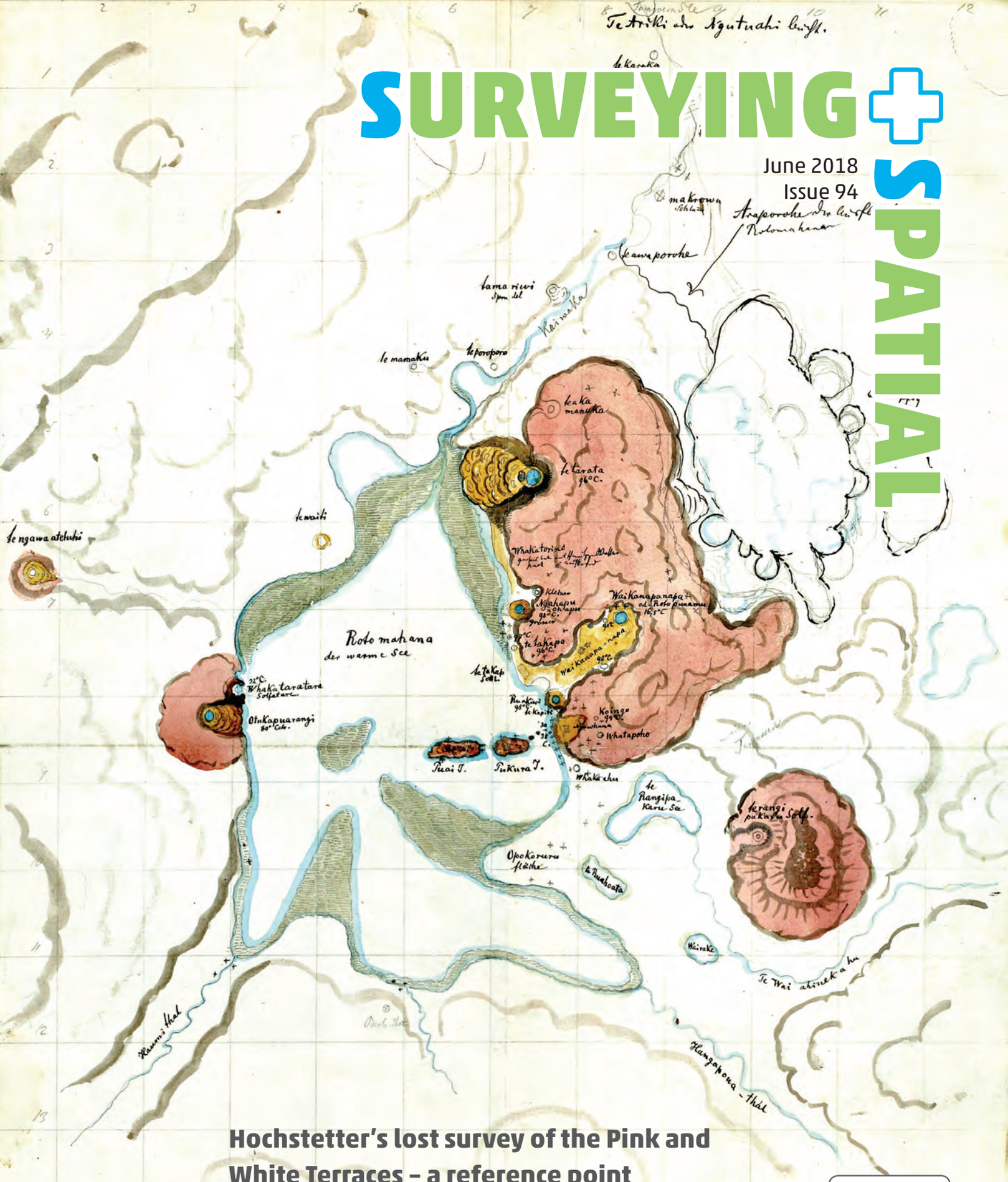

SURVEYING + SPATIAL

June 2018
Issue 94

Hochstetter's lost survey of the Pink and White Terraces – a reference point

NZ land development after the Global Financial Crisis – a surveyor's perspective

2018 FIG Congress and Young Surveyors Conference in Istanbul

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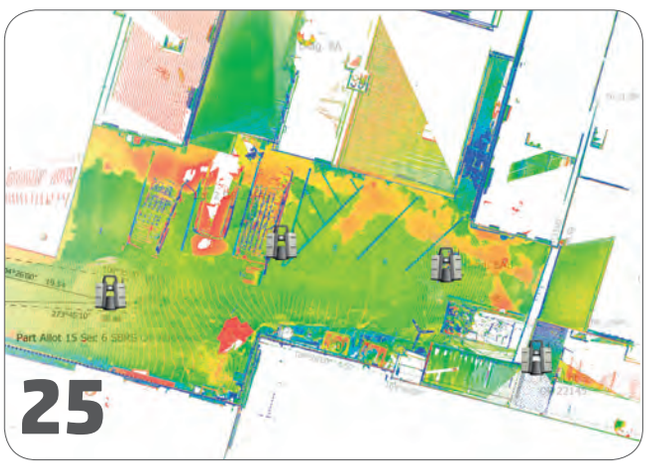
COVER IMAGE
Hochstetter's method-of-squares (MoS) map,
Hochstetter Collection Basel, 2013



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New Zealand Institute of Surveyors
Te Rōpū Kairūri o Aotearoa

ISSUE 94 JUNE 2018

SURVEYING+SPATIAL
A publication of the New Zealand Institute of Surveyors – Te Rōpū Kairūri o Aotearoa
ISSN 2382-1604
www.surveyors.org.nz

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Distributed free to members of NZIS.

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

DESIGN & PRINT MANAGEMENT
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Progressive new outcomes

Rachel Harris

Winter is starting to get underway here in the south, with plenty of snow now visible on the Southern Alps.

The winter season also marks the return of NZIS's annual conference, which recently concluded in Nelson this May, with a number of successful discussions and outcomes for the industry.

The conference featured plenty of thought-provoking topics this year, including a special focus on climate change planning, and the potential role in which the surveying and spatial industry could play in future planning and policy decisions in New Zealand.

The focus on this issue will undoubtedly intensify over the next few years as local and national agencies and the surveying and spatial sector continue to explore projections, potential impacts and look at long-term strategies.

The newly established Kairūri Community Trust also had a very successful start this conference, with $20,000 raised at auction during the Glenn Stone Insurance dinner. The funds raised from this event will enable the Trust to achieve its goals towards educational scholarships, programmes, and awareness of the surveying and spatial sector in the community, a great start for this charitable organisation.

This edition features a wide range of topics from across the industry, from GNSS technology in cadastral surveys to new research and industry developments.

Researcher Rex Bunn, Nick Davies and David Stewart of Cheal Consultants provide their fascinating interdisciplinary research findings on the search for the Pink and White Terraces based on Dr Ferdinand von Hochstetter's 19th century survey diary of the area.

Hochstetter's 1859 survey, the only survey of old Lake Rotomahana and the Pink and White Terraces, provides some informative data along with his Method-of-Squares Map, to reveal a likely route to his field of view at old Lake Rotomahana.

From the Young Professionals, Robert Mears and Claire Buxton report on New Zealand's representation, international Volunteer Community Surveyor Program and professional development initiatives presented at this year's FIG Young Surveyors Conference in Istanbul.

The current role of the land development surveyor in New Zealand in the post-global financial crisis world is examined by cadastral surveyor and land development sector specialist Carl Salmons in our land Development and Urban Design Professional Stream article this edition.

And from the University of Otago's National School of Surveying, postgraduate student Todd Redpath has compiled a remarkable range of postgraduate research topics currently being undertaken by students.

Winter update

The 2018 NZIS Conference has just taken place, and what an event it was!

Congratulations to everyone who presented or helped organise and run this event. It was another step up from last year's conference and I very much enjoyed the opportunity to be inspired by our keynote speakers, learn something new and catch up with friends old and new. I encourage participants to share key takeaways with their families, colleagues, branches and wider community. Use social media technology and face-to-face conversations to spread the word about what makes our sector unique, and how we are contributing to society as a whole.

During breaks and at the social events, several members reported that their branches were not functioning as they should. I want members to know that NZIS Council and Board have committed to engaging more regularly with branches across the country, and to share more widely the issues we are debating. Our branches should be the lifeblood of our organisation and where our members receive most value.

In early April, I attended the Pacific Geospatial and Surveying Council (PGSC) meeting in Tonga to sign a memorandum of understanding between PGSC and NZIS.

Under this agreement, NZIS's role will be to support the PGSC in ways such as offering free overseas NZIS membership to PGSC members which will enable access to NZIS training resources, assistance with applications for NZAID funding to cover costs for PGSC representatives attending key surveying and spatial conferences or workshops in New Zealand (such as the NZIS Auckland conference in 2019) and applications for training scholarships.

One particular challenge facing surveying bodies in Small Island Developing Nations (SIDS) is a lack of expertise in specialist areas such as geodesy. This makes it very challenging to update geodetic reference frames and to use modern technology that could help speed up recovery efforts following natural disasters or to monitor the effects of climate change.

Several of our members have provided support to PGSC over the years since the FIG Working Week in Christchurch – I know of Chris Pearson (University of Otago) and Matt Amos (LINZ) specifically, but I am sure there are many more. Thank you on behalf of NZIS for the discretionary time and effort you have put in to progress this important work.

At our meetings in April, both NZIS Board and Council discussed the need to develop stories about the ways in which surveyors and geospatial professionals are helping to solve the big issues facing New Zealanders. One example was the housing crisis, others include climate change and education. We realised that by developing these stories, we stand a better chance of being able to communicate the breadth of skills within our sector, how our members can provide useful advice at the early stages of policy development and the wider effect that skills shortages in our sector will have on achieving government priorities.

It is also clear that we cannot expect to convey these messages alone. There is a lot of value in showing that we can work alongside other professions to jointly offer advice and develop solutions. I would encourage members to let NZIS technical stream and branch committees know early if there are particular issues in your region that we should be providing advice on. Our National Office is now well staffed to help develop responses, but we do need to ensure adequate lead-in time is provided in order to fine-tune our messaging.

Rebecca Strang, NZIS President

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Dr Hochstetter's Lost Survey

THE PINK AND WHITE TERRACES AT LAKE ROTOMAHANA

Rex Bunn, Independent Researcher;
Nick Davies and David Stewart, Cheal Consultants, Rotorua

Introduction

The first survey of the central North Island was undertaken in 1859 by a team led by Dr Ferdinand von Hochstetter, who was visiting New Zealand with the Austrian Novara expedition. The colonial government commissioned surveyors Julius Haast and Drummond Hay, along with cartographer Augustus Koch, to join Hochstetter in a 21-strong party. The project took three months and surveyed 10,000 square miles (259,000 hectares) and 200 peaks across the North Island.

As it is an important part of the New Zealand surveying profession's history, and uniquely involves our lost eighth wonder of the world, the authors set out to include it in the country's survey estate.

Hochstetter based his survey method on the approach used by the 1856 Pandora coastal survey of New Zealand. (Byrne 2007) This was executed "…by means of the Azimuth-compass, a system of triangulation which I based on Captain Drury's nautical coast-survey". (Hochstetter 1867:20)

The 19th-century marine surveying technique is summarised thus: "The first part of the work… laying off a suitable base line… The next thing to be done is… a process called 'triangulation'. Each end of the base line is made a station for observations, and from these stations angles are measured… The first point chosen is then plotted off on its true bearings from both ends of the base line…". (Brown 1953:191-192)

Hochstetter could not know that his survey would be the only one of old Lake Rotomahana and of the Pink and White Terraces, which had achieved worldwide fame as New Zealand's eighth wonder of the world and within a decade was producing the first tourist boom for the young country. He predicted the Tarawera eruption but could not

know this would destroy a lake he much enjoyed – given the 24 pages of his diary devoted to his two days at Lake Rotomahana.

Hochstetter was realistic about the accuracy of his survey mapping, commenting later: "It stands to reason that a map which contains nearly 2500 miles [10,000 square miles] and embraces more than the fourth part of the Northern Island, executed by the assistance of a compass alone, within the period of three months, can make no pretensions to a trigonometric exactness. It is, however, the first map which gives a correct view of the rivers and mountain systems, and of the lakes in the interior of the Northern Island, and will be useful until some better and more complete map takes its place." (Hochstetter 1867: 49-50) Nothing ever did take its place for the vicinity of Lake Rotomahana.

Later that year, he returned to Europe but retained links with New Zealand until he died in 1884. His survey field diaries and mapping remained in Europe. In 1886, the Tarawera eruption destroyed the old Lake Rotomahana and the Pink and White Terraces and despite Māori first responders reporting that the Pink Terrace had survived, four later government-commissioned reports (Hector 1886, Smith 1886, Hutton 1887 and Thomas 1888) concluded that the terraces had probably been destroyed. Their survival or demise was debated in the media until the eruption survivors died out, and after World War II, there was little to question this presumption until 2011 when a GNS Science marine team reported finding the Pink Terrace deep under today's Lake Rotomahana, in a crater lake 10 times larger and 12 times deeper than the old lake. After two further missions to the lake, GNS resiled from its many media announcements and reported in 2016 that both terraces were probably destroyed. (De Ronde et al 2016:1)

In 2015, researcher Rex Bunn met the authority on Hochstetter, Dr Sascha Nolden, who was curating Hochstetter's estate in Basel, Switzerland. On 23 February 2016, Nolden passed to Bunn diary pages from his Rotomahana visit. Bunn noted the compass bearings and considered the possibility of reconstructing the 1859 survey to establish the terrace locations and resolve continuing uncertainty of their survival or demise. Bunn and Nick Davies, of Cheal Consultants, met soon afterwards and examined the survey bearings.

The following is a summary of the interdisciplinary research. The diary did not contain sufficient bearings and landmarks to accurately coordinate the Pink and White Terrace locations via resection methods. It did however; provide sufficient data along with Hochstetter's manuscript map (termed the method-of-squares map), for us to reverse engineer his surviving survey data, retrace his footsteps and establish the field of view from his two observation stations around old Lake Rotomahana.

From these stations, (Stations 21 and 22), there are 13 bearings on 10 surviving landmarks which enable us to reconstruct Hochstetter's survey baseline. The reciprocal bearings from his 10 landmarks to the two observation stations, establish the latitude and longitude coordinates of these stations. From these stations, further diary bearings can then be projected to the Pink and White Terrace spring locations.

Finally, Hochstetter's method-of-squares (MoS) map is georeferenced over Google Earth (V 7.3.1.4507 © Google 2018) to provide intersections for the Pink and White Terrace spring locations. The approach was assisted by Nolden providing access to Hochstetter's field sketches, copious notes, artwork, correspondence, lectures and books. The method-of-squares map was derived on the basis of a 19th-century survey method which is also a technique employed by artists to establish scale on a canvas. The survey baseline provides scale and orientation to the Hochstetter MoS map.

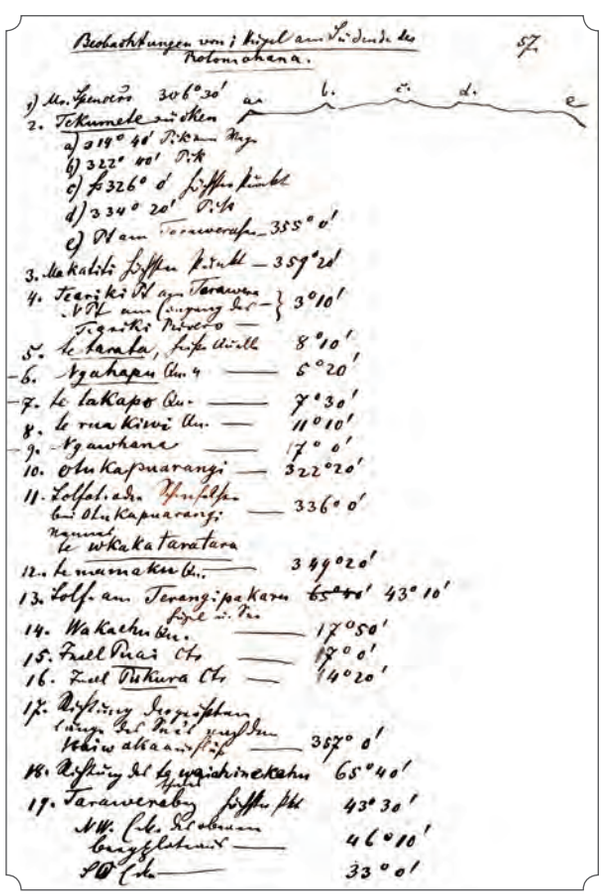

Figure 1: Page 57 from Hochstetter's Diary (Hochstetter Collection Basel).

The first survey iterations in 2016 relied on topographic maps and ruled bearings, using essentially the latitude and longitude of identified landmarks. These included trig

stations, but there were no trig stations in this region in 1859, nor were there any maps or previous surveys. It was terra incognita.

In 2017, Bunn finally resolved the altimetry of the old Lake Rotomahana. Due to the non-availability of barometric altimeters before 1928, 19th-century altimetry used Bourdon pressure gauges which were inaccurate and could not be calibrated given the remote location of the sites, poor communications and the lack of aerodromes. Bourdon gauges used in this application were compromised by hysteresis, imprecision, lagged mechanical response, inconsistency, temperature and humidity effects. Thus, every previous terrace researcher (who throughout the 20th century and early 21st century were principally geologists) had been reduced to guessing that old Lake Rotomahana was one to two metres above Lake Tarawera, as water flowed from one to the other down the Kaiwaka Channel. Being unable to account for altitude, further geographic information system research was impossible. With latitude, longitude and altitude data computed during 2017, the location of the terraces and their likely distances underground were able to be first estimated.

In 2018, to improve the accuracy of Hochstetter's terrace and lake locations, Bunn went back to the field diary, zero-based the landmark identification and re-analysed every bearing and each bearing dataset. It was recognised that a GIS model approach was of limited application, as the new Lake Rotomahana, said to contain the old lake, was about 10 times larger and 12 times deeper than the old lake; nearly all close-in landmarks were destroyed, and landform changes from the eruption, overlain with chronic erosion, had significantly changed the topography around the new lake. The landmarks and peaks used by Hochstetter might also have altered in the past 132 years since the eruption and 160 years since the survey.

To determine this, Davies and Bunn adopted a fourth criterion – Hochstetter's field of view (FOV). Building on the 2017 altimetry, we could now estimate Hochstetter's FOV from his observation stations, and establish his landmarks with greater precision and accuracy than when relying on latitude, longitude and altitude.

In March 2018, after more study of the Hochstetter data by Cheal Consultants in Rotorua, it was realised the crucial Hochstetter bearings on Mt Tarawera had been misidentified in 2016. This reflects the colonial confusion in the naming of the mountains. The traditional names of Wahanga, Ruawahia and Tarawera were frequently concatenated as Mt Tarawera. Hochstetter, we realised, in referring to the highest point on Taraweraberg, Ruawahia, was in fact referring to the highest point on Tarawera Peak, the smaller mountain constituting the south-western section of the Tarawera massif. Site, photographic, cartographic and desk research over February to March 2018 placed this beyond doubt. Hochstetter's bearing (Bunn terms it his master-bearing) establishes both stations 21 and 22 by providing ideal cross bearings taken on Koa Peak, an overlooked part of Mt Tarawera but undoubtedly the highest available peak on the massif to Hochstetter on April 29, 1859. The landmarks and bearings are discussed below.

Hochstetter's landmarks and bearings

While his notebooks contain many compass bearings, only two pages contain bearings at Lake Rotomahana. Among these, all close-in landmarks below Te Tarata along the Steaming Ranges (later termed Pinnacle Ridge by Keam), i.e. the geothermal tourist features, were lost in the eruption and their sites are not discernable in today's landscape. The surviving landmarks with bearings from Hochstetter's observation station 21 are listed below and shown in Figure 1, taken from his diary.

The 10 surviving survey landmarks include:

- Rev S. M. Spencer's home at Te Mu
- Five peaks along Te Kumete Ridge
- A peak on Makatiti Plateau
- Three bearings on Mt Tarawera

Azimuth 1 – Rev S. M. Spencer's parsonage at Te Mu (bearing 306° 30').

The house no longer stands at Te Mu. We knew Hochstetter stayed there before and after his Rotomahana visit, and was familiar with the location. Bruno Hamel photographed the residence in 1859. The Te Mu block subdivision plans survive and show the parsonage on a ridge above Te Wairoa. The intervening country rises to c. 500 MASL and the parsonage could not have presented in a line of sight from Station 21. In 2016, Bunn presumed a surrogate location and Hill 505 above the parsonage appeared the best candidate. It assisted with a fair resection only.

In 2018, with better altimetry and with Google Earth's ability to explore oblique views, Bunn made two more field visits to Te Mu, climbing up past the parsonage elevation and examining the skylines to the NW and SE. Clearly the parsonage was below the skyline, yet it also appeared in bearings from observation stations 18 and 20, the latter above Kakerangi (Oneroa). Given the relative elevations, a considerably higher surrogate peak must have been involved, i.e. ≥600MASL. Hochstetter had labelled these bearings as 'Rev. Spencer's' for his own usage, for the peak he actually used had no name. The answer became clear after identifying the probable Kakerangi location above Oneroa. By triangulating bearings from Station 21 and Station 20, the intersection lay on Hill 2410, the

location of the 1970s trig 7693. From skyline analysis, this peak at 698m, with defined convexity and visible above the skyline from both stations; was indeed the parsonage surrogate. From Station 21 it is a run of ~10km. The reciprocal passed through the established Station 21 locus. Clearly, Hochstetter had noted this peak, probably while walking up Lake Rotokakahi and selected it for future use. It was one of 200 he used and he appears to select peaks with a pronounced point of reference and ones that were just visible along a skyline, perhaps as an aid in finding the true highest peak along an array of similar peaks.

Azimuths 2-6 – Five peaks along Te Kumete Ridge

Five bearings are given along this ridge as below:

- Bearing One –Peak on the way or Peak on the route/ track 314° 40′
- Bearing Two – Peak 322° 40′
- Bearing Three – Highest Point, 326° 0′
- Bearing Four – Peak 334° 20′
- Bearing Five – Point on Lake Tarawera 355° 0′

Peaks one to four were clustered, lending themselves to a gap analysis. Peak Three, Te Kumete is the middle of five peaks and the best identified with two trigs. After the eruption, Te Kumete remained visible in the post-eruption reports and at the same altitude as now – 558m.

Peak One was interpolated by gap analysis as a saddle below a high point on the western escarpment of Te Kumete Ridge. This was consistent with the Te Wairoa-Rotomahana overland route described by Hochstetter. Peak Two is a 520m peak west of Te Kumete. Peak Four is Hill 515 today and Peak Five is the unnamed point below Mataneho Point. In 2016, Bunn used Mataneho Point. Either can be said to abut Te Kumete Ridge, while the unnamed peak meets the FOV (field of view) requirement and the reciprocal strikes the 2018 locus.

Azimuth 7 – A peak on Makatiti Plateau

This bearing was problematic in 2016. Bunn erred in selecting Hill 873 as the landmark, based on a Hochstetter sketch showing only one left-hand peak on the plateau. Under our FOV approach, Bunn located images by George Valentine and Frank Coxhead showing the pre-eruption Makatiti Plateau skyline as in Figure 2. This Coxhead photograph was shot from ~326MASL, i.e. almost the same elevation as Station 21, and from ~1600m north of Station 21. Valentine was perhaps the best terrace photographer and we can discount rectilinear distortion in his image, given he used a large format 12" by 10" camera with almost certainly a Dallmeyer Rapid Rectilinear lens. (Bunn 2016 and Hall 2004: 27) This Coxhead image was shot seven years earlier but is technically comparable to the Valentine image and the rendition of Makatiti Plateau is identical. This bearing runs for ~15km.

Figure 2: Makatiti Plateau in 1878-1880 (Photo by F. A. Coxhead, Te Papa 0.031022).

The Hochstetter 'Peak 873' can be seen away to the left of the wide feature in Figure 2. However, this was not the highest peak. There are two candidates for this, and these lie close together above the Coffee Cups. These correspond to today's trigs ALU9 and RGMK. If we project the reciprocals from these trigs to Station 21, the rays pass close to Station 21 and at an equal distance either side of the locus. The trigs are barely 1° to 2° apart along this bearing. We conclude Hochstetter's Makatiti landmark lay between today's trigs.

Azimuths 8-10 – Three bearings on Mt Tarawera

These bearings were taken on a mountain which erupted in 1886. However, the upper mountain plateau of Mt Tarawera was largely unchanged after the eruption, save for the fissure. Ruawahia remained the highest point and the south-eastern and south-western edges remained defined, as did Koa Peak.

As Ian Nairn reported: "In general, the mountain did not look greatly different prior to the 1886 eruption, except that there were no craters on the summit." (Nairn and Houghton 1986:202) This was particularly the case over the plateau edges which Hochstetter had used, and again Nairn advises: "The 1886 basalt deposits… rapidly thin to c.1m only a few hundred metres away from the fissure". (Nairn and Houghton 1986:204) Also, Smith in his 1886 eruption report provides pre- and post-eruption skyline views of the Tarawera summit, assuring that pre-eruption high points remained visible and were also post-eruption high points. (Smith 1886:43) (See also Figure 3)

These three bearings were important, for they provided right-angled crossing with the Te Kumete bearings, for optimal loci accuracy. They comprise as written:

- Taraweraberg (mountain) 43° 30′ Mount Tarawera highest point
- NW 46° 10′ [north-western corner of the upper mountain plateau]
- SW 33° 0′ [south-eastern corner of the upper mountain plateau]

In 2016, these bearings were misconstrued following the colonial confusion over the mountain names at Tarawera. The three named peaks, Wahanga, Ruawahia and Tarawera, were colloquially termed Tarawera, i.e. the massif. While Ruawahia was, and remains, the highest peak along the massif; it was not in Hochstetter's FOV either from Station 21 or Station 22 on April 29,1859. Fortunately, photographic evidence exists to confirm this.

Figure 3 was taken on April 29,1859 by Hochstetter's photographer Bruno Hamel on Puai Island, the location of Station 22. The view looks up beside the Waikanapanapa Valley, as shown in Figure 8. Along the central skyline are shown two peaks on Mt Tarawera, with the Steaming Ranges in the foreground. The right-hand peak (arrowed) is the characteristic head of Koa Peak, with its arrowhead shape and out-thrust eastern ledge. To its left (arrowed) is Tarawera Peak peeping over the skyline, as if the shot were composed to show these two skyline features.

This photo is from the earliest photo shoot at Lake Rotomahana. As with terrace photographs, we know neither the camera, lens, nor in most cases the plate size. The lens was possibly a Chevalier landscape lens. Most plates from this era were lost and the terrace photo estate now comprises mainly prints and these are often cropped, precluding them from photogrammetry. There appears to be only little distortion in this image and it does not impede our interpretation of relative elevations. The inclination is ~6.64°, and Station 22 was set back ~50m from Hamel's location and at ~-2m altitude. Given the 6.2km run to Koa Peak, this set-back made negligible difference to perspective, i.e. from 6.64° to 6.60° inclination. Tarawera Peak is lower than Koa Peak from this line of sight, confirming that:

- Hochstetter could see Mt Tarawera from his Puai observation station Station 22, but not Wahanga or Ruawahia, ruling them out of contention for the highest point or highest peak.
- He could only see Koa and Tarawera peaks on Mt Tarawera.
- Koa Peak was higher than Tarawera Peak and was the highest point he could see from Station 22.
- The pre-eruption peak form of Koa Peak is near identical to the post-eruption form (in early 20th-century photos), and the form today.
- The shot was taken from the eastern end of Puai Island.
- Due to Puai's small size (76m by 30m), manuka bush cover and seven or more huts, the only all-round view for Station 22 lay at the western end. The ~50m set-back, offset by ~2m lower elevation gave a marginally better skyline to Koa Peak.
- We can exclude Pukura Island as the site of Station 22.

The photographic evidence shows Koa Peak bearing on Mt Tarawera was the landmark Hochstetter first used from Station 22.

Figure 3: Steaming Ranges with Koa and Tarawera peaks behind (Tarawera arrowed left and Koa right). Photograph by Bruno Hamel, 1859 (Hochstetter Collection Basel, HCB 2.7.31 Copy 2).

Hochstetter also specified the highest point on Tarawera from Station 21, and it's important to check his FOV from that station as well. In Figure 4, Koa Peak is shown clearly to the right of the massif. Tarawera Peak is next left at 1050m and is higher than Koa at 1024m in this view. Tarawera Dome is down at 824m. However, we know the rim ash on Tarawera was ≤60m deep (Nairn and Houghton 1986:204). This places Tarawera Peak below Koa Peak elevation today, once we account for ash residue. We conclude Koa was the highest peak in view on Mt Tarawera that day in 1859 and also note Ruawahia is just visible above the skyline to the left. As with Tarawera Peak, once we deduct the eruption ash cover of ≤52m (Smith 1886:204), Ruawahia is no longer in our FOV, leaving Koa Peak as the Hochstetter landmark from Station 21.

Hochstetter's remaining landmarks on Tarawera were the corners of the upper mountain plateau. Given Nairn and Smith's reports above, one can be reasonably certain these plateau edges remain defined, especially on the eastern flank. The drop-offs were plotted along the west-

ern edge 900m contour below Hill 949 and the eastern edge along the 1000m contour adjacent to Koa Peak.

Figure 4: Mt Tarawera and Koa Peak taken near Station 22 (Photograph by Ingrid Fisher 2016).

The Tarawera bearings contain an author's correction. Hochstetter overwrote SW 33° to SE 33°. This was a transposition error, as the correction ought to have applied to the NW bearing. A simple spatial analysis from Koa clarified this. The eastern escarpment is close to Koa: it is ~4 times further to the western edge. The corrected bearings are below:

- Taraweraberg (mountain) 43° 30′ Mount Tarawera highest point
- NW 46° 10′ [north-western corner of the upper mountain plateau] – should read NE 46° 10′ [north-eastern corner of the upper mountain plateau]
- SW (overwritten SO for SE, *ost* in German is *east*) 33° 0′ [now south-eastern corner of the upper mountain plateau] – should read as originally written SW 33° 0′ [south-western corner of the upper mountain plateau]

Station 22 was located on Te Puai Island and this station has only three surviving bearings – to Tarawera's highest point Koa and to two points on Kumete Ridge, the highest point and a SW peak about 15° to the west. This latter peak proved to be the same peak as his Peak One used later that day from Station 21. These bearings are shown in green on Figure 8.

For declination correction, a validation was performed on the next segment of Hochstetter's survey, from Mt. Ngongotaha, a location without recent volcanism and local magnetic variation. Bunn passaged declination through a set of nine reliable bearings on close and distant landmarks, examining the mean error and variance in Figure 5.

The 1855 Admiralty correction of 14.48° gave a mean error of 1.34° and range 1.67°. The 1859 Auckland IGRF declination of 13.44° gave a mean error of -0.32° and range 3.78°. The 1859 Mt. Ngongotaha IGRF correction of 14.01° gave a mean error of 0.25° and range 3.78°. The Ngongotaha validation indicated the IGRF model gave the lowest average error, but the Admiralty data gave the smallest range. We elected the IGRF correction.

Figure 5: Mt Ngongotaha Survey Validation to Motiti, Whakaari and Mokoia islands (Bunn, Google Earth 2018).

Findings

This survey iteration includes every bearing on a surviving feature. It incorporates data from Station 20. It updates the Tarawera bearings to Koa Peak, and the Spencer, Mataneho and Makatiti landmarks. It uses a four-stage algorithm:

Stage 1. Locate 10 surviving landmarks and prepare 13 reciprocal bearings from 1859 true north.

Stage 2. Resect locations of observation stations 21 and 22 in today's landscape.

Stage 3. Plot 1859 bearings for Te Tarata and Te Otukapuarangi from Station 21.

Stage 4. Georeference method-of-squares map over terrace bearing arrays. The intersections of the Tarata and Otukapuarangi bearings and the MoS locations confirm

the spring locations with the best possible accuracy from Hochstetter's data.

The MoS map rediscovered in 2010 with the diary is Figure 6. Its 3cm squares represent ~240m, reflecting the lake length of ~1620m. The map scale is 1:8000. This is close to the old imperial scale of an inch to 10 chains.

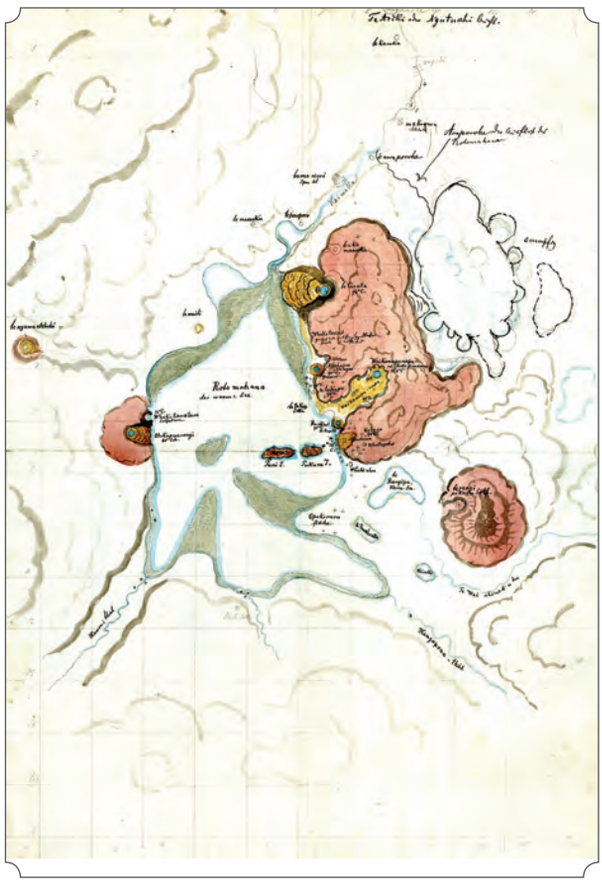

Figure 6: Hochstetter's method-of-squares (MoS) map (Hochstetter Collection Basel, HCB 3.5.10).

Figure 7 is a compound illustration with the second unpublished Hamel photograph (at top) containing annotations by Hochstetter. Five peaks are numbered from left to right. These peaks are south-east of the lake, where no diary bearings were recorded. This implies there are other sections of Hochstetter's survey to be discovered. Below the fifth peak is the location for Station 21. An arrow (below the numeral 5) appears to mark the spot. There is a triangle beside the arrow marking Station 21. Bunn checked Hills 1 to 5 against today's skyline and the plotted Station 21 location, and there is a close fit as shown in the Figure 7 bottom image, and with the MoS map.

The four survey stages are portrayed in Figure 8. The yellow rays comprise the surviving feature 10 bearings from Station 21. The green rays comprise the surviving feature 3 bearings from Station 22. The Koa Peak and plateau bearings are from the right, providing good crossing by Hochstetter's design. The Kumete

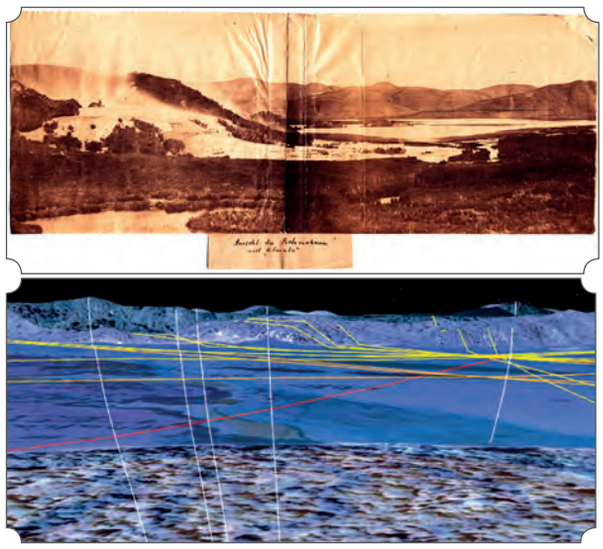

Figure 7: Top, View of Rotomahana with Te Tarata, with Hochstetter's annotations including Station 21 below Peak 5. Photograph by Bruno Hamel, 1859 (Hochstetter Collection Basel, HCB 2.7.23 Copy 2)

Bottom image: reproducing the bearings (in white) to Peaks 1-5 and Station 21. Note the Peak 5 bearing passes over Station 21 in both images (Courtesy of Google Earth, used with permission).

bearings radiate down from the ridge at left, converging on both loci. The Station 21 locus (with 10 bearings) has an ellipse of ±61m by ±35m. The Station 22 locus has an ellipse of ±9m by ±1.5m. The locus for station 21 is at ~-38.2705, 176.4268 and for station 22 is at ~-38.2628, 176.4296. The survey baseline is ~830m.

In Stage 3, we return to the diary and plot the bearings to the Pink and White Terraces' springs from Station 21. In Figure 8, the red rays are these bearings. In Stage 4, we establish the coordinates of the terrace springs by georeferencing the MoS map over these bearings: their intersections marking the terrace spring locations. This fourth stage is also shown in Figure 8.

Figure 8: Close-up of the Iteration Five resection, 10 bearings (yellow) on Station 21 and three bearings (green) on Station 22. The two red bearings are to the Tarata and Otukapuarangi Springs, from Station 21 (Bunn April 2, 2018).

Discussion

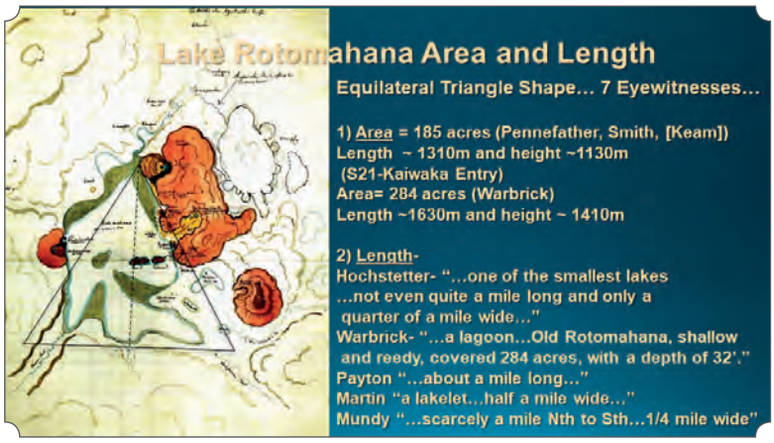

Figure 9: Old Lake Rotomahana: How Hochstetter drew his map (Bunn, 13/3/2018)

The field of view approach introduced in this article contributes a step-wise advance in our understanding of the terrace locations and their potential survival. It uses all Hochstetter's bearings which survived the eruption and integrates these to optimise survey accuracy.

However, the survey is made by compass only, and therefore cannot be claimed to have a trigonometric accuracy as Hochstetter advised. Given that it is the only survey of New Zealand's eighth wonder of the world, however, we are bound to try our best to obtain the maximum possible terrace location accuracy, without compromising the integrity of Hochstetter's original survey data.

Of the three major terraces on the old lake, the Pink and White spring locations appear to lie on land, while sections of their terraces lie on land and over the new lake which follows the alignment of the 1886 eruption crater between the Pink and White Springs. This indicates it's likely only parts of these terraces may have survived in position, proportionately more of Tarata than Otukapuarangi. The Black Terrace location lies wholly on land, as does Black Terrace Crater.

In Figure 8, the terrace locations are Te Otukapuarangi, ~-38.2612, 176.4218 (1899398.056 mE, 5759663.701 mN) and Te Tarata ~-38.2557, 176.4343 (1900514.765 mE, 5760233.640 mN). Note each red ray strikes the terrace spring with an error of ≤1°. This is impressive accuracy from Hochstetter's compass survey and given the steps in the reverse engineering algorithm. The close fit between the MoS map and diary bearings increases confidence in the terrace locations.

This latest survey resection can answer other questions about the lost landscape of the old lake. The old lake size and area has been unclear till now. Colonial records in Figure 9 show a minimum length of 1300m with an area of 75 hectares and a maximum length of 1600m with an area of 115 hectares. The old lakelet would thus have been 50-80% of the area of nearby Lake Tikitapu. These lakes were of similar shape and length. Our estimated old lake length is ~1600m. This agrees with Warbrick's area of 115 hectares, corresponding to a lake length of 1630m. It was indeed only a shallow lakelet, pond or lagoon and really not a lake at all – but it did hold the eighth wonder of the world.

In Figure 9, the MoS map was drawn by Hochstetter in the shape of an equilateral triangle, with a swampy, semi-inundated area to the south-east. In his first sketch of the lake, after looking 200m down onto it, side on from Te Kumete Ridge; he planned his future station 21 on the point where the altitude intersects the base. This shifted slightly by his fourth sketching in the MoS map, but remains close (refer diary page 53). This helps explain the absence of a true north or magnetic north arrow on his map. The map wasn't drawn with a north/south axis – the lake was drawn as he first saw it from above. He placed Station 21 at the base of the lake for artistic and geometric reasons, much as Smith had done a year before when he made the first western sketch map of the old lake. (Smith, 1858)

NB: This recognition provides a fascinating corollary, as the old lake has vanished; its true orientation can only be measured by resecting the Hochstetter survey bearing sets, plotting the spring bearings and then georeferencing the MoS map over Stations 21 and 22 as above. Only then will the diary bearings for Tarata and Otukapuarangi align with the springs. Stage 4 shows the lake axis lay at ~31°E from true north.

The Ngongotaha validation and our resections show Hochstetter provided generally accurate bearings. Some are not and we explore this. Key locations, e.g. the terraces and his Puai Island Bed & Breakfast were generally accurate and in his FOV, regardless of wind and weather. Other features were essentially holes in the ground surrounded by bush and invisible from metres away. Hochstetter used a surrogate and the obvious one is the steam plume. Figure 10 is a third unpublished Hamel photograph showing plumes from Ngahapu and Tekapo deflected by the strong south-west wind which interfered with his compass sightings and photography, his passage to the lake on April 28 1859 and marooned him at Te Mu for three days afterwards.

It is unsurprising that there are observational errors when we take an aerial view of these hole-in-the-ground features versus Hochstetter in 1859 gazing through his compass sights across the lake, locating features beneath shifting plumes and steam clouds.

Figure 10: Steaming Ranges under a strong sou-wester during Hochstetter's visit, showing the difficulty of taking bearings on hidden holes in the ground (Photograph by Bruno Hamel, 1859, (Hochstetter Collection Basel, HCB 2.7.32 Copy 2).

Conclusions

This survey iteration discloses the Pink and White Terrace locations with maximum possible accuracy. With each iteration, the quality of resection has improved, and now includes all surviving bearings in the analysis. This was not solely due to improved statistical analysis or better software. It reflects the interdisciplinary approach over 2016-2018, numerous field visits, the help of generous volunteers and growing competence with the historiography of the new and old Rotomahana lakes and the Māori and western histories of the area.

Error propagation

For the Topo50 map, LINZ advises accuracy about the terrace locations is +/-22m. Contours and streams in this area have not been updated since the 1970s and in backcountry regions, it's possible for locations to err by +/-44m. As a result, the authors used Google Earth for resection. Published studies on Google Earth accuracy and precision indicate the optimal error measure is to compare a GE distance against a known local landmark. The authors measured local error around Rotorua via the Rotorua Airport main runway 18R/36L (*www.aip.net.nz/pdf/NZRO_51.1_51.2.pdf*). This is 2114m (including extensions) and the GE measure is 2116m –. an error of +2m. This indicates an error contribution of ~6-10m over the longer runs to Rev Spencer's and Koa Peak.

Error ellipses were constructed for Station 21 and Station 22 as in Figure 8. The 10-bearing Station 21 ellipse major axis lies at 330° TN (true north) with an error of ±61m and the minor axis at 60°TN with an error of ±35m. The Station 22 ellipse major axis lies at 323° TN with an error of ±9m and the minor axis at 53°TN with an error of ±1.5m. It's worth noting the innermost 4 bearings of the Station 21 bearing dataset (i.e. Rev Spencer's, Peaks 4 and 5 and Tarawera NE), form a second, quasi-concentric Station 21 error ellipse, however we do not have the expected error for each of these observations. While the Station 21 major axis error of ±61m and the Station 22 error of ±9m are statistically significant, when searching for a structure such as Te Tarata occupying ~13 acres, they are insignificant in practice. The ~6707m^2 10-bearing Station 21 ellipse area compares with the Station 22 area of ~42 m^2.

The empirically determined errata include observational error to landmarks, random error from wind and steam clouds, error in resection, compass error (due local magnetic variation and inclination), declination error, i.e. actual to IGRF model, landmark displacement since 1859 by natural forces and Google Earth error. It is difficult to accurately apportion these, beyond making provisions. For example, the New Zealand Walking Access Commission advises a provision of 1-2m/km for pre-1870 surveys and for longer runs, e.g. for Koa Peak, this implies a 6-12m error. Clearly, the Station 21 10-bearing precision was affected by random error. Equally, the observations from Station 22 were taken with greater precision.

Acknowledgments

The authors gratefully acknowledge the assistance of Dr Sascha Nolden in providing wise counsel and reviewing the drafts, and for contributing unpublished Bruno Hamel photographs from the Hochstetter Collection Basel, prepared by Sandy B Nolden, for this article.

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Cadastral

After the positive feedback we received following the GNSS for Cadastral Surveys seminar last year, we have begun preparation for our next seminar.

Currently we have a working title of 'Good Survey Practice' for this. We are anticipating that this will be held later this year and it will be broadcast via an internet stream as we did last year with GNSS for Cadastral Surveys – we understand there is a significant time and cost for those outside the main centres to attend, and those members still need to have access to these CPD events.

We have also been working closely with the National Office to support the application which has been made by Don McKay to the Environment Court for a determination if conversion of a cross-lease title to fee simple would constitute a subdivision under s218 of the Resource Management Act 1991. We will keep members updated once the outcome of this case is known.

As always, if you wish to contact the stream, please do so via the National Office.

Matt Ryder, Cadastral Stream Chair

Engineering

It is great to see our Engineering Surveying Stream membership increasing and becoming more active in NZIS. At the last Auckland Branch meeting, I enjoyed meeting a few new faces and catching up with old ones to see a larger representation!

The Nelson Conference was similar, with a few presentations directly related to engineering surveying, and a lot of discussion on our field of work.

From both the branch meeting and the conference, the common question is still: "How can I become certified as an engineering surveyor?". The answer is: "RPSurv is being reassessed to provide a fit-for-purpose certification that caters to the need of every stream, and rest assured it is coming soon, and when it comes, it will be worth the wait." With the current high demand for surveyors, this certification will quickly and clearly separate the best from the rest.

A snapshot of some of the large construction projects in progress are: Auckland's City Rail Link contracts 1 and 2, Northern Corridor improvements, Southern Corridor improvements, Puhoi to Warkworth, Wellington's Transmission Gully, Peka Peka to Otaki, Waikato's Hamilton Bypass, Huntly Bypass, Kaikoura's NCTR, Christchurch's Southern Motorway . . . to name a few.

There are also some significant projects starting very soon, such as the Northern Interceptor and the Central Interceptor for Watercare, and the third contract for the City Rail Link. Then there is Labour's $28 billion commitment to improving Auckland's transport infrastructure, such as light rail to the airport and 'Pen Link'. With all this activity, it is a great time to be primarily associated with the Engineering Surveying Stream.

Michael Cutfield, Engineering Surveying Stream Chair

Hydrography

The Hydrography Professional Stream had a fantastic 'Hydro Day' on May 17 during the NZIS conference in Nelson. We enjoyed a packed schedule with a visit to Port Nelson, presentations covering project work in New Zealand – inland and in the Queen Charlotte Sound, the latest technology developments, research, marine geospatial information initiatives, Seabed 2030 project and the AHSCP certification process, a stream meeting and open forum, then a visit to the NMIT maritime simulator.

Thank you to those who assisted with the organisation of this – especially those who coordinated our requirements within the three-day conference programme.

The New Zealand Region of the Australasian Hydrographic Society sponsored student attendance at the NZIS Conference Hydro Day, with the successful applicants tasked to report on the events of the day. Watch this space!

Abstracts for the HYDRO18 conference in Sydney close soon. The conference will run from October 30 to November 2018.

More details can be found at: *www.hydro18.ahs.asn.au/home.html*

Emily Tidey,
Hydrography Stream Chair

Three students sponsored by the AHS to attend our Hydro Day. Photo: G. Chisholm.

NZIS CEO Hadyn Smith welcoming the crowd to Hydro Day. Photo: G. Chisholm.

Land Development and Urban Design

In early April, a request for assistance regarding the review of the Quality Planning website content was circulated to stream members. It was great to receive several responses from surveyors who are able to assist Brett Gawn with this task. This review is now under way with the first subcommittee meeting being held in May.

The Land Development Urban Design Stream is also seeking to assist NZIS in finding a replacement examiner in Land Development Engineering due to the retirement of Ross Thurlow. The position is to examine graduates for membership of NZIS and on behalf of the CSLB. The ideal candidate will be a RPSurv or CPEng, or both; the last three examiners (including Mr Thurlow) have held both qualifications. If you are interested in the role or can nominate anyone who would be suitable, please contact me. *juliag@maven.co.nz*

Julia Glass, LDUD Stream Chair

Positioning and Measurement

It was great to see so many members of the Positioning and Measurement Stream in attendance at the NZIS Conference in Nelson, and also some of our members contributing to the conference programme.

The P&M committee has identified a few stream related highlights from the programme. These include presentations by Jordan Friis on the Volunteer Survey Programme in Nepal, Chris Pearson's discussion about the SBAS trails, surveying in Kaikōura following the earthquakes by Andrew Sinclair, and Bruce Robinson's descriptions of the changing GNSS technologies and systems.

The stream was also pleased to support the panel discussion 'Making the Shift to New Zealand Vertical Datum 2016' and would like to thank Rachelle Winefield, Tony Nikkel and Steve Read for sharing their insights, and Susan Shaw for moderating this session.

The stream committee would like to encourage continuing conversations on these topics and looks forward to seeing you and your contributions at NZIS 2019.

Rachelle Winefield,
Positioning and Measurement Stream Chair

Spatial Stream

The Spatial Professional Stream (SPS) has been busy in the last quarter on a number of key focus areas, including our approach for raising awareness of – and getting feedback on – the proposed Registered Spatial Professional certification, and contributing to spatial content for the NZIS Conference.

The committee has met twice this quarter, with a focus on the key areas mentioned, as well as discussions around additional representation on the SPS committee and spatial representation on the ASaTS working group, fostering wider industry connections and awareness raising, further clarifying the value for spatial members in joining NZIS, and identifying some potential new areas for advocacy in the spatial industry.

We have continued to support spatial events, such as the GeoSocial gatherings in Christchurch (along with the NZIS Christchurch branch and SIBA). We have provided feedback on some new geospatial degree proposals, as well as continuing to be represented on both the national Geospatial Capability Committee and WIS.

We continue to encourage and welcome feedback and input from spatial members to the committee as we work to develop a stronger spatial professional representation and value proposition.

Kat Salm, Spatial Stream Representative

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National Geodetic Adjustment and Coordinate Updates

Miriam Broadbent,
Geodetic Data Analyst, LINZ

The purpose of the National Geodetic Adjustment

The National Geodetic Adjustment (NGA) is used by Land Information New Zealand (LINZ) to compute a nationally consistent set of New Zealand Geodetic Datum 2000 (NZGD2000) coordinates and New Zealand Vertical Datum 2016 (NZVD2016) heights.

The NGA uses geodetic observations spanning more than 100 years, including GNSS (global navigation satellite system) baselines, precise levelling and control traverse data. The NZGD2000 deformation model and the NZGeoid2016 quasigeoid model bring these disparate observations into a consistent reference frame within a single least squares adjustment.

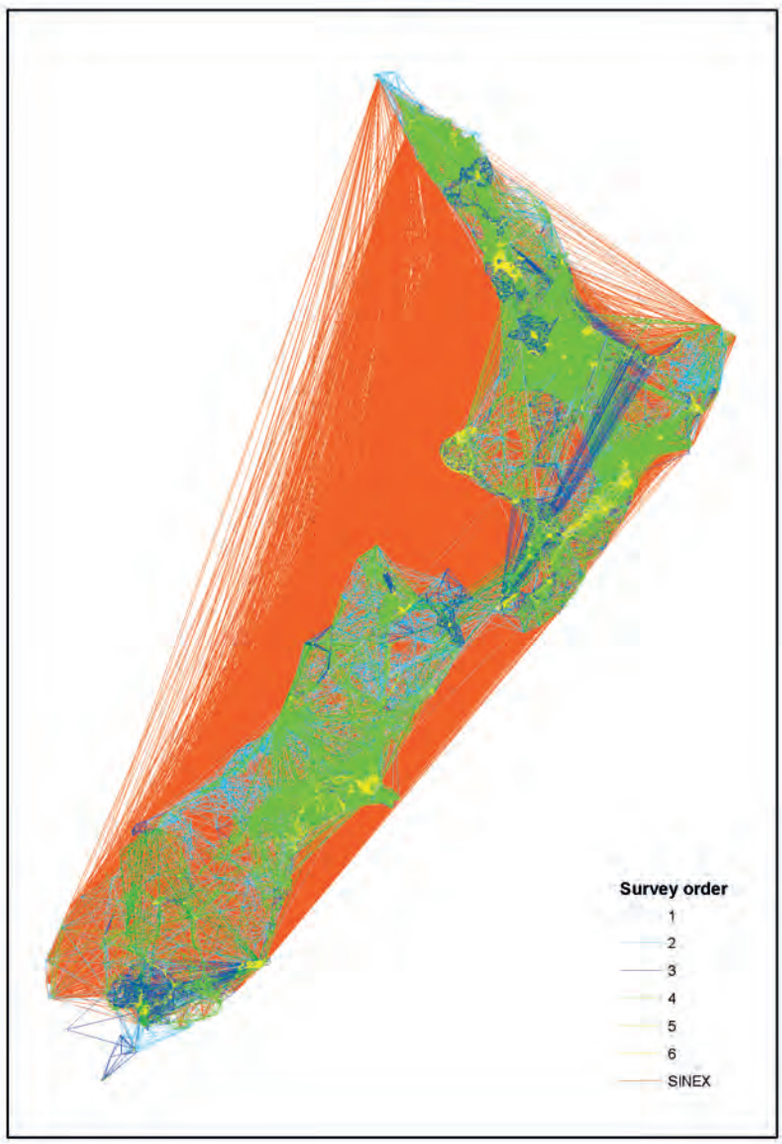

Figure 1: Mainland NZ NGA (SINEX visualised as lines).

Motivation for the development of the NGA

Efforts towards creating a national adjustment began in 2012. One of the motivations for creating a single geodetic adjustment was to ensure consistency of geodetic coordinates throughout the country. Before the NGA, new geodetic surveys were integrated in a piecemeal fashion. They relied on strong connections to higher order control to ensure coordinates from different geodetic surveys were consistent.

While this approach generally worked satisfactorily, it had a number of deficiencies:

- Errors in higher order control could propagate down through the system.
- When higher order control was re-coordinated, there was no simple way of identifying which other coordinates were based on them and what the consequent changes should be for those coordinates.
- Order 0 PositioNZ CORS (continuously operating reference stations) were coordinated independently of other geodetic marks and were sometimes out of terms with nearby non-CORS marks.

Furthermore, calculating NZGD2000 coordinate orders was not handled rigorously. Localised adjustments do not provide sufficient information about the accuracy of coordinates, particularly in relation to other nearby marks not included in the adjustment.

In a country straddling two continental plates, and a constantly moving land mass, it was becoming increasingly difficult to maintain the datum in a timely and accurate way.

Figure 2: HAAS Haast PositioNZ Order 0 NGA control station.

NGA software

The NGA is adjusted using the LINZ SNAP (Survey Network Adjustment Package) software. SNAP is a least-squares adjustment software package developed by LINZ to rigorously calculate coordinates from a wide variety of survey data. It is free to download from the LINZ website and is typically used for geodetic and engineering survey computations.

Least-squares is a mathematical approach used to determine the best set of coordinates from a set of observations. It also calculates observation and coordinate uncertainties, as well as generating statistical outputs to help identify data error. To cater for the size and characteristics of data in the NGA, significant enhancements have been made to SNAP in the past few years. One of these enhancements implemented a criteria-based approach to common least-squares tasks to improve the efficiency and consistency of the adjustment. For example, it is possible to apply a reweighting command to all the data within a specified area before a certain date – a useful tool after an earthquake.

Observations types in the NGA

The NGA includes GNSS baselines, correlated GNSS point coordinates, horizontal and ellipsoidal distances, horizontal angles, azimuths, projection bearings and height differences. Some of these data types only occur in the historical data, but are particularly valuable where a geodetic mark has not been observed with GNSS. Modern data mostly consists of GNSS baselines and point coordinates and (to a lesser extent) precise-levelled height differences.

The correlated GNSS point coordinates are included as SINEX files (Solution INdependent EXchange format) which accurately define the relationship between the points. SINEX data from long (24 hours-plus) occupations are a critical component of the NGA as they give national coverage, are highly accurate, and are often repeated every few years providing confidence in mark stability and monumentation. Along with the coordinates of Order 0 PositioNZ stations, these observations form the backbone of the NGA.

Orthometric height differences from precise levelling are combined with ellipsoidal heights from GNSS through the inclusion of the NZGeoid2016 quasigeoid model. This means it is not difficult to identify conflicts between the levelling and GNSS data, a situation that is common in subsidence zones throughout New Zealand. It also means heights calculated in the NGA can use the high relative accuracy of precise levelling, as well as the currency and high absolute accuracy of GNSS.

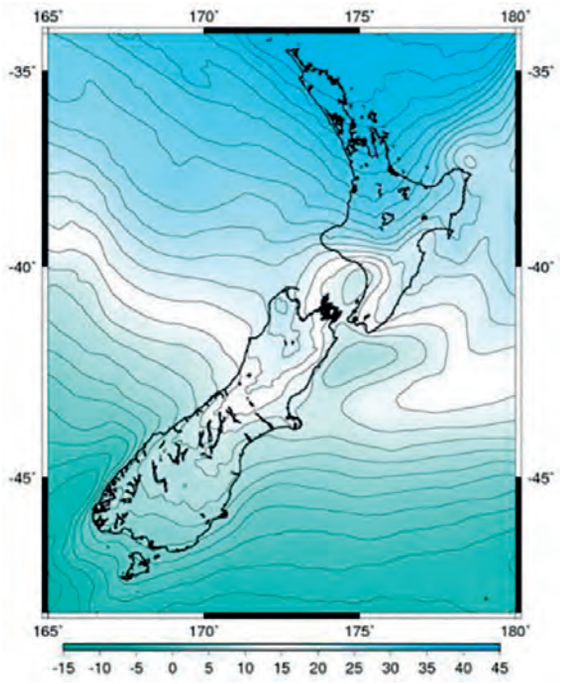

Figure 3: NZGeoid2016.

Observations are initially weighted according to their observation type and the accuracy of the methodology used to collect the data. For example, an Order 3 static GNSS survey is given more weight in the adjustment than an Order 5 GNSS RTK survey. This initial weighting may be further modified depending on other factors. For example, in an area affected by a significant earthquake, pre-earthquake data may be down-weighted so that post-earthquake observations take precedence in mark coordination. Finally, a particular survey may be reweighted based on the root-mean-square of the standardised residuals, using the adjustment results to improve the estimate of observation uncertainty.

The deformation model

Due to the seismic activity in New Zealand, the NZGD2000 deformation model is of significant importance to the

NGA. Secular (continuous) deformation of ~0.05m per year and occasional notable earthquake events (up to ~10m) have an impact on the relationship between marks over time. Data from the 1990s to early 2010s was used to model secular deformation in New Zealand. In addition, deformation due to earthquakes since 2000 has been modelled. Earthquake modelling starts with a geophysical model which is adapted to a surface land deformation model. On the whole, the deformation model does a very good job in the NGA at combining dataset from epochs after 2000.

It is important to note that the deformation model has some limitations. Currently vertical deformation is only modelled for the significant post-2000 earthquakes. There are parts of the country known to be deforming vertically, such as parts of the Taupō Volcanic Zone that are consequently not accounted for vertically in the deformation model. In the NGA, this presents as conflicting data because heights measured at different times do not fit well together. A method to deal with this situation is to only use the latest data in coordination, or to downgrade the coordinate order to reflect the uncertainty.

Another limitation is near fault lines where the deformation model does not have sufficient resolution to model the very complex movement. In the NGA, all pre-earthquake data close to faulting is down-weighted and new surveys are undertaken to re-establish the network after an earthquake. This works very well for marks that are found and surveyed after an earthquake. The marks that are not resurveyed usually have their order downgraded.

Although there is a substantial amount of data in the NGA that predates 2000, the model is only based on data after the mid-1990s and does not represent deformation caused by significant earthquakes before 2000. This means that the pre-2000 observations may distort the NGA. However, these observations are mainly lower weighted observation types which provide infill between modern control points, and the lack of model accuracy before 2000 has very little impact on the NGA.

Running the adjustment

There are currently about 1 million observations and 120,000 geodetic marks in the NGA. New coordinates are generated in terms of Order 0 fixed control in the adjustment. Order 0 coordinates are the most accurate and are based on time series of daily solutions.

It takes about 16 hours to run the whole adjustment on a Linux laptop to calculate coordinates. SNAPSPEC, a SNAP function, is then run to calculate the absolute and relative accuracy of the coordinates and assign orders. This is run for both NZGD2000 and NZVD2016 orders and takes about a week to complete. These coordinates and orders are used to update the data published on the Geodetic Database (GDB) and in Landonline.

Coordinate updates

There have been three national coordinate updates generated from the NGA thus far:

Date updated	Geodetic Database Reference	Description
30-06-2016	National Geodetic Adjustment 2016-07-16	This update had the most impact by aligning geodetic marks nationally and fixing some historical inaccuracies. It also accounted for the 2013 Cook Strait and Lake Grassmere earthquakes, and the 14 February 2016 Christchurch earthquake.
18-11-2016	National Geodetic Adjustment 9-11-2016 OR NZVD2016 heights from National Geodetic Adjustment 9-11-2016	This update realised NZVD2016. The national precise levelling dataset was added to the NGA just prior to this update. There were also minor NZGD2000 coordinate changes. Note: In the GDB, the reference in the Orthometric Heights section is slightly different to the NZGD2000 section.
14-01-2018	National Geodetic Adjustment NZGD2000 20171201 update	This update accounted for the 14 November 2016 Kaikoura earthquake as well as minor changes due to new data.

The first and third updates were to realise a new version of NZGD2000 due to earthquakes. The second update was to realise NZVD2016. Each update is also an opportunity to increase the accuracy of the dataset. Further updates will be run periodically in response to earthquakes and as significant amounts of new geodetic data becomes available.

Summary

The National Geodetic Adjustment enables LINZ to extract the maximum value from geodetic observations made at considerable effort by geodetic surveyors over many decades. It had a significant role in the implementation of NZVD2016 and facilitates efficient restoration of accurate geodetic coordinates after major earthquakes.

Acknowledgments

Thanks to the institutions and surveyors whose high-quality geodetic surveys over many decades have directly led to the high-quality result achieved in the national adjustment.

Thanks also to Chris Crook for his work developing the SNAP software to efficiently cater for very large adjustments.

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LAND DEVELOPMENT POST-GLOBAL FINANCIAL CRISIS

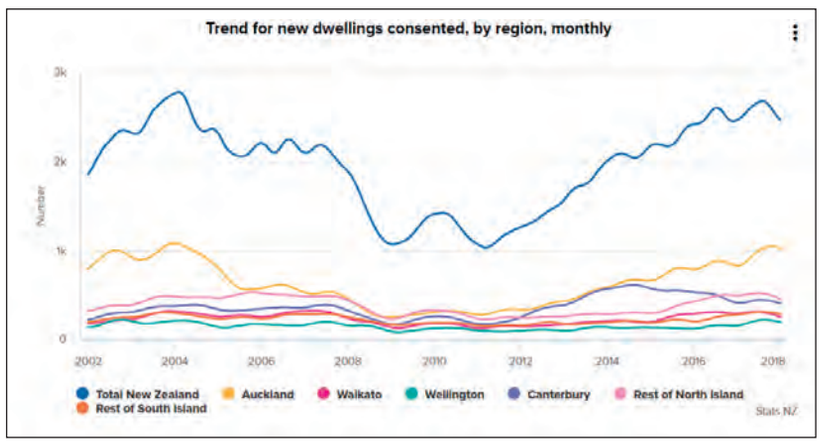
A Surveyor's Perspective

Carl Salmons, BSurv, MNZIS, MCSNZ, Licensed Cadastral Surveyor

VOLUMES. GRADIENTS. LEVELS. CLAIMS. CONTRACT PROGRAMME. SLEEPLESS NIGHTS. THE SURVEYOR PRACTISING IN LAND DEVELOPMENT IN NEW ZEALAND WILL BE FAMILIAR WITH THESE TERMS. THIS ARTICLE FOCUSES ON THE SURVEYOR'S ROLE IN CONTENDING WITH HIGH LEVELS OF DEVELOPMENT ACTIVITY POST THE GLOBAL FINANCIAL CRISIS.

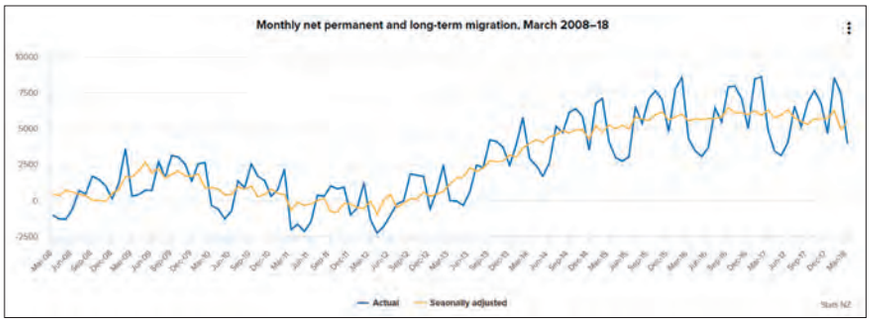
Setting the scene

During the Global Financial Crisis (GFC) and aftermath (say 2008 to 2012), there wasn't much residential land development happening in New Zealand. Surveyors were heading overseas, or the ones lucky enough to have work were operating in rural areas, or doing work for councils and other public sector clients. Surveying graduates had a hard time getting a job and many left for Australia and the UK.



Graph 1: building consents since 2002

During this time, the local councils shed planning and engineering staff and didn't replace the ones who left. The Auckland councils amalgamated and restructured. Senior staff with institutional knowledge hung up their scale rules and retired.



Graph 2: monthly net migration since 2009

Large developments that had built up steam leading up to 2008 (by then, you couldn't go wrong in land development) suffered catastrophic shifts in the availability of finance, and buyers and builders vanished. The developers who had been bullish and put vast sums into infrastructure extensions and high-end landscaped subdivisions all of a sudden had the rug pulled from underneath them.

Suffice to say, most private firms with a focus on land development, councils and also contractors were running a lean crew by about 2011/2012.

A useful way to illustrate this low level of work is to look at the number of building consents issued since 2002. The trend on Graph 1, sourced from Statistics New Zealand, shows the heady days of the early 2000s, where almost 3000 building consents were issued in New Zealand per month, followed by the 2008-2012 period where this number was halved.

If most of your business was land development, theoretically you would have needed to halve your staff over the period of 2008-2010 to stay afloat. Firms had to plan for the worst, and structure accordingly.

The bounce

With skeleton staff and often meagre profits, firms were ticking over. Banks and second-tier lenders were still licking their wounds from the GFC and developers were not flavour of the month.

The length of the slow economic times (4-5 years) in my opinion changed the behaviour of surveyors practising in land development. They tended to become more risk averse and conservative, particularly those in management who had to face just breaking even each month and let their good staff go in the quieter times. Councils were equally conservative and capital spending on infrastructure projects was put on the backburner. This mentality extended well into the economic recovery period.

Graph 2 illustrates the monthly net permanent and long-term migration for the past 10 years. The numbers coming into New Zealand from mid-2015 to date are quite remarkable, about 6000 more people per month.

Low levels of new building consents (which include alterations) and high levels of new migrants into a recovering development sector – a recipe for a significant residential boom was at hand.

So, when 2012 came along, the Christchurch rebuild was under way and net migration into New Zealand turned positive, the surveyor's equivalent of the 'home guard' was in place to face the onslaught of residential land developers.

Starting off in the cities, led by Christchurch and then Auckland, vast greenfield and brownfield subdivisions were commissioned. Surveyors found themselves, almost overnight, needing to resource large projects for their clients.

Busy times

Land development was popular again. Builders were scaling up, contractors were hiring and banks were starting to lend to developers. Surveyors, however, were scratching for staff. Where had they all gone? Councils couldn't find land development engineers. Plan approvals and 224(c) timelines dragged out. Recruiters were having a feast as everyone was hiring.

Having had low levels of work for almost half a decade, many surveyors took on land development work quickly as it came in the door.

Many firms were overwhelmed. Skilled and experienced staff were doing long hours to keep up, and junior staff, without the benefit of land development experience during slow times, found themselves at times in the deep end. Cashflows were under pressure as profits were used to fund growth.

Projects muddled their way through the design, consenting and construction phases, and often changed hands many times at the council as staff turned over quickly. Earthworks were done well into winter to try to bring product to market faster. Design errors were carried through to site and firms were kicked off projects. Long-standing relationships were tested.

Many land development practitioners during this time were suffering from high levels of stress. Policies, procedures and attitudes that worked for organisations during the quieter times no longer worked during the busy times. Staff turnover was high. The projects kept coming.

The role of the surveyor in land development

In busy times when resources are stretched, the role of the surveyor in land development becomes even more critical. In my experience this role is defined in one word – leadership.

Boundaries (pun not intended) are tested by developers, contractors and others – quality, cost and time are always under pressure.

It is the surveyor who is connected to all of the key stakeholders in a land development project. Therefore, it is the surveyor who must apply their skills and experience to guide a project through, as calmly and as best as they can, to a successful completion.

Surveyors are involved in all facets of the land development process – initial feasibility advice to the client, procurement of other services, planning, design, construction monitoring, surveying and completion. In small rural practices, the surveyor is the planner, engineer and surveyor, as well as the guidance counsellor and financial adviser to the project.

In urban areas, where large land development projects exist, surveyors are often on the sidelines as 'legal peggers' or 'topo guys' with civil engineers leading projects. In reality, both are quite capable of running a project as there is a significant overlap in the discipline when it comes to land development. What is important is for professional disciplines to know their limits and leverage off each other's skills and experience to deliver a good project outcome.

In some areas, the ability for surveyors to sign off land development works are slowly but steadily being eroded. The reasons for this are multi-faceted and I believe that this is a key challenge for the wider industry and NZIS to tackle head-on. There are not enough land development professionals in New Zealand generally and removing the certification rights of surveyors unnecessarily will only compound the current and ongoing housing supply issues.

Risk

Understanding where the risk sits in a land development project and managing that is a good way to reduce the occurrence of problems. Cost risk and programme risk are equally critical on a developer's radar and the more that can be done to mitigate this upfront, the better.

The usual suspects, in my experience, are earthworks volumes and contractor resourcing. Having a robust project review process after a project is completed ensures that lessons are learnt.

Communicating risk to the client as early as possible is crucial, as they cannot manage risk they are not aware of. Workshopping with key stakeholders in a project early on is a good way of identifying risk and mitigating it. A 'troubleshooting' session at the outset of a project, and again prior to construction can save a lot of pain.

Communication

Leadership requires good communication, internally (other staff), and externally (clients, councils, contractors and other disciplines). I have found it is most important to understand how others work. This allows you to communicate at their level – for example, an email to one party insisting on action may not work for another who prefers using the phone.

Since the GFC, a huge number of workers trained and experienced overseas have migrated to New Zealand. This includes surveyors and land development engineers. These people are a major part of the solution to the skills shortage here – however, where language is a barrier, firms and councils have another challenge to work through and patience must be applied on all sides.

Summary and looking forward

In the main centres of New Zealand, land development activity looks to be cooling following a peak in 2016/17. Net migration shows signs of slowing slightly. However, interest rates remain low and there is a large 'backlog' of homes that need to be built to cater for demand and it is expected that these drivers will continue to, partially at least, fuel land development for some time yet.

Surveyors by nature 'just get on with it' and when we are busy, tend to keep a low profile and get the job done. However, surveyors have had a hand in each and every allotment, unit and lease area created, often as the lead of the project, and this should be celebrated. The profession has a lot to do in terms of promoting its land development capabilities to the industry.

Surveyors have gained a lot of land development experience in the last four to five years during the economic recovery. It is important that this experience is not wasted and that surveyors continue to provide input into all levels of land development – from design, through to submitting on engineering codes of practice, attending council workshops and leading major projects.

Land development is not for the faint hearted – it is high risk, and invariably high stress from time to time. It can also be highly rewarding, however, and is an essential part of providing for the growing and changing population of New Zealand.

Carl Salmons has worked in the land development sector for 12 years in New Zealand. Carl is a Licensed Cadastral Surveyor and Director of multi-disciplinary firm Maven.
www.maven.co.nz

Accurate wingtra

ACCURATE AND WINGTRA AG ANNOUNCE PARTNERSHIP FOR NEW ZEALAND

In Feburary 2018, Accurate Instruments (NZ) Ltd and Wingtra AG Switzerland forged a partnership for the sales distribution, support and industry advisory on the WingtraOne UAV drone for precision surveying and aerial photogrammetry.

This followed a successful product technical demonstration seminar in November 2017, undertaken by Wingtra in Christchurch, which some NZIS members attended.

Antonio Zivolic, Sales Manager for Wingtra Ag who was present at the product showcase, has shared his enthusiasm and support of the partnership stating "I'm excited that we're kicking off our new partnership and looking forward to working together in 2018"

ABOUT THE WINGTRAONE

The WingtraOne is a tail-sitting VTOL unmanned aerial vehicle developed and commissioned in Switzerland by Wingtra AG.

It is powered by two electric motors, designed primarily for use in precision agriculture and surveying roles, and collects high resolution aerial data using precision world class digital SLR technology, which is used to generate ortho photos, 3D reconstructions , point cloud and NDVI maps.

Wingtra have also had their product and design globally recognised, with the WingtraOne being awarded the Swiss Excellence Product Award in 2016.

The first of the WingtraOne UAV's will be arriving into NZ in March 2018 and technical seminar showcases will be kicking off in Canterbury in April.

The WingtraOne seminars will also be popping up in other locations through 2018.

To learn more or register your interest, contact us today.

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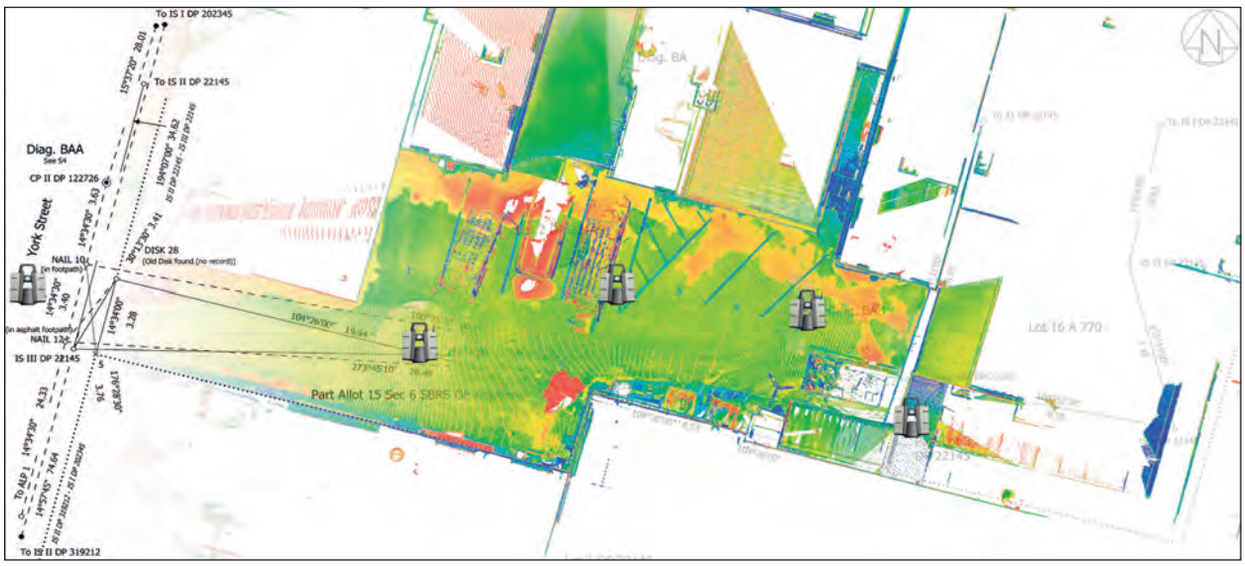


GNSS IN CADASTRAL SURVEYS

Rowan Hallam, Survey Manager, Senior Associate, Woods

GNSS technology and how best to apply it to cadastral surveys is a continuing topic of debate among surveyors who have access to a growing arsenal of measurement devices and technology. The question often arises: Can it be used for cadastral surveys and how best to show the resulting measurements? The following article outlines two examples that applied Terrestrial and Aerial LiDAR (Light Detection and Ranging) technology to cadastral surveys.

Adverse possession by terrestrial laser scanning

Background

Our client owns a property in Newmarket, Auckland, with an existing brick building from the 1920s occupies most of the parcel. In 1928, a surveyor defined two new lots as shown in Figure 1 below.

Lot 4 (6.52m x 0.07m), containing a brick wall supporting our client's building, and Lot 3 (4.48m x 1.67m) which encompasses an attached brick building and is solely accessed from our client's building in the south.

A new certificate of title was created for the two lots as a result of this survey. Since 1928, our client's land had changed owners regularly, however, the CT for Lot 3 and Lot 4 remained in the original owner's company name which no longer exists. Our client was looking to secure this CFR by adverse possession.

Figure 1: Areas for adverse possession

Adverse possession

For our client to claim adverse possession they required a surveyor's certificate to confirm that the occupation boundary (edge of the building) coincides with the title boundary. Lot 4 was straightforward as the original survey defined the building as the boundary. Lot 3's definition showed a thin rectangle 0.11m wide that was not occupied by a building or solely for our client's use. A survey was required to create a lot of the area solely occupied by the building.

Definition

This survey used GNSS to determine orientation, total station to traverse the urban environment and laser scan-

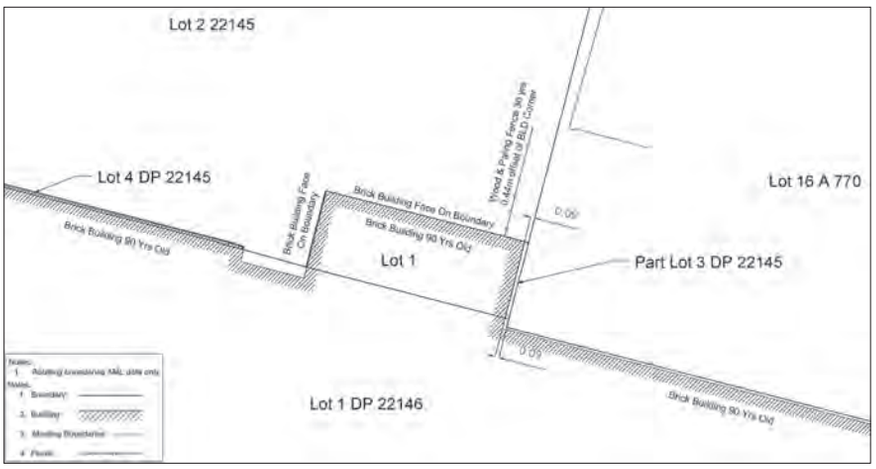


Figure 2: Occupation diagram

ning to delineate the building alignment which provides boundary definition for new and existing boundaries. A triangle shape traverse into the service lane from the road corridor was established for fixes of the building occupation.

Newmarket has been developed regularly over the past few years, destroying significant cadastral survey marks leaving the subject block of land with few defining cadastral ground marks. As the 1928 plan defined the building and boundary as coincidental, definition of this property was to be largely based on our building fixes. Two reasons led us to determine laser scanning as the best method for the cadastral survey. They were:

- The east wall of the lot/building being claimed was difficult to survey using conventional methods as it is facing a direction only visible from neighbouring roofs.
- Multiple walls were to be used as the basis of definition from the underlying survey. The saturation of points from laser scanning would provide clarity for the multiple wall alignments. The point cloud allowed clear decisions to be made to use or discard areas of wall whether they contained plastering or showed deviation in the wall or wall deterioration. Traditional methods of individual points on a wall can be open to interpretation dependent on where the fixes are taken.

Cadastral scanning

The scanner was set up in five locations to cover building alignments from the road corridor to the rear of the service lane. One scanner location was on the roof at the rear of the lane with site lines to the east end of the building. Each scan connected to the single, nearest non-boundary marks. The five scans were registered together in isolation first, then registered over the newly established non-boundary marks. The building occupation elements were delineated from the point cloud and EDM calculated ties were determined from the newly established non-boundary marks. The building vectors were found to be in good agreement with the boundary vectors from 1928.

Water boundary definition by aerial LiDAR

Background

In the coming months, we are planning to prepare a cadastral dataset for the first stage of a multi-lot residential subdivision north of Auckland. A 1.1km watercourse runs the length of the balance lot of Stage 1 of the subdivision. The watercourse was last defined by survey in March 2002, a Class III survey. The land beside the stream is held in a Queen Elizabeth II National Trust for Open Space in New Zealand. This land beside the water boundary is eventually intended to be transferred into Auckland Council ownership.

To validate the current water boundary position and define a better fix, we are planning to use freely-available aerial LiDAR. In the past 15 years, significant vegetation growth has occurred meaning the watercourse is not visible in aerial photography and vegetation on the covenanted land prevents the use of GNSS observations to the top of bank.

Figure 3: Development overlay and relationship to stream

Boundaries defined by survey

We intend to define the stream boundaries by survey, as per the Rules for Cadastral Survey 2010 6.2(a)(i). A thorough investigation/search will be undertaken for all old marks used in the previous stream definition. The stream boundary will be noted as a 'better fix'.

Rules for Cadastral Survey 2010

In planning this project, we have applied the Rules for Cadastral Survey 2010, particularly Rule 3.4 Accuracy of water boundaries and irregular boundaries.

By diagram, we have shown there is no risk of overlap including the boundary on the other side – Rule 3.4(a)(i) – and we would be inclined to capture and or show by diagram the LiDAR definition of the other stream bank.

We do not believe there is any potential movement in the bank – Rule 3.4(a)(iii) – due to the nature of the banks being densely vegetated and there had been no discernible movement in the location and shape of the stream banks between 2002 and 2016.

The land to the north of our stream boundary is held in a QEII covenant and intended to be transferred into Auckland Council ownership, therefore the value of the land and intensity of the land use are unlikely to change – Rule 3.4(a)(v).

LiDAR extraction

The top and bottom of banks for both sides of the water boundary have been extracted from the ground classified raw LAS data from the 2013/14 LiDAR survey, obtained from Auckland Council. The shape of the stream alignment was modelled at 5-metre spacing along the stream alignment. The data was then visually inspected and additional points were extracted where necessary to create a reliable definition.

We intend to use the 2017 Auckland Council LiDAR data (due for release soon) to confirm and digitise the watercourse into our cadastral dataset, provided it proves comparable to the current cadastral definition and the 2013/2014 Auckland Council LiDAR data. The 2017 LiDAR data has a higher points per square metre specification and we expect good vegetation canopy penetration to produce ground classified points at greater density to the 2013 data.

LiDAR accuracy

The following information is taken from the LiDAR Flyover 2013/2014 Project Final Report for Auckland Council by NZ Aerial Mapping and Aerial Surveys Ltd:

- *Raw point cloud, point density > 1.5 points per square metre.*
- *Vertical accuracy - +/-0.1m @ 1 sigma.*

The horizontal accuracy has not been reported on the 2013 dataset; through our own investigations we believe the expected accuracy to be less than 0.5m. Dependent on the reporting of the 2017 LiDAR data horizontal accuracy, Woods will carry out horizontal accuracy checks of the data to ensure they are of a suitable quality to meet the Rules for Cadastral Survey 2010. This will be done by capture and comparison of features characterised by any clearly defined change in height greater than 1m such as a building with a flat roof.

Comparison

As can be seen in Figure 4, the cadastral definition and LiDAR extracted definition of the Weiti Stream are very similar in location and shape. Where the boundary fixes shown on the 2002 survey coincide with the LiDAR extraction points, the difference is generally less than 0.5m. The greatest deviations come in areas where there have been LiDAR extracted points but no existing ties to the stream. We intend to digitise the LiDAR extracted stream bank in Landonline. Calculated ties from witness and traverse marks to the stream bank will be used to fulfil the Landonline Capture requirements and allow for future capture of the boundary by other methods.

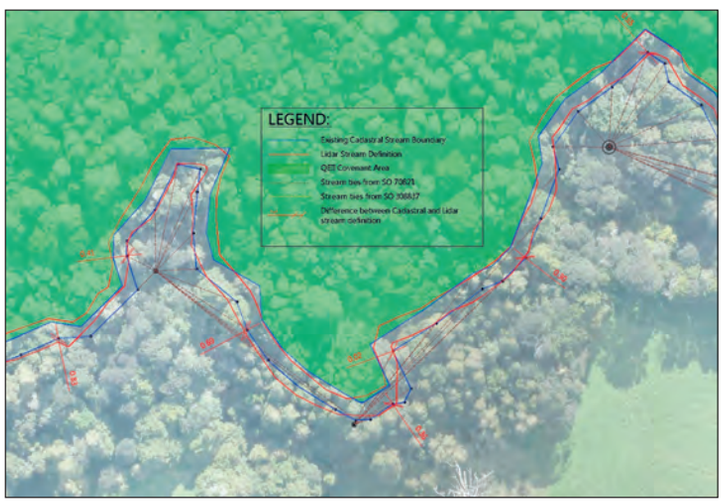


Figure 4: Comparison, Lidar definition to survey fix

Summary

We are exposed to many measurement technologies and must decide suitability for different applications and methodologies to achieve the desired results. With intensification of urban areas, terraced housing, apartments, unit titles and built form subdivisions, terrestrial laser scanners can help to provide clarity on what structures exist and their relationship to existing and proposed boundaries.

GET INVESTED!

Claire Buxton & Robert Mears

The FIG Congress and the 4th FIG Young Surveyors Conference was held this year in the enchanting city of Istanbul, Turkey. New Zealand's young professionals were strongly represented. New Zealanders were often seen leading the charge on new ideas and initiatives during the week. Many of us either presented technical papers or ran workshops on key issues which need to be solved in the near future.

Since the FIG Working Week in Christchurch in 2016, the Kiwi connection to these events has been strong. Our very own Melissa Harrington is a constant inspiration for many of our local young professionals. Melissa's involvement has certainly been a reason why our groups have such strong links. She is the incoming Chair of the FIG Young Surveyors Network, a position that Melissa is perfect for, evidenced during the week as she calmly led events at a minute's notice and spoke on behalf of the network with confidence and clarity.

The event covers a spectrum of diverse topics and has many presenters speaking at the same time in parallel technical sessions, meaning that we had to make tough choices on which sessions to go to as there were so many to get immense value out of. Pairing this with the opportunity to write and present professional papers, network with world leaders in the profession, and become involved with numerous working groups and volunteering initiatives, it is hard to imagine anyone shying away from the opportunity to get involved.

Workshop for professional development

The problem

Increasingly though, people are not seeing the value in attending or supporting such an event. In a competition run by the NZIS Young Professionals, only one person applied for a $2000 grant from Eighty4 Recruitment towards attending the FIG Congress in Istanbul.

As a result of young professionals and employers in New Zealand not supporting attendance to conferences, we were asked to run a workshop at the Young Surveyor Conference. This was in an effort to identify the value that professional development and professional organisations offer to all parties.

The format

The workshop, entitled 'Invest in Yourself, Get Others Invested in You', was a collaboration of young surveyor superstars from around the world, employers of young surveyors and key FIG sponsors.

We focused on finding what the most important benefits were from involvement in these events or organisations. We debated these, and then captured opinions from both a young surveyor perspective, and from an employer or sponsor perspective.

The results

Of course, every debate needs a winner. Our judge was the inspirational Narelle Underwood. Narelle is the first female Surveyor General in Australia and youngest in New South Wales in 200 years. The winning teams managed to convince Narelle that hard skills were more important than soft skills and that having young surveyors advocating for a product is more important than having them test it.

More importantly though, the following was the outcomes of our workshop:

- **Invest in your soft skills**
  - Help create a happier workplace and therefore retain staff
  - Learn to manage workloads and people more effectively
  - Grow your career
  - Work to live, not live to work
  - Employers tend to send the employees with soft skills to conferences because they will return and share their learnings
- **Invest in your hard skills**
  - Get the knowledge and technical skills that will get you 'in the door' of a business
  - Increase your productivity and become a more efficient operator
  - Be able to innovate and better respond to the demands of ever-changing technology
- **Get others to invest in you for advocacy and marketing**
  - Greater brand awareness for your company or organisation
  - As a platform to either directly or indirectly reach out to young people who are invested in their careers and make recruitment easier
  - Education on products: get your message across through word of mouth
- **Get others to invest in you for ideas and 'sowing seeds'**
  - Putting young people on the right track to enable us to make informed decisions
  - Use us for user-experience or testing: young people hold the knowledge and the skills to solve problems in new ways
  - The people involved in these groups are the future of the profession, by supporting them, the profession's future is brighter. What will happen if you don't?

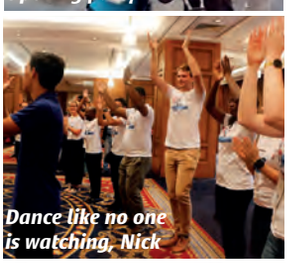
The outputs

The output of this workshop will be a guide which can be used by all young surveyors throughout the world. It will enable better understanding and explain the value of investing in their own professional development. It will also be used to help better communicate the value that these events can offer, both to organisations and employers who support these events through either partnerships or promotion of their companies.


Opening party

Life in Nepal


How will the VCSP continue?


Dance like no one is watching, Nick


Collaborative mapping


What is the future of the Young Surveyors Network, Taryn?

The two strands of land rights are not separated in social-tenure

Embrace technology with wisdom and ground up design


Proud New Zealanders

Volunteering

One aim for the Young Professionals Group was to get support from the partners of the Volunteering Community Surveyor Programme (VCSP) to run a workshop in New Zealand.

Jordan Friis presented on his time as the first volunteer on the pilot of the VCSP last year. He has left a lasting impression both on the local community he worked with in Nepal and also on the partners of the VCSP. We should be proud of his efforts and support this initiative going forward.

To keep the momentum going, the Young Professionals Group will be running a volunteering workshop later this year as a pilot. All going well, the attendees will find themselves in a position to get involved in volunteering initiatives. The intention is to have multiple sessions around New Zealand and in the future, branching out to the Asia-Pacific Young Surveyors Network. Keep your eyes peeled for invitations to the first workshop in Dunedin.

Aotearoa proudly represented

This year, a total of seven NZIS young professionals attended the entire week. We were accompanied by a handful of 'seasoned' surveyors too, who got involved in both young surveyor events as well as an impromptu Women in Surveying lunch.

A few people were invited to present during the week. James Berghan presented his and David Goodwin's current findings on incorporating social-based tenure principles into mainstream planning. Jordan Friis presented on his experiences in Nepal with the VCSP. Claire Buxton presented on Melissa and her paper about the social side of technology use: encouraging us to use technology wisely. Nick Stillwell did a quick-fire presentation on his role as the Lead Consulting Surveyor on ASaTS. We encourage you to read some of these papers through the FIG website.

The Kiwi contingent in Istanbul did our profession proud by leading and putting their hands up for new challenges. As a result, everyone has left with different experiences and all the better for it, both personally and professionally.

We hope that in future, more of our local community will take a greater interest in their own professional development and professional organisations. The opportunities are limitless.


Young surveyors bring value through onselling products

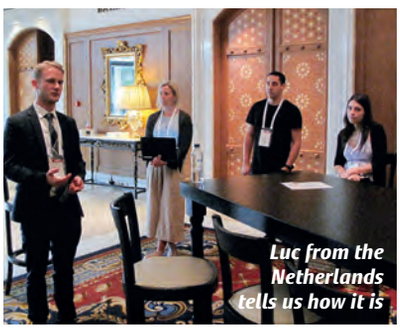

Judge Nel watches on in anticipation


We are seeds that need water and sunlight (mentors)


Mark shares his wisdom with all


Rules of the debate


Soft skills nurture a workplace at which people want to stay


Luc from the Netherlands tells us how it is


Hard skills get you in the door

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Layered Unit Title Subdivisions

Stephanie Harris and Vicki Toan

What is a layered development?

A layered unit title subdivision is the creation of a new unit title development within an existing unit title development. Sections 19-22 of the Unit Titles Act 2010 ("UTA") allow the creation of unit title developments within and alongside other unit title developments.[1] The UTA has provided for layered developments since it came into force in June 2011, but uptake has been slow.

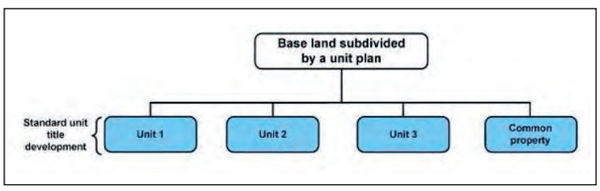
A layered development is the subdivision of a principal unit to create a (new) unit title development. It is different and separate from the creation of additional units by way of redevelopment under s 68 of the UTA. It is defined as:[2]

…a grouping of unit title developments in which—

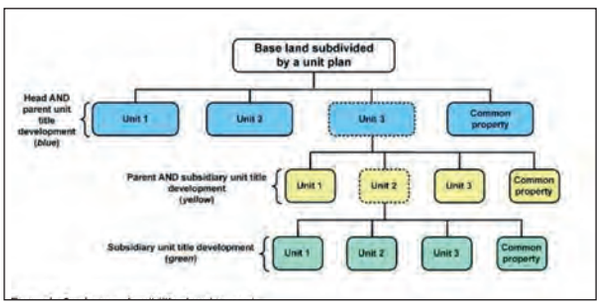
a. *there is 1 head unit title development; and*

b. *there is at least 1 subsidiary unit title development.*

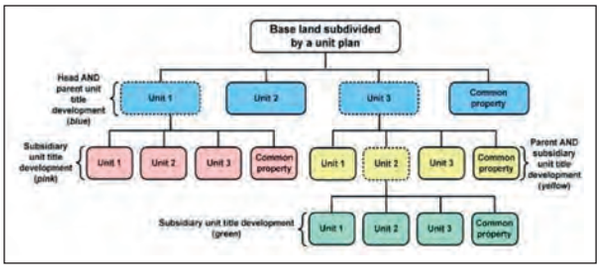
The visual representations of a layered development in Examples 2 and 3 in sch. 1 of the UTA (reproduced below) are a useful tool for conceptualising what a layered development is.



Example 1 – Standard unit title development

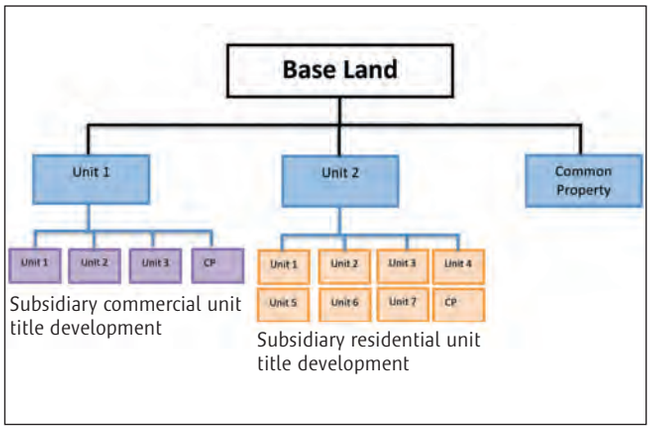


Example 2 – Layered unit title development



Example 3 – Layered unit title development

The more common example (not included in the UTA) would look like this:



A layered unit title subdivision creates from one principal unit and any accessory units held by the unit owner in the same title:

- two or more principal units;
- any number of accessory units (if any); and
- common property, being the balance of the parent principal unit not comprised in any new unit.[3]

A layered unit title development therefore comprises multiple unit title developments. The parent or head unit title development with its own body corporate it at the top. Sitting under that development are the subsidiary unit title developments with their own bodies corporate.

A subsidiary unit title development is subordinate to its parent and the head unit title development.

Why have a layered development?

A layered development is essentially an alternative management approach for units within a single building or units within multiple buildings, which are part of the same development. A layered unit title subdivision can be effected by:

- the developer creating a new unit title development; or
- unit owners within an existing unit title development.

As well as being part of an initial proposal for a new unit title development, the layered development provisions in the UTA provide unit owners and bodies corporate with opportunities to bring their buildings with them in response to the changing needs of owners, occupiers, and market demands. The flexibility that this offers makes unit

title ownership less rigid that it was under the Unit Titles Act 1972, and is one area where the UTA does provide a responsive legislative framework.[4]

Situations where a layered development approach may be desirable include:

- multi-storey mixed-use developments where each use can be a subsidiary unit title development with its own body corporate, rules and identity; or
- multi-building developments where each building or cluster can be a subsidiary unit title development with its own body corporate, rules and identity.

The layered development approach is an alternative to:

- having a single body corporate for a multi-unit mixed-use building; or
- having multiple bodies corporate under an umbrella incorporated society for a multi-building development.

How to implement a layered development

A layered unit title subdivision requires expert input from a surveyor, a valuer, a lawyer, and the territorial authority (district council). For an existing unit title development, the body corporate manager (if any) will also be involved.

A surveyor is required to prepare the unit plan for the new subsidiary unit title development. The plan is required to show:[5]

- the principal unit being subdivided;
- the principal units, accessory units and common property that will make up the new subsidiary unit title development; and
- the relationship between the new subsidiary unit title development to every other unit title development (head, parent and other subsidiaries) in the development.

A valuer is required to assign an ownership interest to every principal unit and accessory unit in the new subsidiary unit title development.[6] Utility interests must also be assigned in accordance with s 39(2) or (2A).[7] The assignment of utility interests may be done by the valuer if they are the same as the ownership interests,[8] or by the owner/developer if they are to be assessed differently.[9]

The lawyer's role is to prepare and collate the necessary notices, application forms, certificates, consents, and authority and instruction forms for lodgement with Land Information New Zealand (LINZ). Lawyers are often involved earlier in the process, advising on the effects of a layered development, the layered unit title subdivision process, assisting with resolutions, and liaising with the body corporate manager, surveyor, valuer, and territorial authority.

The territorial authority is required to issue a certificate under s 32(2)(a) of the UTA to enable the deposit of the amended or new unit plan. A redevelopment may also require resource (subdivision) consent under the Resource Management Act 1991 ("RMA").[10] Whether subdivision consent is required will depend on the specific requirements of the relevant district plan.[11]

For an existing unit title development, the body corporate manager will be required to facilitate communication, meetings, minutes and other information such as the register of owners to assist with service of notices of designated resolution.

The steps to achieve a layered unit title subdivision include the following, but not necessarily in this order:

- the creation of a survey plan showing the unit plan for the new subsidiary unit title development;[12]
- the assignment of ownership and utility interests to the new principal units and accessory units;[13]
- resource consent;
- a special resolution of the body corporate and the completion of the designated resolution process (for an existing unit title development),[14] or the written consent of the developer and any mortgagee (for a new development);[15]
- an application to Land Information New Zealand.[16]

The documents typically required for registration are:

- an application form signed by the principal unit owner;[17]
- certificates signed by the territorial authority under s 32(2)(a) of the UTA and s 224(f) of the RMA;
- a survey plan meeting the requirements of s 21(1) of the UTA;
- a certificate from a registered valuer;[18]
- a copy of the special resolution;[19]
- a certificate signed by the body corporate under s 216;[20]
- authority and instruction forms signed by the principal unit owner; and
- mortgagee's consent (if relevant).

After registration, certificates of title will issue in respect of the new principal units. Land Information New Zealand will also record reference to the subsidiary unit title development on the supplementary record sheet for the parent unit title development.

Pros and cons

Whether a development would benefit from a layered unit title subdivision, depends largely on what type of devel-

(continued p35)

Some of the surveying postgraduate students and staff. Left to right: Martin Forbes, Todd Redpath, Craig MacDonell, Sam West, Antoni Moore, Tobias Brunk (visiting student from Germany), Yong Chien Zheng, Emily Tidey, Saeed Rahimi, Richard Hemi, Christina Hulbe, Kelly Gragg, Greg Leonard, Pascal Sirguey. Photo: Yong Chien Zheng.

Postgraduate Students at the National School of Surveying

Todd Redpath

Over the past several years, the number of postgraduate students working on research projects at the National School of Surveying has increased substantially. There are currently a number of PhD as well as Masters students working on theses within the school.

Postgraduate research projects often have an interdisciplinary nature, with surveying methodologies employed to tackle problems across a range of scientific and social disciplines, often providing valuable opportunities to test and evaluate surveying technologies in a range of innovative applications. Currently, thesis students in the department include the following.

James Berghan is a PhD candidate working with Dr David Goodwin and Dr Lyn Carter (Te Tumu), undertaking research in the area of land tenure and Maori land issues. His thesis title is *Ecology of community – Maori understandings and values in relation to spatial data.*

Long Chen is a PhD candidate working with Assoc. Professor Antoni Moore and Assoc. Professor Sandra Mandic (School of Physical Education, Sport and Exercise Sciences). Long's research interests are in the analysis and visualisation of the relationship between human activities and the built environment, spatial analysis applications and geovisualisation through time.

Martin Forbes is undertaking his PhD with Professor Christina Hulbe, Professor David Prior (Geology) and Assoc. Professor Andrew Gorman (Geology). Martin's work is focused on applying fracture mechanics to understanding rift propagation in the Ross Ice Shelf, Antarctica.

Yong Chien Zheng is working with Dr Paul Denys and Dr Christopher Pearson. His PhD thesis is focused on tectonic geodesy, applying geodetic measurements to understand tectonic deformation in the Sundaland Plate.

Emily Tidey is a PhD student (and lecturer in hydrographic surveying) with research interests in applying hydrographic surveying techniques to marine ecology and management. A particular focus of her thesis research is quantifying measurement uncertainty in digital acoustic technology to enhance and improve marine habitat mapping.

Saeed Rahimi is undertaking his PhD under the supervision of Assoc. Professor Antoni Moore and Assoc. Professor Peter Whigham (Information Science), focussing in particular on machine learning and space-time data analysis. He is trying to develop a unified framework to adopt with agent-based modelling to simulate and model an individual moving object's decisions in reaction to their internal states, context, as well as other moving objects behaviour.

Todd Redpath is a PhD student supervised by Dr Pascal Sirguey, Assoc. Professor Nicolas Cullen (Geography) and Professor Sean Fitzsimons (Geography). Todd's research interests are in environmental applications of remote sensing and geospatial analysis, with his PhD research focused on using satellite imagery and RPAS photogrammetry to better resolve and understand spatial and temporal variability of seasonal snow in the Clutha Catchment.

Craig MacDonell is undertaking his MSc with Dr Pascal Sirguey and Dr Wayne Stephenson (Geography). Craig's thesis research involves the 4-dimensional RPAS photogrammetric mapping of a low lying coastal reserve in order to characterise the spatio-temporal evolution and vulnerability of a coastal restoration programme.

Sam West is an MSc student supervised by Dr Pascal Sirguey, Professor Kath Dickinson (Botany) and Assoc. Professor Peter Whigham (Information Science). Sam's research interests are in understanding the distribution of alpine plants (particularly snow tussock) in relation to controls such as snow cover and topography. His MSc thesis is focused on the use of RPAS and satellite imagery to model tussock distribution in the Pisa Range.

(continued from p33)

opment it is, its built form and configuration, the uses of units, and the personalities of the owners. A layered development structure imposes additional administrative requirements on all owners and their bodies corporate, which will add to the cost of ownership over time. Subsidiary bodies corporate also have less control over their own development compared to stand-alone bodies corporate.[21]

Conclusion

Layered developments offer an alternative ownership and management structure for unit title developments. The uptake since June 2011 has been slow. I am personally aware of only two such developments. This indicates that the benefits of a layered development do not outweigh the shortcomings of alternative structures.

NOTES

1. UTA ss 5, 7, 9, 19-22, 24, 41, 44-45, 48, 51, 56, 58, 60, 62, 63, 74, 75, 80, 82, 83, 91, 92, 93, 94, 96, 97, 98, 107, 121, 129, 138, 141, 142, 163, 165, 178, 181-182, 184, 186-188, 209 and 212 are also relevant to layered developments.

2. Section 19(1).

3. Section 20(3).

4. Section 3(c).

5. Section 21(1).

6. Section 38(1).

7. Section 39(1).

8. Section 39(2).

9. Section 39(2A).

10. The amendment or replacement of a unit plan falls within the definition of a subdivision under s 218(1)(v) of the RMA.

11. By way of example, a layered development in Auckland are likely to require resource consent under the Auckland Unitary Plan – Operative in Part. Rule E38.4.1 (A4) provides that unit title subdivisions are classified as controlled activities and s 87A (2) of the RMA provides that controlled activities require resource consent.

12. UTA, s 21(1).

13. Sections 38(1) and 39(1).

14. Section 20(4) and (5).

15. The provision of written consent is a workaround approved by Land Information New Zealand to avoid the need to pass a special resolution and carry out the designated resolution process between the deposit of the unit plan for the head unit title development and the deposit of the unit plan for the subsidiary unit title development because the UTA does not provide a separate process for layered developments that are completed at the same time as the head unit title development.

16. Section 21(2).

17. Section 21(2)(a) and Unit Titles Regulations 2011 ("UTR"), sch 2, form 1.

18. UTA, s 32(2)(b) and UTR, sch 2 form 5.

19. UTA, s 21(2)(b).

20. UTR, sch 2, form 33.

21. For example, s 107 of the UTA provides that where there is a conflict between subsidiary body corporate operational rules and parent body corporate operational rules, the parent's rules prevail, and parent body corporate approval is a prerequisite to a number of subsidiary body corporate decisions.

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- BeiDou: B1, B2
- SBAS: L1C/A, L5, QZSS, WAAS, EGNOS, GAGAN, MSAS

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ASaTs Update

Nick Stillwell, ASaTS Consulting Surveyor

What is ASaTS?

Advanced Survey and Title Services (ASaTS) is a project Land Information New Zealand (LINZ) is undertaking to look at a replacement for Landonline.

When is ASaTS going to affect me?

The project will seek government approval later this year, so timeframes for when things might impact surveyors should become clearer later this year.

What is my role in this?

In November 2017, I was employed by the New Zealand Institute of Surveyors (NZIS) to sit inside LINZ's ASaTS project to advocate for the views of surveyors. I will be getting out and talking to surveyors to understand their issues and ideas, and advocating for these issues throughout the project.

Where have I come from?

Up until I started this role, I was working as a practising licensed cadastral surveyor in the private sector based in Hawke's Bay. Hopefully as things progress, I will still get a chance to get my hands on the tools every so often.

What have I been up to?

Over the past few months, I have been capturing information from a number of surveyors about inefficiencies in their processes that were introduced by Landonline. This has been useful to:

- Understand the time cost of these inefficiencies
- Understand the key types of issues that surveyors are facing

Most of the surveyors I have spoken with to date are based in Hawke's Bay and Wellington as this is where I spend most of my time.

What am I up to soon?

I am starting to contact branches so I can get out around the country and meet more of you. Feel free to contact me when I come to your region (email: *nick@surveyors.org.nz*) if you would like me to come to your office to meet you and your team.

I appreciate any chance to hear about issues you are facing and ideas you have for the future. I can come prepared with questions about specific things, or I can just sit and listen to your ideas – get in touch!

What are the most common issues I am hearing?

Two sources of truth waste time: One of the most common complaints is about the amount of effort wasted by having a version of your data within third party software and another version of your data in Landonline, and having to manually keep them in sync with each other. It is common to have to make changes in both places, to lose work on re-import, and to build complex QA processes to ensure they are both in sync with each other.

Citrix keeps dropping out: It sounds like there are more and more issues with Citrix. There are regular reports of it dropping out, lagging, freezing, crashing. Rest assured, I will be advocating for a system more stable than Citrix in ASaTS. In the meantime, remember to report these issues to LINZ every time they happen at *www.linz.govt.nz/report-citrix-connection-issue* so we can use the information in these reports to understand the issue and help work towards a solution.

Easements are taking too long: A common piece of feedback is that the process of extinguishing and recreating easements over and over again with the current tools is wasting a significant amount of time, and that easement schedules are becoming increasingly complex be-

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CLIMATE CHANGE AND AOTEAROA

Christina Hulbe, Dean, National School of Surveying

Climate change is a global environmental challenge. Its effects are already apparent in Aotearoa New Zealand, across the Pacific and around the world. While the details of the forecast are uncertain (in large part because we don't know what people and governments are going to do next), we do know that additional change is already locked in by past carbon emissions. How New Zealand will respond to the forecast is also uncertain, but the longer we wait to act, the more intense the consequences will become and the fewer options we are likely to have.

Last December, the new coalition government released a 'Stocktake Report' written by the previous government's Climate Change Adaptation Technical Working Group. The report was clear about the costs and risks associated with climate change and about the limited planning under way to confront it. The Working Group's final report, 'Adapting to climate change in New Zealand', has just been released. Both documents are easy to find online and in my view should be required reading. Here's a quote from the final report:

> *New Zealand will experience increases in the frequency and intensity of extreme events such as higher temperatures, flooding, droughts, and wildfires. There will also be slowly emerging changes to our climate such as ongoing sea-level rise, and warmer and more acidic oceans. We are already seeing evidence of this. These changes threaten our coastal communities, cities, infrastructure, human health, biodiversity, oceans, and our natural resource-based economy.*
>
> *There will be losses and damages. Opportunities will also arise for new and innovative ways to adapt. We need to act now to address the ongoing changes to our climate.*

The reports call for strong leadership and immediate, nationally coordinated action. They warn that information is not making its way to communities, businesses and local governing bodies in ways that support effective planning and decision-making. And where information is available, there may be no clear mandate about how to respond.

The call for coordinated action requires leadership at all levels. In April, the government created an Interim Climate Change Committee and appointed a civil engineer as its Chair. There could be no clearer signal that the surveying and spatial sector has something to contribute – and perhaps also that we could be more visible in this space.

What can surveyors and spatial professionals do? Firstly, our work is relevant to both mitigation and adaptation so we should know the forecast and how it affects our regions. Secondly, recognising that not all regional responses will be

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cause of a lack of usable tools to intersect overlapping easements. It is not uncommon to hear that capturing easements is taking as long as creating primary parcels on rural residential developments.

Water/irregular boundaries: There continue to be ongoing issues with capturing water boundaries, examples include distortions because of linking, issues capturing nodes halfway along water boundaries, difficulties importing them, not sure if the xml versions downloaded can be trusted, no ability to enter compulsory attributes in third party software.

Plan drafting: It is common to hear frustration about the need to log into Landonline to draft plans, about the quality of tools available with Landonline versus commercial CAD packages, and about the format and layout of plans that can be achieved using the tools.

Are these the main issues?

I am always keen to hear feedback on whether these are the major issues for surveyors. These are certainly the issues that are popping up the most in my discussions, but if there are others that are a high priority for you, I am keen to hear them (*nick@surveyors.org.nz*).

What is LINZ considering to address these issues in ASaTS?

More on that in a future publication. For now, I look forward to receiving feedback from you on issues and opportunities, and look forward to meeting more of you as the branch visits come around.

the same, we should apply our specialist knowledge about the cadastre, engineering design, topography and coastal environments to inform climate-aware development. In his presentation at the recent NZIS Conference in Nelson, Professor John Hannah showed us that different parts of the coastline there have different vulnerabilities related to their specific geographic settings and composition.

Thirdly, we can advocate for and participate in planning that takes future climate into account, including both mitigation (choices about land use) and adaptation (choices about infrastructure, urban design, and more). In this way, the surveying and spatial sector can help communities, businesses, and governments to manage risks *and* make the most of the opportunities.

Finally, we can walk the talk. How climate-friendly is your business and your home? Was your last vehicle purchase based on the fringe benefit tax or on its fuel usage? Becoming more energy efficient is one of the easiest and most effective things the average kiwi can do to reduce their carbon footprint.

Climate change will affect both what we do and how we do it. Some surveyors and spatial analysists are already involved in forward-looking projects. Local and national governments are starting to make decisions about both mitigation and adaptation. Members of the NZIS have knowledge and expertise that can improve those decisions – but only if we step up to the challenge. We should, at the national level, be advocating for climate-aware policy and planning, and for a professional voice in the process. There was clear call for this during the Climate Change panel discussion at the Nelson Conference.

I'm not the first to make this call. Alan Milne made it nearly a decade ago in the pages of *New Zealand Surveyor* (n.299, pp.3-6). We need to start somewhere, we need to start now and the surveying and spatial sector have a lot to contribute.

On an unrelated note, I want to share some news about the New Zealand Diploma in Surveying at Toi Ohomai Institute of Technology. The New Zealand Diploma replaces the expiring National Diploma. It is highly industry focussed, emphasises project-based assessment, and is designed to support people already working in the industry. Thanks to modern distance learning tools, the programme allows students to fully participate from anywhere in New Zealand. Now in its second year of delivery, the Toi Ohomai programme has 23 students and the first cohort will graduate in December. Feedback so far has been positive, with most students finding their new knowledge immediately useful at work and many taking on new responsibilities as a result. If you would like to find out more, please contact Hamish McKenzie at: *hamish.mckenzie@toiohomai.ac.nz*, phone: 07 557 8352.

NZIS YP's at NZIS Conference

Mariana Pagan

Thank you to those that helped support all the young professionals in attending the conference this year. Nelson raised the bar with specific panels and presentations directed at young professionals along with the rest of the educational and inspirational three-day programme.

Some highlights included a young professionals networking lunch with Mark Fisher and the leadership team from Woods. They sparked up a good discussion around some "tough questions to ask your boss" and offered some good advice. Additionally, there was a panel discussion with business owners telling their story and some challenges they had to overcome along the way. This invited an active discussion and insight around career progression within the surveying and spatial industry.

The key note speakers really demonstrated the theme of the conference - Ambitious, Diverse, Connected. This began with Mai Chen encouraging us all to step outside our comfort zone with her inspiring talk about diversification and enhancing critical competencies for surveyors in the 21st century. Additionally, Liam Malone ended our conference with his touching story of determination throughout his journey to become a gold medallist Paralympian and his work with Artificial Intelligence.

Jordan Friis delivered a presentation on the FIG Volunteer Community Surveyor Programme which he was involved with in Nepal last year. This illustrated an example of cultural diversity and a very rewarding experience.

A group of high school students in the region came to the conference and were introduced to our profession with a series of short-fire presentations. These presentations were on young professional's different roles and paths since graduating with an underlying theme of their involvement within the North Canterbury Transport Infrastructure Recovery project.

The networking involved with a conference really is invaluable. Reconnecting with existing connections within our industry, and even more, the ability to form new relationships for the "personal board of mentoring directors" was so valuable.

Thanks again to those that made conference what is was and supporting the attendance of young professionals. Looking forward to what next year will bring already.

NZIS CONFERENCE 2018: *AMBITIOUS,*

NZIS's annual conference was held at the Rutherford Hotel in Nelson this year, with members and industry delegates across the surveying and spatial sector gathering for three days of comprehensive sessions and networking. Here are a few of the highlights from this year's conference.

NZIS President with closing Keynote Speaker and gold medal Paralympian, Liam Malone

Scene from the Glenn Stone Insurance NZIS themed dinner, "Lord and Lady Nelson"

Networking in the trade exhibition area

A session gets underway at the conference centre

More scenes from the Glenn Stone Insurance NZIS themed dinner, "Lord and Lady Nelson"

NZIS President Rebecca Strang with NZIS stream representatives

Women in Spatial lunch meeting

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Nelson Cathedral and view of Trafalgar Street

From the Glenn Stone Insurance NZIS themed dinner, "Lord and Lady Nelson"

Former Paralympian Liam Malone discusses his trials and triumphs in life and sport

Kairūri Community Trust – creating an exciting legacy for the future

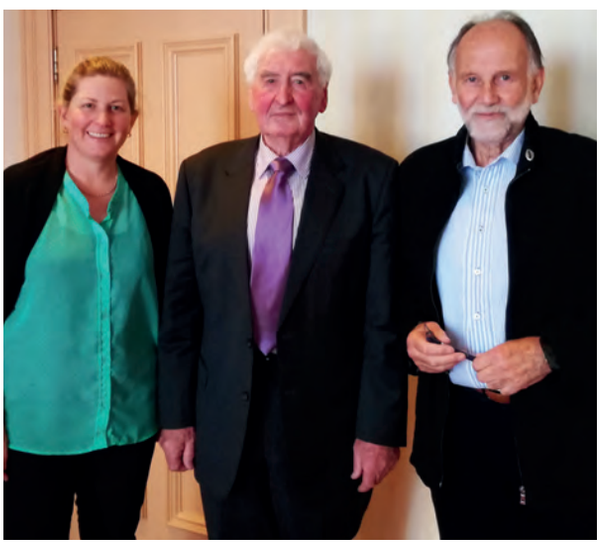
Kairūri means 'surveyor' in Māori, which makes it a fitting name for our first charitable trust set up with the aim of fostering the future of the surveying and spatial community.

After several years of planning, the Kairūri Community Trust was set up in 2017 and launched to NZIS members, sponsors and commercial partners at the annual conference recently held in Nelson. The launch included an auction of items contributed by Accurate Instruments, Allterra and Global Survey and was followed by a generous donation from Glenn Stone Insurance.

NZIS CEO Hadyn Smith says, "The Trust is off to a great start with $20,000 being raised on the night. It's great to see involvement from everyone at such an early stage which bodes well for the Trust's future."

The sole purpose of the Trust is to benefit the profession and create a legacy for the future. The trustees' objective is to build up awareness, grow and educate the public on the surveying and spatial community. This future focus gives benefactors the opportunity to provide educational scholarships, support inclusive school programmes, foster diversity and support the next generation of surveying and spatial professionals.

Bill Robertson, ONZM and Trust Chair, believes, "The Trust can give surveying and spatial careers an awareness; a real lift and the focus is pure. The concept of helping the communities we live in is huge and all the trustees are extremely excited about the potential effect this can have on young people and the sector."



Trustees Jayne Perrin, Bill Robertson and David Fox

Trustee Jayne Perrin and Glenn Stone of Glenn Stone Insurance Ltd

The Trust aims to support allied causes that are currently unfunded or in need of economical backing. They will be looking to address diversity in the profession by giving equal opportunities based on gender, ethnicity, and the socially and economically disadvantaged.

Other key aims are the preservation of historical records, vital to the understanding of the profession, research scholarships and school programmes, essential to advancing the science of the profession.

An important aspect is the complete independence of the Trust from NZIS operations. This is reflected in the charitable status that has been granted and the appointment of independent trustees, all of whom are well respected in the surveying and spatial community. Bill Roberston is joined by trustees Jayne Perrin, of Beca, and David Fox, founder of Fox & Associates.

There are several options for people to contribute to the Trust including bequeaths, donations, attending fundraising events and gifting.

Watch out for regular updates in *Surveying+Spatial* and to find out how you can support the Kairūri Community Trust, visit *www.kairuri.org*.

National MAGNET Conference – Save the Date

Position Partners Sokkia and Topcon will present the MAGNET Conference on 17 August at The Westin Hotel, Sydney.

This one-day-only conference will provide attendees with a full breakdown and demonstration of the latest updates to the MAGNET software. Attendees will learn how they can use MAGNET Office to improve efficiency and productivity.

The conference will be chaired by Garry MacPhail, Executive Director and National Geospatial Manager of Position Partners.

Jason Hallett, Vice President of Global Software Business Development, Topcon Positioning Group, will present the Sokkia and Topcon Vision to attendees, giving attendees the inside scoop on what's next for MAGNET Office.

Members of the MAGNET research and development team will be on site to discuss and present upcoming developments and address any challenges that end-users may be experiencing.

Attendees will have the opportunity to attend information sessions detailing the MAGNET Office Version 5 release, new features, enhancements, reviews and product demonstrations. Attendees will also benefit from MAGNET Office support desks and Tips and Tricks sessions.

Greg Goodman from Landteam is leading the users' wish list session, where attendees will be invited to help shape the future of MAGNET Office by providing their own wish list for future enhancements.

Throughout the conference, the Position Partners' national MAGNET support team will give MAGNET software users the opportunity to participate in three punchy class- →

Speakers at the National MAGNET Conference

Barkley Hensley, Senior Product Manager for MAGNET Office Products, Topcon Positioning Group.

Barkley Hensley has been involved in the surveying industry for 30-plus years and has been employed by Topcon since 2007. Prior to Topcon, Hensley was the director of technical support for a software company in the land surveying industry and has been a licensed land surveyor since 1990.

Jason Hallett, Vice President of Global Software Business Development, Topcon Positioning Group.

Jason Hallett has been employed by Topcon since 2007 and has been involved in the precise positioning industry for 30 years. Hallett's main responsibilities include leading the MAGNET Systems business of the Topcon Positioning Group, focused on software solutions and services for the surveying and construction markets. →

room sessions and multiple workshops targeted towards specific features of the software.

The Q&A Panel will give attendees the chance to ask MAGNET Office experts questions specific to their own needs. The Q&A Panel will comprise:

- Jason Hallett, Vice President of Global Software Business Development, Topcon Positioning Group
- Barkley Hensley, Senior Product Manager for MAGNET Office Products, Topcon Positioning Group
- Scott Wielt, Senior Manager of the MAGNET Product Management Team, Topcon Positioning Systems
- Graeme Hetet, Technical Support Manager, Position Partners (New Zealand)
- David Banks, Senior Application Specialist, Position Partners.

This event will be assessed for CPD points. Tickets to the MAGNET Conference are $300 + GST each, with an early bird rate of $200 + GST each if registered by 13 July 2018.

To book accommodation for the duration of the conference at The Westin Hotel, call 02 8223 1111. For more information or register for the MAGNET Conference, call 1300 867 266.

Hallett was most recently the VP of Global Product Management at Topcon. He is a licensed California professional land surveyor (since 1999) and has been awarded three patents with two more pending. He holds a Certificate of Business Excellence from the Haas School of Business at U.C. Berkeley, a B.S. degree in Management, and an A.A. degree in Business.

Scott Wielt, Senior Manager of the MAGNET Product Management Team, Topcon Positioning Systems

As Senior Manager of the MAGNET Product Management Team, Scott Wielt is responsible for defining and managing the innovation for the MAGNET system of solutions.

Wielt has worked for Topcon Positioning Systems since 2013. He is responsible for the management of the Topcon Technical Partner Program which provides access to Topcon technology for software and hardware development partners. Wielt has been in the Geomatics Industry for more than 30 years and holds a Bachelor of Engineering degree from the Ohio State University, specialising in Geomatics.

Garry MacPhail, Executive Director, Head of Geospatial Business, Position Partners

Garry MacPhail is a qualified engineering surveyor and began his career with Hinco Engineering in 1984. Hinco were distribution agents for Topcon equipment in Western Australia. In 1989, Topcon established a direct sales office and Garry was appointed State Manager for Western Australia.

In 2000, he founded Stadia Instruments with Bernard Cecchele taking over the distribution of Topcon in Western Australia. MacPhail was company director for eight years until Stadia Instruments combined with ABC laser, Laser Quip, Laser Beams and Ross Instruments to form Position Partners. Since the formation of Position Partners, MacPhail has held the role of State Manager for Western Australia and is also a member of the Position Partners Board. MacPhail has recently been appointed the head of Geospatial Business within Position Partners.

Graeme Hetet, Technical Support Manager, Position Partners (NZ)

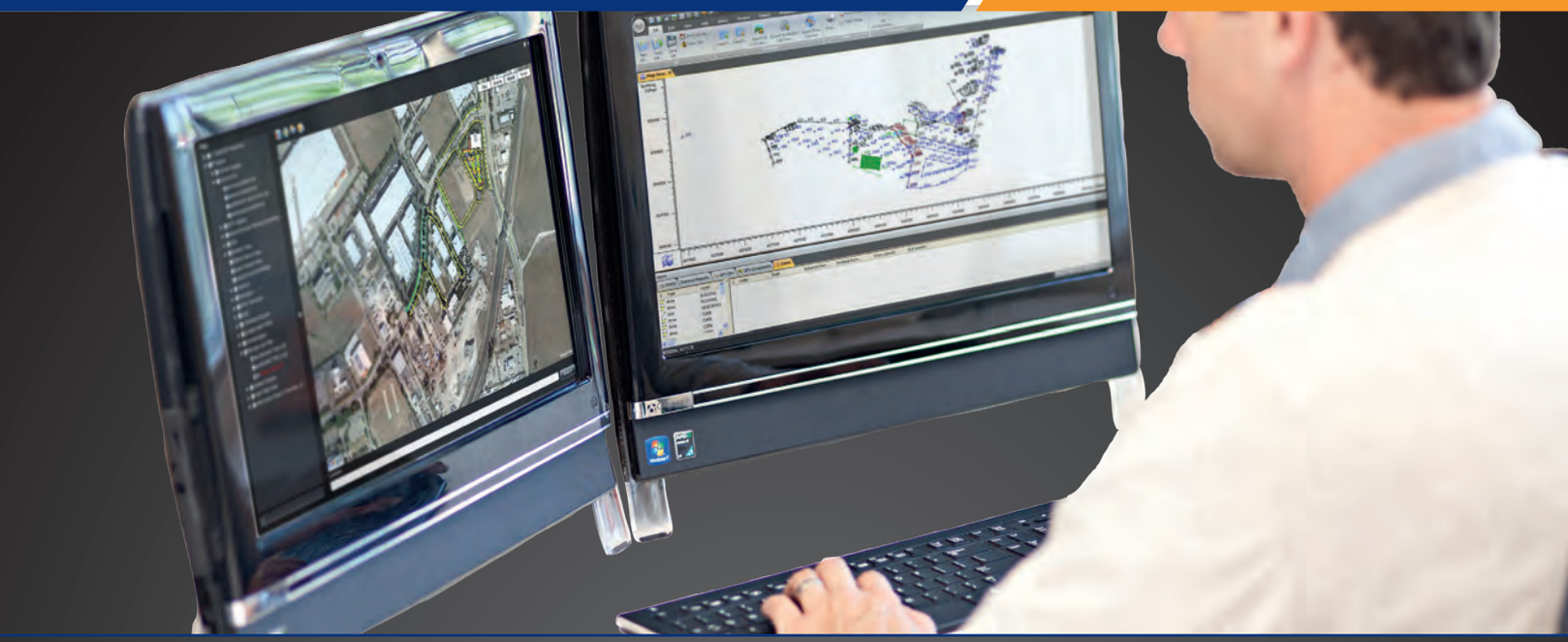
Graeme Hetet supports Position Partners' New Zealand clients and Australia's Position Partners Support Team in the everyday use of MAGNET Office. Hetet is based in New Zealand and has a civil background with 22 years' experience with CAD software – previously CivilCAD and, more recently, MAGNET Office.

David Banks, Senior Application Specialist, Position Partners

David Banks is a qualified survey technician who has been with Position Partners for seven years, although he started his career working in the field on T1 road projects around Sydney.

Using his industry experience, Banks has had an interchangeable path with Position Partners, as he has been an integral member of the Campus and Support teams providing training nationwide for all solutions with a focus around the MAGNET Suite.

Banks has spent many years as the National MAGNET Office Support Manager building relationships with customers and product managers to aid their success. Banks is now servicing New South Wales as a Senior Application Specialist in the Position Partners' geospatial business.



Australia and New Zealand MAGNET™ Conference

SAVE THE DATE 17th AUGUST 2018

Position Partners, Topcon and Sokkia are proud to present the MAGNET Conference on the 17th of August 2018. This conference will provide attendees with a complete breakdown and demonstration of the latest updates to the Magnet software. Attendees will also get the opportunity to learn how they can use MAGNET Office to improve efficiency and productivity. Members of the Sokkia MAGNET research and development team will be on site to discuss and present upcoming developments and address any challenges end-users may be experiencing, to help with achieving the overall outcomes of improving efficiency within the software.

Throughout the conference, Position Partners national MAGNET support team will give MAGNET software users the opportunity to participate in three punchy classroom sessions and multiple workshops targeted towards specific features of the software. Attendees will also have access to MAGNET Office support desks and Tips and Tricks segments.

LOCATION: The Westin Hotel
Heritage Ballroom
1 Martin Place Sydney

COST: Early Bird Rate $200^{+GST} if registered before 13th July
$300^{+GST} if registered after the 13th of July
Gain 5 NZIS CPD Points for attending

SCAN THE QR CODE FOR MORE INFORMATION AND TO REGISTER

www.positionpartners.com.au/events/survey-geospatial/australia-and-new-zealand-magnet-user-conference

Get in touch today:

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