are not guaranteed in our cadastral system. Dimensions and coordinated position are a guide to parcel definition but they should not be considered absolute. We should not be hesitant about recognising the flexibility and fuzziness of measured boundaries, including the applicable survey tolerances and the legal determination of 'a little more of less', or of recalculating boundary dimensions when justified by land movement.

NOTES:

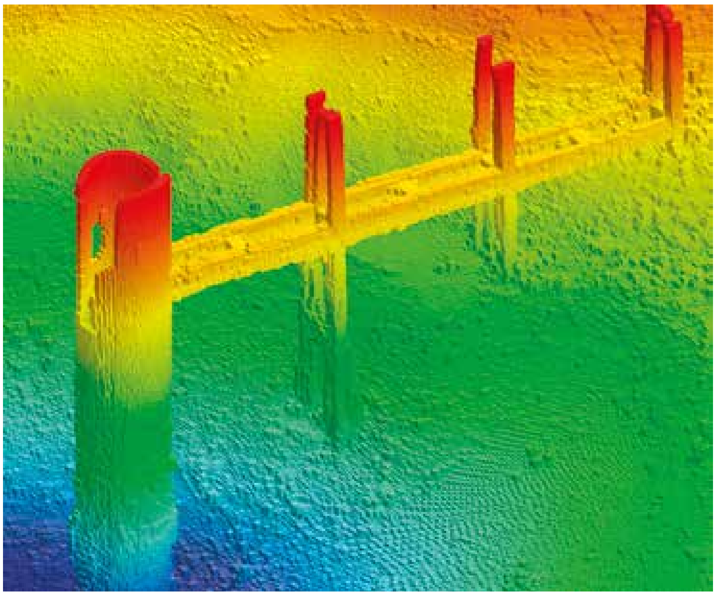
Applicable and proposed guidelines are available on NZIS website: 'Canterbury Updates'

References are available from author.

MOBILE 3D MAPPING

A hydrographic first in NZ

D. Stubbing & K. Smith,
Discovery Marine Ltd



SHALLOW WATER MULTIBEAM ECHOSOUNDERS (MBES) PROVIDING HIGH-RESOLUTION MAPPING OF THE SEAFLOOR HAVE BEEN IN COMMON USE SINCE THE 1990'S. THE TECHNOLOGY IS NOW WIDELY USED IN SUPPORT OF SUBSEA OPERATIONS INCLUDING NAVIGATIONAL CHARTING, OFFSHORE RESOURCE EXPLORATION, HABITAT MAPPING, COASTAL ENGINEERING, DREDGING AND PORT ASSET MANAGEMENT. RECENTLY TERRESTRIAL LASER SCANNERS (TLS) HAVE BECOME AN ESSENTIAL TOOL IN THE SURVEYING AND MAPPING INDUSTRY, PROVIDING RAPID, HIGH RESOLUTION 3D POINT CLOUD DATA, HOWEVER LOCALLY TO DATE, THE USE OF DEDICATED MOBILE LASER SCANNERS (MLS) OR TLS ON MOBILE PLATFORMS HAS BEEN LIMITED.

This paper investigates the potential to acquire and integrate TLS data and high resolution shallow water MBES data simultaneously from a mobile platform. The aim of the trial being to efficiently generate a seamless 3D data set, above and below the waterline.

Introduction

High resolution point cloud data is fast becoming the backbone to any construction or maintenance project whether on land or subsea. The ability to digitally model physical structures on the seabed or land improves the planning, design, implementation and maintenance phases of projects. Further, the ability to remotely capture high resolution data efficiently in hazardous environments is seen as a potential benefit to all clients.

Discovery Marine Ltd (DML) has recently been involved in projects where the client's requirement for accurate survey data of structures above and below the waterline but in potentially hazardous locations for personnel could have been readily resolved with the use of a TLS or MLS from a vessel.

Background

DML specialises in providing hydrographic survey services to clients within the littoral zone [littoral zone extends from the high water mark, which is rarely inundated, to shoreline areas that are permanently submerged - editor] and inland waterways. These clients are now seeing less of a boundary between water and land and wish to acquire seamless high resolution datasets to manage assets above and below the waterline.

Through the use of MBES systems DML has become extremely proficient in acquiring high resolution bathymetric data below the waterline. Improving the resolution of data gathered above the waterline in order to provide clients with a seamless data set is the goal of this trial. To achieve this DML has been exploring the integration of laser scanning technology with its existing MBES acquisition system. Initially it was envisaged this would involve a dedicated MLS unit that could be fixed to the vessel. Due to costs, timing and logistical issues, attempts to trial a dedicated MLS on a suitable project here in New Zealand have not eventuated.

After further research and discussions with software and equipment suppliers a decision was made to attempt to integrate a TLS in Profile Scanning Mode with an existing Inertial Navigation System (INS) and Real Time Kinematic (RTK) Global Navigation Survey System (GNSS). While the combined use of TLS and MBES on mobile platforms is not new, combining the equipment and software within New Zealand to achieve a local combined mobile 3D mapping system is a first.

Multibeam Echo Sounders

MBES systems have now become the industry standard for hydrographic surveying in ports for channel monitoring, dredging and dynamic under keel clearance with a growing use in engineering and construction of subsea projects.

MBES's project a swath of sound energy into the water column with energy reflected from the seabed processed into discrete points forming a swath of data. Sonar footprints of between 0.5° and 1° in the across and along track directions are recorded at up to 6 times the water depth. Modern shallow water systems are capable of acquiring high resolution data at frequencies generally between 200 kHz and 400 kHz.

3D Laser Scanners

Terrestrial 3D Laser Scanners (TLS)

The first commercial terrestrial 3D TLS were released in 1998. Since then advancements in scanning speed, software processing, decreasing cost of equipment and training have led to the wide adoption of the technology in the survey and engineering industry.

A TLS consists of a scanning head that rotates 360° in both horizontal and vertical planes, from a fixed position. Scan data is logged to the on board memory and downloaded for processing and visualisation in dedicated point cloud or CAD software packages.

The New Zealand market is serviced by a number of manufacturers offering products that vary in accuracy, resolution and cost. Refer Figure 1.

Figure 1: Terrestrial 3D laser scanners

Mobile Laser Scanners (MLS)

Dedicated MLS units consist of 1 or 2 scanning heads coupled with a high accuracy RTK GNSS positioning system and an Inertial Measurement Unit (IMU) or INS. The scanning heads rotate 360° on one axis generally orientated near to 90° to the along track movement of the scanning unit. Refer Figure 2.

MLS use in New Zealand has been limited with units hired from Australia or Singapore. While manufacturer demonstrations have proved popular in New Zealand suppliers have struggled to make the systems available due to the high purchase and/or lease costs relative to project size.

Figure 2: Typical MLS units available to the New Zealand market

TLS Trial

Combined Vessel Setup

The aim of the trial was to mobilise a vessel capable to capturing MBES data and TLS data simultaneously. The survey system included the integration of MBES, TLS and INS data within the QPS QINSy hydrographic survey acquisition software package.

The benefit of this configuration is that seabed and structures in the marine environment can be mapped to a common horizontal and vertical datum quickly and safely.

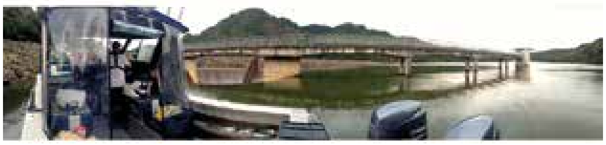


Figure 3: Fresh water dam riser above the surface

It is envisaged a fully calibrated system will capture data above and below the water line to a similar density in areas that are difficult or slow to measure with traditional techniques e.g. Wharf and bridge piles, under wharf batter slopes, dam faces, water intakes, breakwaters and seawalls etc. See Figures 3 and 4.

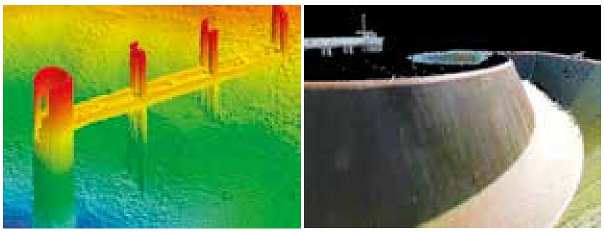


Figure 4: Submerged fresh water dam riser surveyed with a MBES and a TLS as two discreet surveys.

Location

After completing bench testing of the configuration settings between the Leica P20 and QINSy software at the Global Survey Ltd office, an on water trial was completed around West Haven Marina, Wynyard Wharf and the Auckland Harbour Bridge on 20th May 2015.

Platform

DML's dedicated inshore survey vessel 'Pandora II' was used for the trial. The 7.3m Kingfisher Boats 705HT Power Cat is a highly stable survey platform. The vessel is configured to operate predominately around New Zealand's waterways including the coastal margins, ports, harbours, rivers lakes and dams. It is fitted with both MBES and Single Beam Echo Sounder (SBES) survey systems.

The typical equipment configuration for this survey vessel is shown at Table 1 Pandora II specifications.

Table 1: Pandora II specifications

Vessel	Pandora II
Type	Kingfisher Boats 705HT Power Cat
Year Built	2014
Hull	Alloy
Propulsion	Twin Yamaha 115HP 4 Stroke
Electrical	12V DC and 230V AC
Survey Systems	R2Sonic MBES Applanix POSMV Wavemaster Reson Navisound 210 SBES QINSy Survey Acquisition and Processing software Trimble R6 RTK GNSS
Survey Class & Limits	Survey for 6 Pax – Inshore Limits

Equipment/Software

Terrestrial Laser Scanner

A Leica P20 ScanStation was supplied by Global Survey for the trial. The P20 is considered an industry standard TLS with a number of units sold to the surveying, engineering

Table 2: Leica ScanStation P20 specifications

Instrument Type	Ultra high speed pulsed laser scanner
Accuracy	3D Position: 3mm at 50mm; 6mm at 100m Linearity error: <1mm Angular accuracy: HZ:8", VT: 8"
Wavelength	808nm (invisible)/658 (visible)
Laser class	1
Beam Diameter (at front window)	< 2.8mm
Range	Up to 120m; min range 0.4m
Scan rate	Up to 1,000,000 points/s
Field of view	Horizontal: 3600 Vertical: 2700
Scanning optics	Vertically rotating mirror on horizontally rotating base. Up to 50 Hz with internal battery. Up to 100 Hz with external power supply.

and construction industry in New Zealand. See Table 2 for specifications.

An accurate dimensional control survey determining 3D positions of all existing sensor locations within the Vessel Reference Frame (VRF) had been completed previously. Utilising an existing mounting location within the VRF, the TLS was fixed to the starboard side of the vessel roof. Data transfer and accurate timing cables were run to the Applanix POS MV inertial navigation system through a ventilation hatch in the roof.

When integrated with the existing survey systems, the TLS operates in 2D profiling mode controlled by the QINSy survey software. The scan mirror rotates around the horizontal axis only, scanning at 90° to the forward motion of the vessel. To restrict the scanner rotating around the vertical axis, the P20 was fixed rigidly to an alloy mounting plate welded to the roof of the vessel.

Multibeam Echo Sounder

DML currently has an R2Sonic 2022 MBES deployed on Pandora II. The 2022 is a light weight high accuracy hydrographic survey grade echo sounder capable of gathering bathymetric data up to 6x water depth. See Table 3 for equipment specifications.

Table 3: R2Sonic MBES specifications

Operating Frequency	Broadband 200 to 400 kHz
Depth Range	100m (400kHz) 300m (200kHz optional)
Maximum Swathe Angle	100-1400
Beam Forming (along track transmit & across track receive)	256 beams (10 x 10 at 400kHz)
Roll Stabilisation	Real Time
Maximum Ping Rate:	60Hz
Depth Resolution	6mm

The MBES sonar head can be retrieved through the moon pool, and raised well clear of the water, for transits.

Inertial Navigation System

The Applanix POS MV Wavemaster is an Inertial Navigation System (INS) that blends accurate GNSS data with angular rate and acceleration data from an Inertial Measurement Unit (IMU) and heading from a GNSS Azimuth Measurement System (GAMS) to produce a robust position and orientation solution.

The Applanix POS MV calculates the 3D vessel position of Pandora II using RTK positioning corrections received from a GNSS base station via a UHF radio. The Applanix POS MV combines IMU and GNSS sensor data to provide an integrated real time centimetric navigation solution.

The Applanix POS MV data is also used to provide accurate heading and motion compensation to all collected

MBES and TLS data. The IMU generates attitude data in three axis. Measurements of roll, pitch and heading are all accurate to ±0.02° or better, regardless of the vessel latitude. Heave measurements supplied by the Applanix POS MV maintain an accuracy of 5% of the measured vertical displacement or ±5 cm (whichever is the larger) for movements that have a period of up to 20 seconds. More accurate delayed heave can be applied in post processing which further increases the vertical accuracy.

The high frequency rate of position and orientation data provided by the POSMV is a crucial element to achieving accurate geo-referenced laser point cloud data from a mobile platform. See Table 4.

Table 4: Applanix POS MV specifications

Roll, Pitch Accuracy	0.02° (1 sigma with RTK)
Heave Accuracy	5cm or 5% (whichever is greater) for periods of up to 20s
Heading Accuracy	0.03° (1 sigma with 2m baseline)
RTK Positioning Accuracy	HZ: ±10mm +1ppm VT: ±20mm +1ppm
Velocity Accuracy	0.05m/s horizontal

QINSy Survey Software

QPS QINSy Survey v8.1 is an integrated hydrographic data acquisition, navigation and processing software package. The suite of applications can be used for various types of surveys from simple single beam surveys to complex surveys requiring multi senor data acquisition and geo-located point cloud data.

QINSy Survey is able to compute, visualise and store up to 500,000 points per second, allowing it to combine real time GNSS data, INS data, precise timing, MBES data and TLS data simultaneously. QINSy also allows the importing post processed trajectory data from INS or GNSS systems.

In 2009 QINSy added support for real time laser scanner data acquisition and in early 2014 began supporting the Leica P20 ScanStation operating in Profile Scanning Mode.

The driver allows QINSy to visualise and record a real time geo-referenced attitude and height corrected DTM, including point cloud data, on the fly from the P20's scan data.

Patch Test Calibration Method

In order to collect accurate TLS and MBES data both systems must be calibrated prior to the start of a project.

The calibration routine, known as a Patch Test requires data to be collected on a number of lines covering particular features or seabed gradient. Data from each survey line is compared to determine the orientation of the TLS head or MBES head, in the three axis of roll, pitch and yaw relative to the IMU. These three angular offsets must be determined to produce accurately corrected and repeatable TLS and MBES data.

Pitch and roll for both the TLS and MBES head are measured relative to the vertical axis of the IMU and the heading (yaw) of the sonar head relative to the horizontal axis of the IMU.

When the data acquisition software is not synchronised to GNSS time using a 1PPS system, it will also be necessary to determine the latency of the positioning system. Installation offsets are usually determined in a fixed sequence: latency (if required), roll, pitch and yaw.

Once the data has been collected, it is processed using the Patch Test tools in QINSy to determine the value to be applied.

MBES Calibration

Existing calibration parameters for the MBES were used as determined by Patch Tests from a previous project.

Terrestrial Laser Scanner

The topography and features around Westhaven marina provided a number of suitable areas for completing a patch test of the scanner.

Reciprocal lines for the roll calibration were navigated through the western entrance to the marina collecting data along a concrete wall on the western side and the end of the northern break water.

Pitch and yaw calibration runs were collected along the eastern breakwater of the marina, with a free standing pile to the south of the breakwater used as the feature as well as signs and poles on the breakwater.

The Patch Test computed angular misalignments between the IMU and Leica P20 3D laser scanner. These values are then entered into the acquisition software for real time correction of the scans.

Estimated Accuracies

"A Priori" estimates of point accuracy have been computed using QINSy's real time Total Propagated Uncertainty (TPU) calculator. The TPU for each point is the interval about a given point that QINSy estimates will contain the true 3D position at a given confidence level. Each value in the TPU calculation indicates either limitations of the measurement sensors or the statistical fluctuations in the measured data from that sensor.

A major source of uncertainty in the TPU calculation for the laser scanner data appears to come from the INS. Standard deviations for the computed Patch Test results plus the RTK GNSS positioning and attitude data all contribute to the final uncertainty of position.

The vertical component of the TPU during this trial indicated laser scan data collected at around 100m to 120m to have a vertical uncertainty of 4-5cm with the horizontal component around 10cm. Further refinement of the values entered into the TPU calculation for the TLS should reduce the A Priori values.

It is anticipated that applying post processed trajectory data will further improve both horizontal and vertical A Posteriori accuracies. Further work will be undertaken to ground truth the TLS data using an RTK GNSS to position clearly visible features within the data.

Data Validation and Post Processing

The QINSy processing suite and Fledermaus was used for data reduction and quality assurance. Final imagery and results were compiled using Fledermaus 3d Editor. See Figure 5.

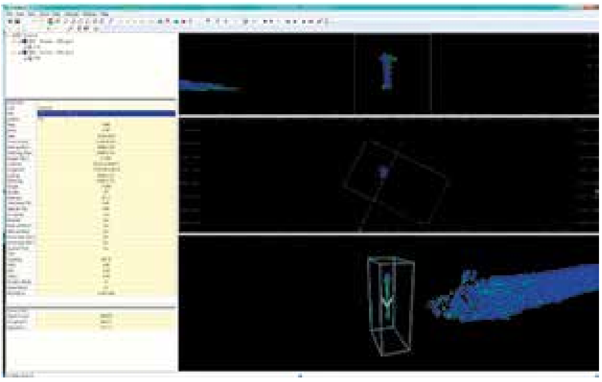


Figure 5: TLS data editing.

Results

TLS data was collected around the Wynyard Wharf area and Westhaven Marina for calibrations and general assessment of laser range and resolution.

Final point cloud results show good repeatability between overlapping and crossing scans, indicating good calibration values. Data resolution is impressive at all ranges around the seawall with some limitation due to line of sight and shadowing behind wharf piles. See Figures 6 and 7.

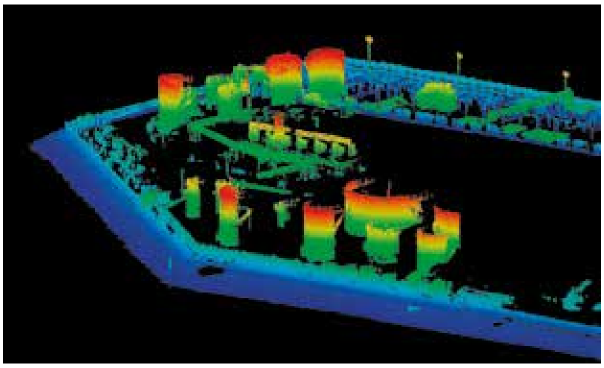


Figure 6: West Haven Marina, Tank Farm and seawall

To create a seamless above and below water data set, combined MBES and TLS data was collected around the Auckland Harbour Bridge. The TLS data was collected on a single north to south pass on the eastern side of the bridge around 80m offset from the bridge centreline. MBES data was collected separately and covers a seabed area approximately 80m either side of the bridge.

The data was then combined during processing and validated to create a single high resolution point cloud data set containing both seabed depths and bridge heights, referenced to a common vertical and horizontal datum.

Initial analysis of the results proves that TLS data can be gathered from a vessel using the method described.

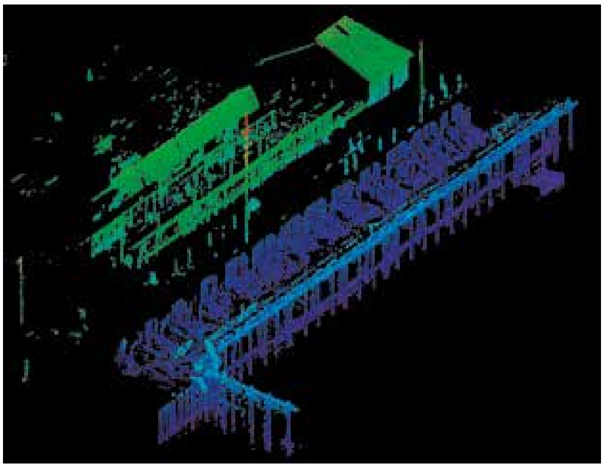


Figure 7: Wharf Piles. Wynyard Wharf

Conclusion

The combined TLS and MBES trial has provided a workflow for the system integration required to acquire a seamless point cloud dataset above and below the water. Improvements were identified during the trial to increase point accuracy and repeatability. With further refinement seabed and submerged structures can be mapped simultaneously.

DML believes the method described in this paper could be applied to a land based vehicle for mobile mapping projects.

Acknowledgements

The authors would like to acknowledge the valuable contribution of Bruce Robinson (Global Survey Ltd) for the use of the Leica P20 ScanStation during this trial.

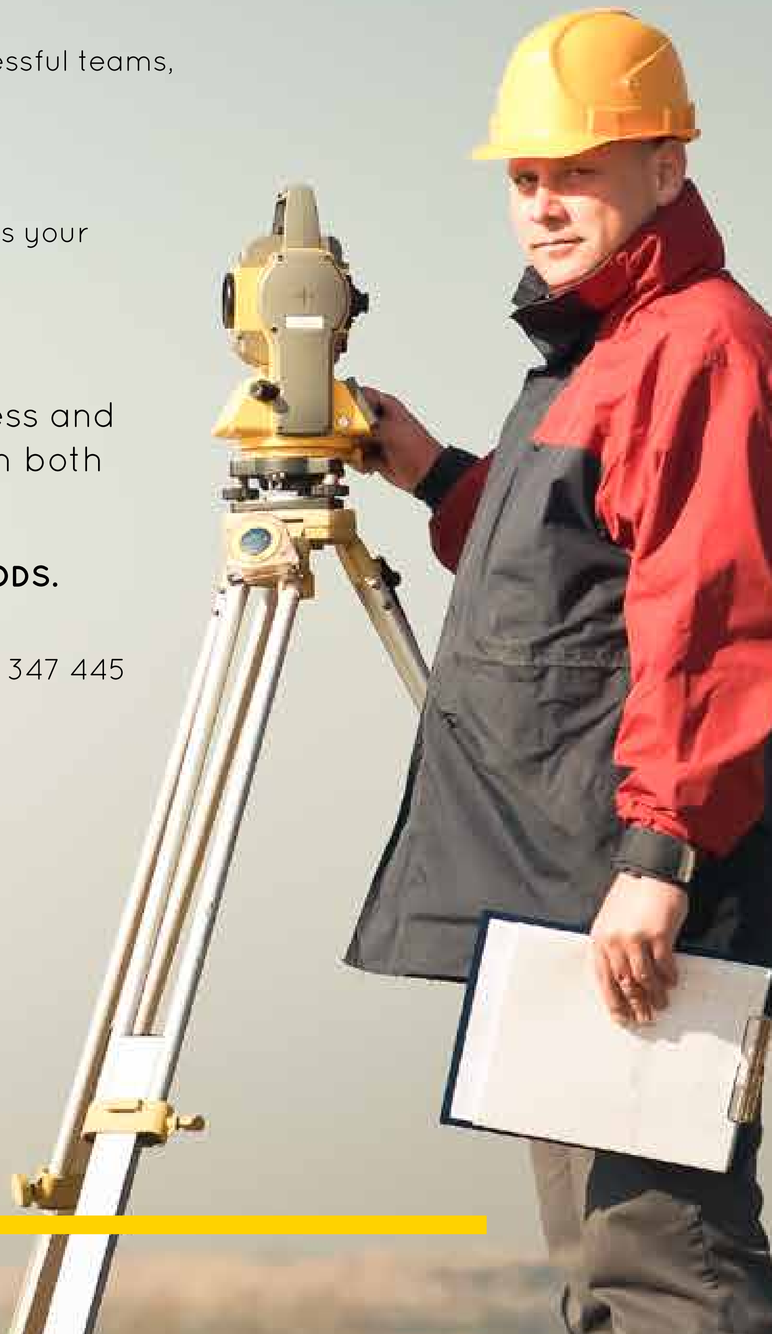
References

"Laser." QPS QINSy. Accessed March 31 2015.
www.qps.nl/display/qinsy/laser

"Drivers Manual." QPS QINSy. Accessed May 19 2015.
https://confluence.qps.nl/display/support/QPS+Support+Portal

"POSMV." Applanix. Accessed May 29 2015.
www.applanix.com/products/marine/pos-mv.html

Leica Geosystems AG. "Leica ScanStation P20 User Manual." Version 1.1 (2013)



Surveying the boundaries in context

Stephanie Harris, Glaister Ennor Solicitors

IN THIS EDITION I WANT TO WRITE ABOUT A FEW CASES REGARDING BOUNDARY DISPUTES BETWEEN NEIGHBOURS AND HIGHLIGHT THE IMPORTANCE OF COMMUNICATION AND COOPERATION BETWEEN SURVEYORS, LAWYERS AND THE CLIENT.

Value added advice to clients

With the boom in the property market, it is not uncommon to come across clients who approach me about subdividing their land or about converting their cross lease title into a fee simple to increase the value of their property. Others decide to expand their existing home to add another bedroom or a deck, which may be located close to a boundary fence. In such cases I will refer my client to a surveyor I have worked with in the past and who I know will communicate well and keep me informed. This is because a lawyer can help identify the issues and assist surveyors to do their job in terms of what the client wants to achieve.

A surveyor's job is not a theoretical exercise and need to take instructions in context. Depending on the client's main objective, the surveyor's nature of work and costs involved for the client will vary significantly. If a client wishes to add a structure to an existing building and it is to be located close to a boundary fence, the client will need to take into account the relevant local authority's rules including the permitted distance from the fence. The client will need accurate information about where the boundary is, but will not necessarily require the surveyor to lodge the survey plan with Land Information New Zealand.

If a client discovers that a flats plan in a cross lease is not in accordance with the actual structure on the land, the client and the surveyor should contact a lawyer who would advise the client on their legal rights and obligations depending on the client's circumstances. A value added advice in an appropriate scenario may be for the client to update the plan at the same time as converting the cross lease into a fee simple. This may increase the economic value of the property for the client. The surveyor will need to formally lodge the new survey of the flats plan with Land Information New Zealand and liaise with the lawyer for issue of new title.

Boundary fence disputes

More commonly featured in the media are issues about boundary fences. You will have heard about disputes between neighbours concerning the proposed erection of fences and its location. The High Court recently settled a dispute about fences in Christchurch declaring that owners on each side of the boundary must consult each other about proposed work on a boundary fence because the fence is bound to encroach on both sides of the boundary (Gosney v Ngai Tahu [2015] NZHC 515). In this case, a surveyor surveyed the boundary and a fence was erected on the boundary, but it was subsequently torn down by the neighbour, who also challenged the contractor's entry upon their land to undertake the works. The Court declared that under the Fencing Act 1978, a fence may not encroach on a neighbour's property to any degree whatever whether or not the neighbour was contributing to the cost of the fence. A fence that was built right on the boundary line must to some degree encroach on the neighbour's land. A person who seeks to construct a fence is not free to erect whatever fence they see fit. They must have either obtained consent of the landowner or an order from the Court before they will be entitled to erect the fence. When a surveyor is instructed to survey a controversial boundary or where there is known animosity between the neighbouring owners, a surveyor should confer with their client to enlist the assistance of a lawyer, who can assist in obtaining the appropriate consent and advise on parties' legal positions.

Obligations regarding boundaries for a vendor

There are still pockets of land in New Zealand which have not been surveyed for a long period of time. It may be difficult to find boundary pegs, and natural features such as hedges that constituted the boundary may have overgrown so that the centre of the hedge no longer represents the actual boundary. When a re-survey is conducted, owners may be surprised to find that one of the parties is entitled to more land than what the parties had previously assumed. In such a case, the surveyor needs to work with the client to consult a lawyer about their legal rights and obligations. If the client intends to sell, he or she must ensure all boundary markers are in their correct position at the settlement date under the standard ADLS Agreement for Sale and Purchase of Real Estate. The lawyer and the surveyor will need to work together to ensure a new plan is lodged against the title to show the correct boundaries in time for settlement.

Encroachment and adverse possession

Where a re-survey indicates that the true boundary is located in a different position to the existing fence or structure dividing two properties, legal issues about encroachment and adverse possession arise. In a High Court case in 2013 (Edmunds v Lauder [2013] NZHC 2770), an owner of a farm property in Dunedin (defendant) issued a fencing notice to his neighbour (plaintiff) to erect a new boundary fence. The plaintiff objected. A surveyor was instructed and it turned out that the fenceline on the western side encroached on to the property of the defendant. The plaintiff, being the owner of the land encroaching onto the neighbouring land, claimed legal ownership of the encroaching land due to adverse possession. Both parties engaged their own surveyor who agreed on the true boundary of the land, but disagreed about the evidence of previous occupation to support an adverse possession claim. A claimant must establish adverse possession when the land was first brought under the Land Transfer Act, and that such adverse possession continued for at least 12 years. The High Court decided that there was no evidence to establish possession adverse to the true owner as persons named Wilkinson owned both sections through the adverse possession period. The Court considered it a natural inference that the owners were related and that they lived in close proximity for many years.

This case illustrates that what starts out as a notice to erect a fence between neighbours may involve far more complex legal issues. Although rare, claims such as adverse possession may arise when re-surveyed boundaries are not in accordance with the existing fence or natural feature or the parties' understanding of where the boundary lies. Best practice dictates the surveyor, client and legal advisor to work together to consider the legal implications of the surveyed boundaries and take appropriate advice and action.

Stephanie Harris is the joint managing partner of Glaister Ennor Solicitors. She has extensive experience in property and commercial law. She acts for SMEs, larger corporates, investors and developers on many large and complex property transactions and developments, ownership structures, leases, security interests and general structuring and finance.

Contact Details:
DDI: (09) 356 8232
Fax: (09) 356 8244
Email: stephanie.harris@glaister.co.nz

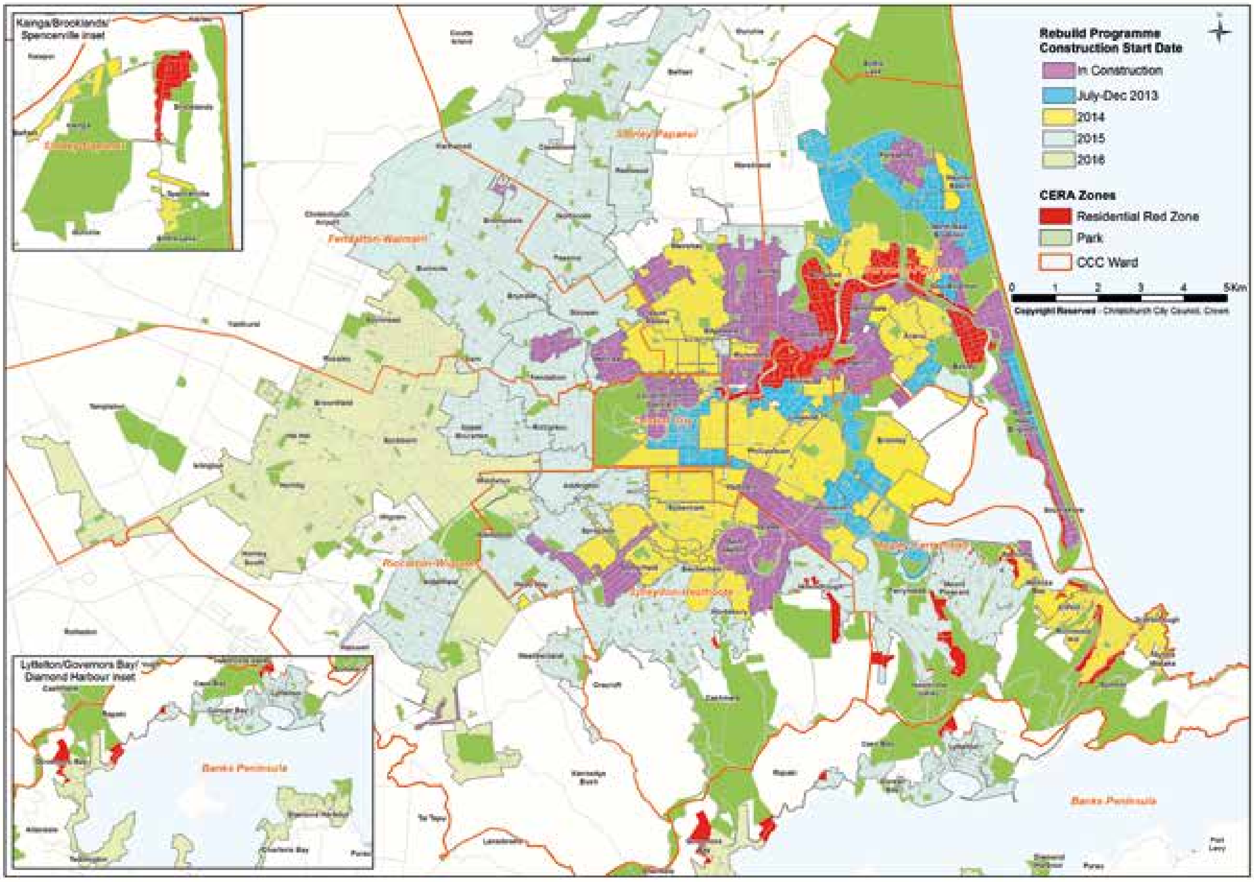


Figure 1: A planned programme of works for a city-wide rebuild.

GETTING IT SORTED

GIS at SCIRT: The Start of a Legacy

Abigail Walshe, GIS Consultant, Stronger Christchurch Infrastructure Rebuild Team

THE STRONGER CHRISTCHURCH INFRASTRUCTURE REBUILD TEAM (SCIRT) WAS CREATED TO UNDERTAKE REPAIRS TO HORIZONTAL INFRASTRUCTURE DAMAGED BY THE 2010–11 EARTHQUAKES IN CHRISTCHURCH. THIS INCLUDED THE 'THREE-WATERS' PIPE NETWORKS TRANSPORTING WASTE WATER, STORM WATER AND WATER SUPPLY IN ADDITION TO REPAIRING ROADS, BRIDGES AND RETAINING WALLS.

With a budget of over two billion and a life span of five years, the infrastructure rebuild in Christchurch was set to be the largest engineering project undertaken in New Zealand. Christchurch City Council (CCC) owns, operates and maintains thousands of assets that make up the underground infrastructure. The key to understanding the scope of works and to plan accordingly was having available the information that represented, at an individual asset level, what was damaged, where was it damaged and how badly was it damaged (Figure 1).

SCIRT is a long programme of many shorter projects, each working through defined consecutive phases, from asset assessment, design, construction and back to CCC via handover. At SCIRT the sheer number of projects (700+) means that in reality all of the project phases can happen at the same time, with each phase having emphasis at different times throughout the programme and GIS tasks supporting all phases at the same time (Figure 2).

As SCIRT's programme reaches its final year in 2016, the GIS team at SCIRT continues to play a major role and as part of SCIRT's Legacy project it's time to start sharing

Figure 2: The SCIRT Project Pipeline approach to creating projects.

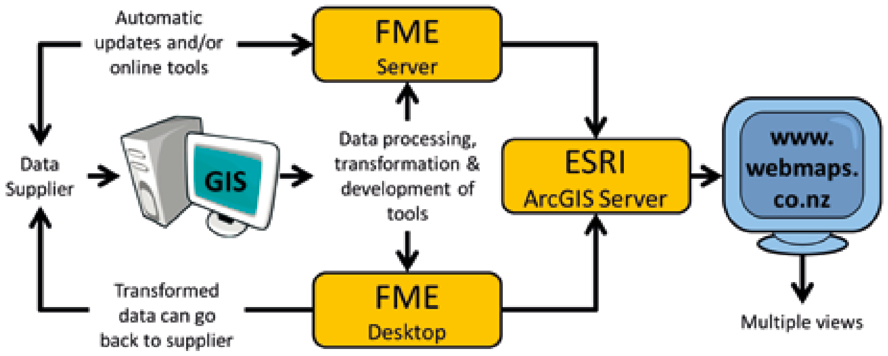


Figure 3: Technologies used by the GIS team to process, transform and validate data.

some of those key learnings. The past four years has seen the GIS team grow from two to ten; from being a portal for the display of data and information via the SCIRT web-map to being a fully integrated system within the organisation and the wider city rebuild. Systems have been developed wherein task automation, the creation of many smart online tools, setting standards and understanding our users' needs have all been key factors to this success.

A single source of information

As part of SCIRT's Integrated Services Team (IST) and responsible for the overarching tactical co-ordination of the infrastructure rebuild, GIS is positioned in the Commercial Team under the umbrella of Business Systems along with Business Intelligence (BI), with BI being responsible for the data warehouse. The data warehouse stores project and programme management information while GIS is the home of the asset and engineering spatial datasets.

The SCIRT GIS system consumes vast amounts of data from many sources – both spatial and non-spatial from multiple organisations – and in different formats specific to those organisations internal logic, rules and specifications. These data sources have been taken as is and then transformed, validated and stored in a consistent spatial format and coordinate system. Tools and processes are provided on top of this in order to present meaningful information through reports, graphs and visualisations that can be used for different purposes by different stakeholders. This enables informed decisions to be made and results in the best outcomes for the SCIRT programme and the people of Christchurch and New Zealand.

The standardised spatial data storage and web and mapping services have been implemented with ESRI ArcGIS software, supported by FME (Feature Manipulation Engine, provided by Safe Software Inc.) which has been used to create nearly all of the data manipulation and automation workflows in SCIRT's GIS system. With the technologies available and a low level of customisation, significant software development has been avoided and upgrades to the newest versions of ArcGIS and FME have been easily deployed, in particular implementing FME Server in 2014 which extended the GIS team's capabilities and allowed outside users without the software to run automated tools (Figure 3).

The SCIRT web-map was created as a portal to all of the information required by the organisation, allowing secure access to over 600 data layers and giving 1500+ users a current, easily-interrogated and quickly-accessible city-wide view of all their required information. Tools available include querying, drawing, annotating and overlaying, printing, editing and time animations. Users are given one of 32 view configurations, restricting views of the data depending on need and security level (Figure 4).

Understanding our users

With a programme the size of SCIRT change was inevitable, requiring flexibility and innovation in this GIS team's approach to data management and integration, with the resources available. It was important that what we were doing was not only relevant and could add value but that it would create efficiencies to saving both time and money, as well providing the best information available.

A key factor in achieving this was simply talking to people. We talked to our users to understand what information was required, in what form and what it was they were trying to achieve; we talked to the data suppliers to understand their data, issues and requirements; we talked to SCIRT's contractors to understand how they collect,

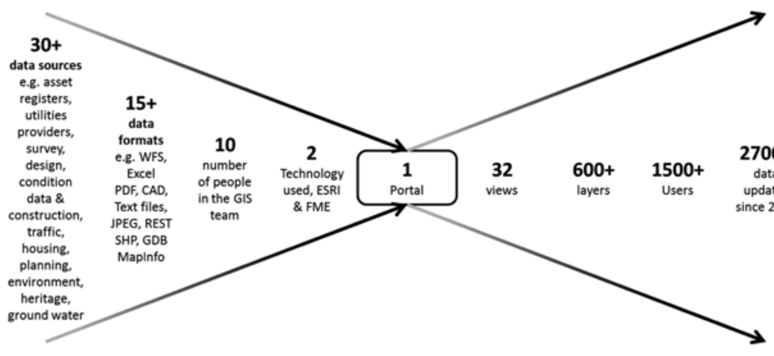


Figure 4: Some key numbers relating to SCIRT web-map.

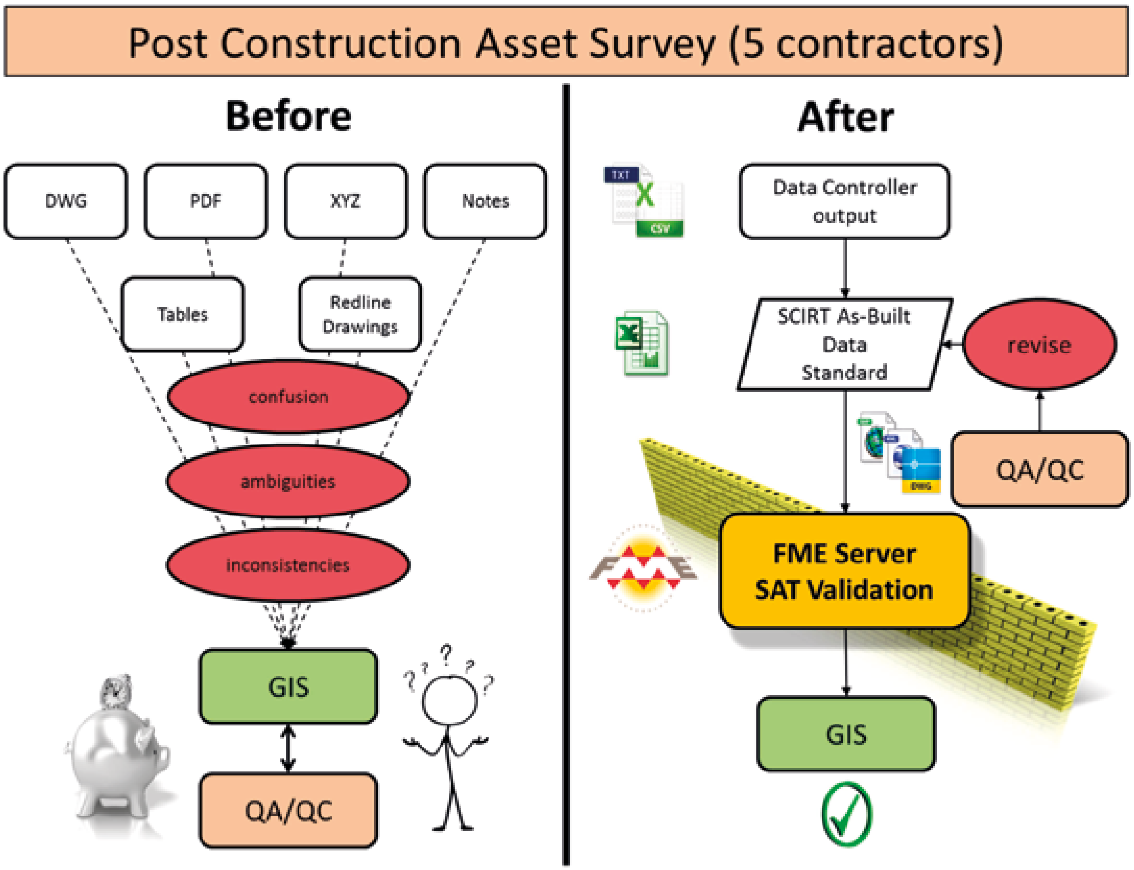


Figure 5: Post Construction Asset Survey before and after guideline development and process automation.

interpret and use data; and we talked to the client to understand the full context of their data and to future-proof the system.

As a result it turned out that the more we listened, the more our users understood what we could do, the more solutions we could provide and the more work we had to do, meaning we had to find ways of working smarter. Although some manual tasks and traditional user requests (for example, maps) were inevitable, understanding the scale of the task at hand and the possibilities of the technology available we focussed upon reducing manual tasks and increasing throughput with the same staff levels.

Working Smarter

Initially the basic solution was to create workflows that could be validated and automated to complete update and data dissemination tasks, utilising live feeds where possible. These outputs are validated thoroughly, before automation to varying degrees from fully-automated scheduled updates to stakeholder-initiated updates.

Since 2014, with the implementation of FME Server many existing and also new work flows and tools have been made available online. Hence allowing complete automation of data updates through scheduled processes and supplying self-validation tools to non-spatial users to give SCIRT's own data creators – our contractors – a full view of their outputs, shifting ownership for complete and correct data back to the source. The automation of repeatable tasks and processes has been fully embraced by the team and in 2015 we successfully automated 90% of our weekly data updates to scheduled processes using FME Server.

Automation of tasks is a key focus and one that we continue to expand. The automation of the post-construction asset survey, data validation and handover process is an example of this.

The GIS team have developed a comprehensive guideline for the surveying of all 3-waters assets which includes the following:

- Survey requirements and specifications for spatial and attribute information.
- A new as-built data format to transfer all survey information as per required standard into SCIRT GIS automated processes.
- Automated data flow of as-built data from site data collection and self-service online data validation through to automated spatial data creation, quality assurance, mapping, updating and reporting.

By taking a large, complex and mostly manual procedure and applying sense, logic, testing, education and training, a process has been created that gives confidence

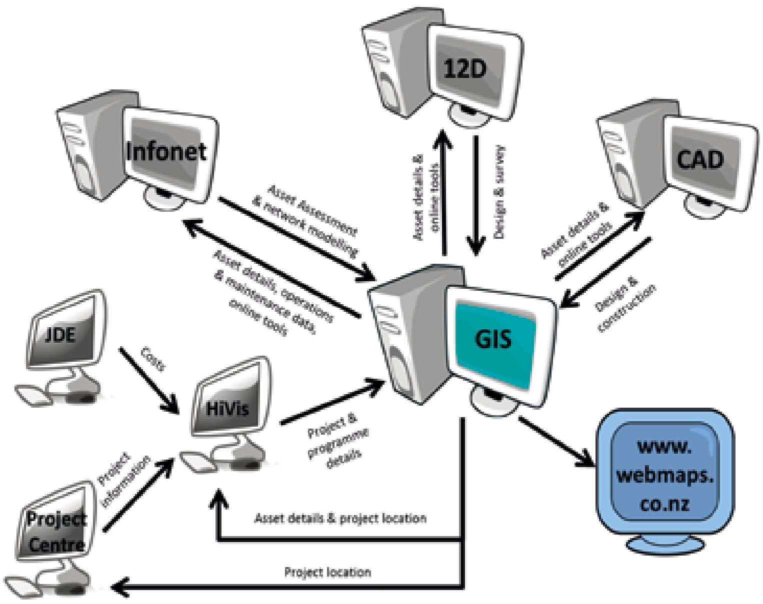


Figure 6: Systems integration at SCIRT.

that output data is fit for use and of a high standard. This is a concept that can be applied anywhere and one that is now serving as a blueprint for the development of a national As-Built Standard (Figure 5).

Benefits from Systems Integration

By leading communications on the processes and data requirements of other teams outside of GIS and also building relationships with the users and maintenance teams of 12d, InfoNet and AutoCAD systems used at SCIRT, an integrated system has been created where asset information flows cohesively through from design to construction and handover. Specific analytical processes are run for these teams with greater ease than existing systems, which while allowing them to create the same complex processes can be inefficient and overly manual in their operation. Many tasks with programme-wide benefits, previously run on these separate systems, have now been implemented within the GIS workflow.

An example of this is the creation of a single design layer on the SCIRT web-map. Design decisions for assets can be sourced from either 12d or the asset assessment spreadsheet where the design decision is updated from several asset assessment sources. The process created by GIS takes both of these sources, validates the data, checking the pipe actions are shown correctly. A single action for each pipe has been created and can be used for financial and forward work load planning, network modelling and project connectivity.

Another example of the successful implementation of GIS processes to support another team within SCIRT lies in our collaboration with the traffic team. Automated traffic impact analysis incorporates the spatial road network and project scheduling information to create a time series of roads impacted by works. As well as providing information that can be used by the governing group for traffic management in Christchurch to approve or reject road works going ahead.

As a result of the organisational structure within SCIRT, both GIS and BI teams sit under the Commercial Team. Thus enabling successful collaboration whereby the benefits of each system have been leveraged to provide solutions neither could achieve in isolation, and avoiding duplication of source data. The advantage that GIS provided was to be the conduit between the two, both reading from and writing into the data warehouse, providing enriched results.

By amalgamating BI and GIS data, it is possible to demonstrate what money has been spent and where, how quickly and by whom, and remaining budgets, all of which feed into strategic decision making as part of SCIRT's monthly board report. The integration of people, data and systems at SCIRT has demonstrated benefits to the programme through time and cost savings and richer outcomes for stakeholders.

Our Legacy

By understanding our users' needs, the possibilities of available technology and also the benefits of systems integration and embracing automation, an integrated system has been created. This system, in terms of pipe networks, represent what has happened to a particular asset over time and also incorporates vital programme information such as the SCIRT schedule, costs and project status.

This is a holistic system that can be used by multiple users, showing data and information from multiple sources, representing multiple phases, and provided through multiple views (Figure 6).

By breaking down the barriers to supplying data, having conversations with all of our users, being flexible in our approach, implementing change and functionality upon request and taking client requirements into account, a system has been created that is easy to use, current and adaptable for the future.

Even though we are now at a stage in the programme where many processes have been set up and are functioning well, these systems are continually being improved following feedback from the internal client, a focus shift or upgrades in technology as SCIRT moves towards its programme goals.

Josie Hawkey and Nathan Heazlewood have been coordinating initiatives to support geospatial professionals early in their careers.

GIS Young Professionals: Next Generation

By Nathan Heazlewood with assistance from Josie Hawkey

Recently I was working with a young industry colleague, Josie Hawkey, and during a side conversation she mentioned some of the challenges faced by her peers early in their careers. The development of the next generation of professionals is critical to any industry so I asked for her help to investigate the challenges (and rewards) of the early years of a career in geography/GIS. Josie contacted some of her peers for opinions that are reflected in this article.

Jobs in the geospatial industry require specialised skillsets, developed through a combination of training and experience. This experience requirement can become a 'barrier to entry'. Many job advertisements require "more than five years of job experience". This creates a classic chicken and egg scenario.

Josie said "I was very lucky to be employed by an organisation that taught me 99% of what I now know 'on the job'. Talking to a few graduates they say that there are not very many entry level positions available, and often job requirements don't match the graduate skillsets". We all remember the process of getting our first 'real-world' job. It is this job after all, that will shape the rest of your career, and therefore is a time when support from the industry is vital.

Josie says: "As an early career geospatial analyst I think New Zealand's geospatial industry could to do more; more to encourage the uptake of GIS in education, more to prepare students for the industry, more to place graduates in entry level jobs and do more to support early career professionals."

GIS in Education

- There are some initiatives (from organisations such as Eagle Technology, Local Government Geospatial Alliance and LINZ) to raise awareness of GIS in schools by making software and other resources available. Organisations such as these do a great job but they don't have the resources to visit every school.
- At universities geography remains popular but Josie doesn't believe there is enough understanding at the undergraduate level of how critical GIS is as a tool in within many organisations. New Zealand universities have started offering more courses in GIS at the undergraduate and postgraduate level with a new GIS Masters programme now offered at a number of universities. It's great to see that tertiary education is responding to industry demand for skilled graduates.
- Feedback from some young professionals suggests that there is also a gap between 'University GIS' and 'Real world GIS'; that university teaching is too prescriptive, with not enough emphasis on creative problem solving. The jump from step by step instructions and 'pre-cooked' datasets, into workplace requirements gathering and solution crafting is a real shock to graduates. As one employer, Tony Elson from Geographic Business Solutions, recently commented: "there is a distinct shortage of GIS Business Analysts – people who can understand and

document how enterprise processes operate and can combine this with GIS knowledge to improve those processes".

- Another common comment from young professionals is a lack of knowledge surrounding the structure of the industry. One graduate commented: "Coming out of my undergraduate degree I don't think I could name a single GIS company or company that would have a GIS team".
- Other feedback suggests that more could be done to inform students of what 'complementary skills' are required. Clearly IT/programming skills are a growing requirement, but courses in statistics, project management, data management and report writing should also be considered.
- Another key skill to GIS roles is communication. Being able to speak to end users of GIS products to understand their requirements and communicate to them the power of GIS is a skill that all professionals need to develop. Although this is a difficult skill to learn one there are established courses that can help, for example Toastmasters International.

Does the industry provide enough support to early career professionals?

Establishing formal and informal networks is one of the most important things that young professionals can do. The classic saying 'it is not what you know, it is who you know' is particularly true in a small community like the GIS industry. After talking to a number of young professionals, it seems that those who have had the most positive experiences entering the industry have actively involved themselves in their respective GIS communities, keeping in touch with lecturers, forming networks and taking internships.

There are a number of industry groups such as the NZ Esri User Group, Women In Spatial, Te Kahui Manu Hokai, Auckland GIS Group, Georabble and WaiGIS. It can be intimidating walking into a conference as a newcomer and trying to forge networks where most of the senior people already know each other. However there is an increasing online presence for the industry groups, offering another (less daunting) opportunity to engage with others in the industry through groups on LinkedIn, Facebook and Twitter. The industry as a whole should continue to support these, and to encourage students to be active in these groups.

What can the industry do better?

As mentioned previously, entry level jobs are the hardest to get, but often the most important, as they shape your career. Josie's peers feel that they learnt the majority of their GIS skills within their first six months of their initial geospatial job, however training a graduate is an expensive and time consuming task. All too often businesses find it easier to employ an experienced analyst, although this is a short-sighted strategy for the industry. Organisations could consider formalising a graduate position, or alternatively offering internships to students over summer.

If you are a senior person in the industry offer your time as a mentor, or give a lecture about your GIS organisation at your nearest university. It seems that coordination of resources and information for young professionals could be improved. For example the various internships and cadet schemes that are available. Many organisations (including Eagle Technology, Environment Canterbury, Auckland Council and Department of Conservation) have these schemes, however I am not aware of anywhere that conveniently collates all of these types of opportunities into one place.

The Rewards of a GIS Career

Many of the points above may sound a bit negative but they are intended to provide encouragement for making positive improvements. It is important to note that Josie and her colleagues were extremely positive about their decision to pursue a career in GIS, and grateful for the assistance that they get from educators, employers, colleagues and mentors. From my perspective, despite the everyday grind of normal office life, I just want to say that I LOVE GIS! It is a profession that I have spent half a career devoted to, it has allowed me to travel around the world and to make friends with a lot of great colleagues.

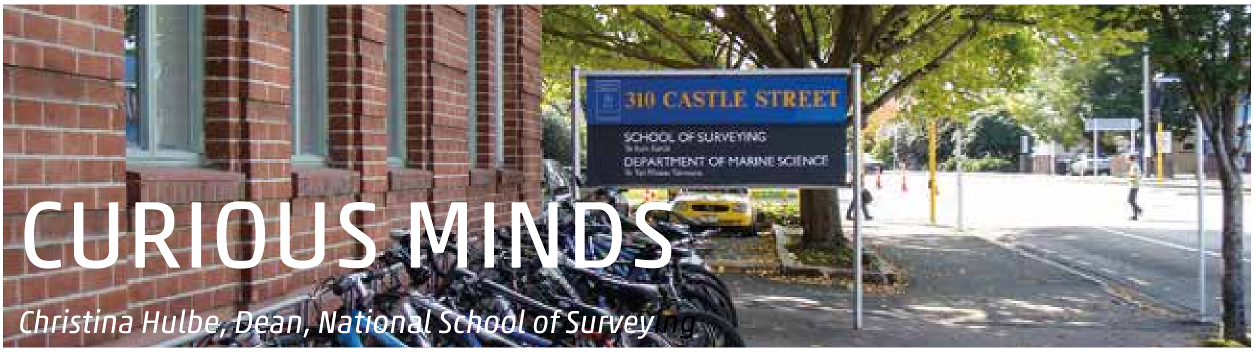
Given that I think GIS is doing great things for the environment and society; it gives me great satisfaction to meet some of the enthusiastic young GIS students and professionals, many of whom are more intelligent than I ever was. I feel a little bit of pride that I helped in some small way to build an industry that they want to work in.

Now that I am uncomfortably settling into an unaccustomed role as a 'Geo-Silverback' and eyeing the second half of my career it gives me great hope for the future to see these young people joining the industry, and I think that we should thank them for choosing this industry over the other options that they had.

The importance of GIS to aid with meeting some of the challenges that the planet is facing means that we need to encourage talented young people into the industry and to aid them in their early careers.

For more information about early careers initiatives email younggeokiwis@gmail.com

The views expressed in this article are personal opinions and do not necessarily reflect the views of Nathan's nor Josie's employers.



CURIOUS MINDS

Christina Hulbe, Dean, National School of Surveying

In July of 2014, Government released an action plan to encourage better connections between the science and technology sectors and the rest of Aotearoa New Zealand society. The plan, titled "A Nation of Curious Minds: He Whenua Hirihi I te Mahara", clearly connects innovation and opportunity with science literacy and science engagement. The importance of that connection isn't news to anybody reading *Surveying+Spatial* but it's important to think about what it means in practice.

Personally, I'm not keen on putting "scientists" in one corner of the room and "society" in another but I recognise that this distinction is common. And students must make choices about what to study. The more New Zealanders know about the role that science and technology research play in shaping the world, the more likely we are to find well-prepared and enthusiastic students applying to our programmes. We also need clear voices translating research findings and technical details into information everybody can use.

The Curious Minds strategic plan calls for a clear code of conduct for science public engagement. The Royal Society of New Zealand recently released a draft "Researcher guidelines for public engagement" in response to that call (*http://www.royalsociety.org.nz/events/consultation-meetings-researcher-guidelines-for-public-engagement/*). It's not a code, but instead a framework for best practice in public sector engagement. The Society is now soliciting feedback about the guidelines online and in a series of public consultation meetings. I attended a consultation meeting here in Dunedin and encourage all of you to have a look at the guidelines too. Your work is directly affected by research and related activities at universities and Crown Research Institutes *and* you are experts in communicating technical information to diverse audiences.

We probably all agree that researchers should share their knowledge when asked to do so, and that this should be accomplished in a professional way. When your salary and work is funded by New Zealanders, they have a right to know what you are up to. Scholars also have an obligation to be clear about the limitations of their work. Just as measurements only have meaning when accompanied by an error estimate, research findings only have meaning when accompanied by information about the context in which they were produced. This can be a challenge: we need to share what we know and quantify the errors in ways that add confidence, not sow doubt, about our findings. This situation probably sounds familiar. Surveyors, planners, and other spatial professionals translate technical material into information their clients can use every day.

A point on which we might not all agree is the researcher's obligation to engage when *not* asked or when the subject is likely to be controversial. Indeed, "advocacy" was a prominent topic at the guidelines consultation meeting I attended. Is raising an alarm or holding a contrary view advocacy? And if it is advocacy, is there anything wrong with that? I'd argue that there isn't, if the alarm or view is supported by research that's been reviewed by scientific peers. Others may disagree and the answer may depend, for better or worse, on who funded the research.

The Education Act is clear, charging universities to act as the "critic and conscience of society", though different university administrations may read this charge differently. The Crown Research Institutes Act embeds a commitment to "social responsibility by having regard to the interests of the community" but paired with close industry partnerships, opportunities for expression are more constrained than in the university setting.

Following the initial release of the Nation of Curious Minds report, the New Zealand Association of Scientists conducted a survey on public engagement among scientists working at research institutes and universities (*http://www.scientists.org.nz/blog/2014/survey-on-the-proposed-code-of-public-engagement*). Respondents clearly believed in a public role for scientists yet about 40% indicated that they were not free to take up that role. That might be an appropriate trade-off for a system in which the public and private sectors often work closely together or it might be exactly the wrong arrangement. Either way, as a community of researchers, technical innovators, and practitioners who work relatively closely together, I encourage you all to review the proposed Royal Society's Researcher guidelines for public engagement and comment if you feel inspired to do so.

"The Leica Captivate solution enables Envivo to make better on site decisions improving the efficiency of our field crews and the quality of our field work. We can now visually check on site the completeness of our job, ensuring that we have captured all the data we need and thus avoiding costly returns to the site. The Captivate hardware along with Global Surveys support solutions also provide Envivo with the technological framework to allow us to cope with the industries changing needs and venture confidently into the exciting world of 3D and BIM."

MARK FINLAYSON
Survey Director, Envivo Planning,
Surveying & Engineering

LEICA CAPTIVATE RANGE

Experience the
future of 3D surveying
Free LIVE Demo

GLOBAL SURVEY

SURVEY &
CONSTRUCTION
TECHNOLOGY

0800 453 422
WWW.GLOBALSURVEY.CO.NZ
Contact us now for our great promotions

Leica Geosystems