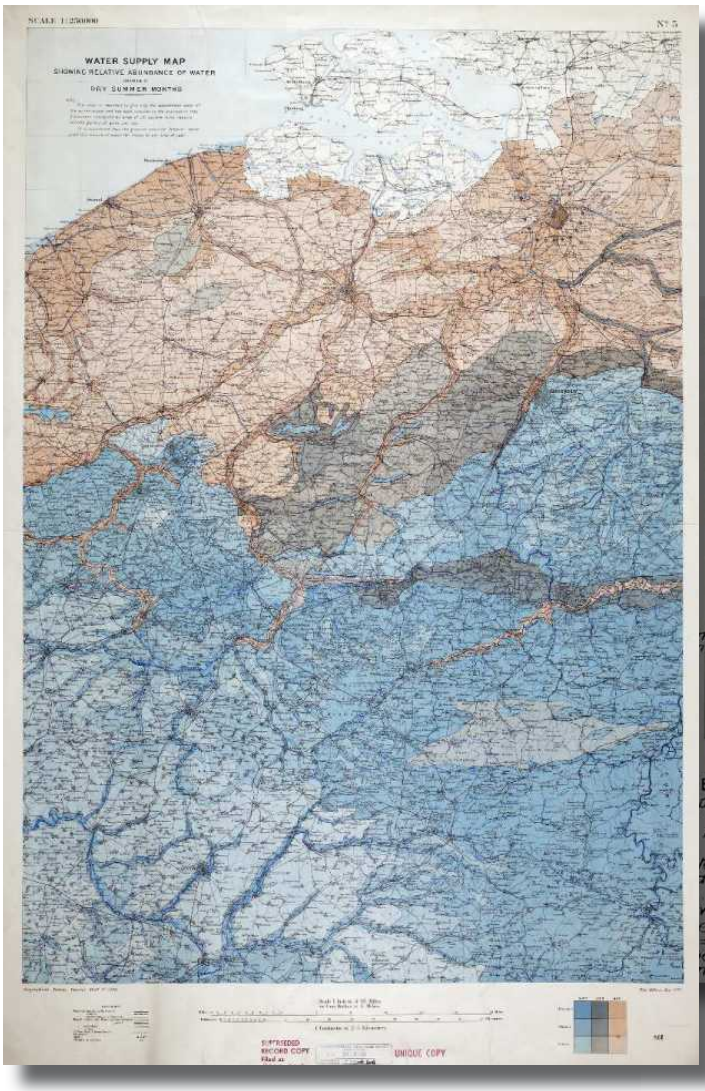
THE RANGER 2012

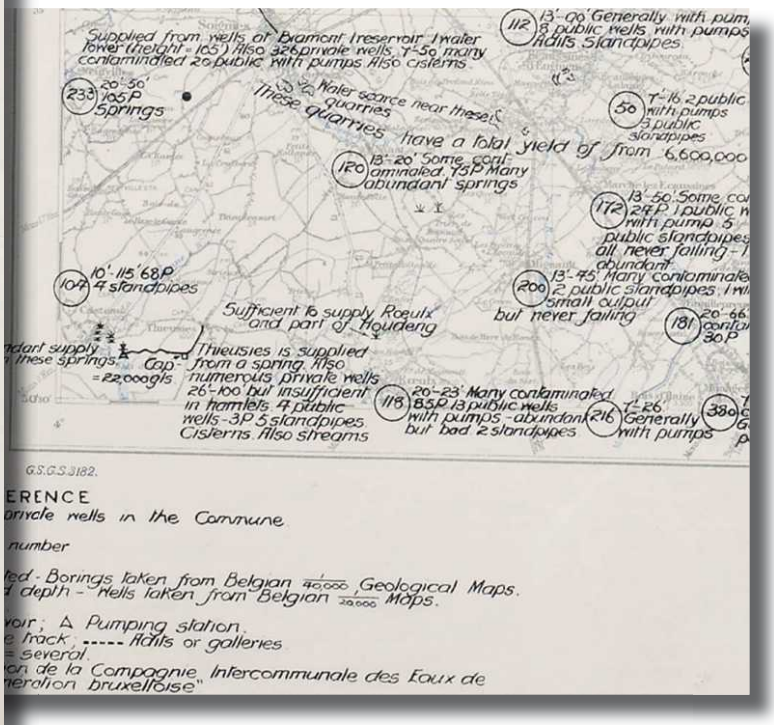
Journal of the Defence Surveyors' Association

Summer 2012

Volume 3 Number 3



Map at 1:250,000 for Belgium and northern France showing the relative abundance of water in the summer months



Water supply maps at 1:100,000 for the whole of Belgium and the enemy-occupied territory of northern France

Defence Surveyors' Association

ESRI UK
VISIONARY THINKING

Registered Charity No. 221816

Sponsored by ESRI UK

Contents - 2012

Designed and typeset by David Johnson.

Printed by: Talk Design & Print, 71 High Street, Winchester, Hampshire. SO23 9DA.

In this edition of Ranger…

This edition of Ranger brings together a wide range of articles covering both historical matters and current events. In this year when the Olympic Games have taken place in the London the magazine includes an article about operational support provided to the Games and on Page 11 the story of how John Bickers carried the Olympic torch in both 1948 and then again 64 years later in 2012.

During what has been a very busy year our operational units have found the time to contribute to the magazine which is very much appreciated. There are articles from 42 Engineer Regiment (Geographic) about an unusual task with English Heritage, how analytical support is provided to operations, and a report on the last DGI Conference. Our Royal Navy colleagues provide an interesting look at the use of unmanned underwater vehicles to assist in rapid environmental assessment, and the Royal School of Military Survey enlightens us about imagery intelligence training. The Defence Geographic Centre explains how its 5K Geodatabase is supporting our forces in deployed areas; in a second article the DGC explores the importance of human geography in Defence; and in a third article new processes and procedures to improve production output at the DGC are discussed. Finally, the Air Information Documents Unit explains how web services are impacting on flight planning.

Historical articles include a personal account of surveying in Malaysia by Roy Wood in the 1960s, notes of vectographs and polarising projectors by Mike Nolan, and a fascinating look at the use of geological mapping during World War One written by Ted Rose.

I would also like to thank Mike Nolan for organising another highly successful 'Maps and Surveys' conference at Hermitage in June and to all of the speakers that made for such an interesting day.

Peter Walker

Officers of the Association

Hon Secretary
Tony Keeley
Royal School of Military Survey
Denison Barracks
Hermitage
Thatcham RG18 9TP
Tel: 01635 204 244
Email: secretary@defencesurveyors.org.uk

Hon Treasurer
Roy Wood
Tel: 01635 32167
Email: treasurer@defencesurveyors.org.uk

Membership Secretary
James Prain
Tel: 01722 503 724
Email: membership@defencesurveyors.org.uk

Editor of the Ranger
Peter Walker
Tel: 01635 204 433
Email: editor@defencesurveyors.org.uk

Desktop Publishing: David Johnson
Email: d.johnson838@btinternet.com

Official Address
Defence Surveyors' Association
c/o Royal School of Military Survey
Denison Barracks
Hermitage
Berkshire RG18 9TP

Web Site:
www.defencesurveyors.org.uk

Registered Charity 221816

DEFENCE SURVEYORS' ASSOCIATION

Formerly the Field Survey Association

The DSA is a registered charity which maintains liaison between officers, warrant officers and senior non-commissioned officers, both serving and retired, and civilians who are working or who have worked in the Defence domain where the focus is environmental information, hydrographic, oceanographic and geographic surveys, locating and target acquisition, navigation, and geospatial intelligence.

The Association provides a variety of services to its members which include:

- A copy of each edition of Ranger magazine, published annually.
- Visits to a technical, military and historical sites, often not available to the general public.
- Opportunities to attend technical and historical seminars, including an annual seminar run by the DSA covering both historical and current issues.
- Opportunities to attend events organised by other professional organisations working in related fields.
- Opportunities to network with senior personnel in the Defence environmental and geospatial sector.

If you would like to join the Association contact details for the Membership Secretary are given on the last page of this magazine or visit the Association's website (www.defencesurveyors.org.uk) where you can complete an application on line.

100 Army Survey Course Reunion (100 ASC) - 2015

No 6 MSc in Geospatial Intelligence (No 100 ASC) forms up in August 2014 and I intend organising another reunion. I suggest 2015 as there are likely to be other events in 2014 marking the move of 42 Engineer Regiment (Geographic) from Hermitage. I have in mind another London based event (probably at the Army and Navy Club) in January to coincide DGI 2015. As at the last reunion I envisage an evening function of reception and formal dinner. No costings have yet been investigated or indeed any sponsorship if forthcoming! As this event is some time off I would be grateful for an indication of interest at this stage to assess the feasibility. I would be grateful for comments to me please as below.

Maj (Retd) Tony Keeley
Defence Intelligence & Security Centre
Royal School of Military Survey
Denison Barracks
Hermitage
Thatcham
Berkshire
RG18 9TP
Tel: 01635 204244 email: DISCRSMS-TrgCoord@mod.uk

Maps & Surveys Seminar Hermitage - 16 June 2012

By Tony Keeley

The annual seminar proved as successful as ever with a creditable turn out of approximately ninety delegates and presenters. Major General Patrick Fagan, the President of the Defence Surveyors' Association, presided over a fascinating series of lectures, the programme as always ably put together by Mike Nolan. Unfortunately Richard Chesney from the DGC was unable to attend to give his presentation on 'Moving Map Displays for RAF Navigation' hence Mike Nolan leapt into the breach with his reserve presentation. Richard's topic is considered of great importance and interest and he will be prevailed upon to deliver the subject lecture at next year's seminar. The programme of lectures was as follows:

Surveying the "Ulu" – A Troop Commander's tour in Sarawak 1964-1966.

By Maj Gen (Retd) Roy Wood, DSA.

84 Survey Squadron R.E. and the Directorate of Overseas Surveys (DOS) were already working in Borneo when the Brunei Rebellion took place in late 1962. There followed four years of Indonesian Confrontation with Malaysia during which time field surveyors from 84 Squadron and DOS were engaged in providing planimetric control and altimeter heighting for the Series T735 1:50,000 scale maps of Brunei, Sarawak and Sabah.

The Gough Map: the first modern map of Britain?

By Nick Millea, the Bodleian Library, Oxford.

Dating from the late medieval period, the Gough Map is internationally-renowned as one of the earliest maps to show Great Britain in a geographically-recognizable form. Yet to date, questions remain of how the map was made, who made it, when and why. By combining existing research and GIS, and collaborating with a variety of partners, we can now shed some new light on the map's possible history and function, and broaden the debate on its significance as an artefact.

The Presenters: Peter Jeffries, John Peaty, Roy Wood, Mike Nolan, Nick Millea.

Wellington's Surveyors in the Peninsula War.

By Dr. John Peaty, Defence Geographic Centre.

A major contribution to the liberation of Portugal and Spain from the French was the superb intelligence service developed by the British Army which enabled Wellington to know to a remarkable degree what was "on the other side of the hill". Our understanding of Wellington's intelligence service in the Peninsular War has been transformed in recent years but the contribution of British surveyors and map-makers during and after the campaign remains unappreciated. This paper examines the work of those surveyors and map-makers.

Capt James White Worsley R.E. – His maps of Corfu and Malta 1824.

By Mike Nolan, DSA.

This presentation described the life and career of Captain James White Worsley R.E. including graphic examples and description of his maps made as a Cadet and his later surveys and maps of Malta and Corfu made during the Post-Napoleonic period of occupation by the British. It was given in the hope it might stimulate research into his missing six-inch map of Malta. His well-known two-inch map of Malta was not engraved and published till 1856 but it then remained in use till the end of the nineteenth century.

Photographic Intelligence Gathering in the Berlin Corridors.

By Major (Retd) Peter Jefferies, TD Int Corps and Medmenham Club.

The presentation describes the RAF reconnaissance operations in the Berlin Air Corridors and Berlin Control Zone from 1945 until their termination in 1990, including the aircraft involved, the modus operandi, some of the analytical methodology and what the international Intelligence Community gained from them. It also covers what we believe the Russians and East Germans knew about the operations.

Current "Geo" Operations.

By Col. Mark Burrows, Commander Joint Aeronautical Geospatial Organization(JAGO) and Maj Brian Gifford.

The initial part of the presentation focused on recent trends and developments within JAGO with a bias towards providing Geo support to recent operations in Afghanistan and Libya. The latter part of the presentation covered the future trends, based around the Ministry of Defence's publication "Future Characteristics of Conflict".

Ample time was available for the other aspect of the Seminar, namely catching up with old friends. At the end of lunch Patrick Fagan presented the DSA prizes, five of the six recipients being able to attend, full citations following. The RAF Air Cartography Prize will be presented by OC No 1 AIDU at a later date. Prior to the final lecture presentation Patrick also thanked all the lecturers for their fascinating insight into their chosen subjects.

Prize Giving - 16 June 2012

By Tony Keeley

Royal Navy

Leading Seaman Richard Faulkner

Although serving in the Fleet HM Unit (FHMU) Acting PO Faulkner has spent the majority of his time loaned to the Fleet Unmanned Underwater Vehicle Unit (FUUVU). FUUVU are the Royal Navy's lead operators of autonomous underwater vehicles (AUV) and as the primary Hydrographic specialist within FUUVU PO Faulkner has been integral to the development of surveying applications of AUVs. Prior to his assignment to FUUVU, the REMUS 100 and 600 vehicles operated by the FUUVU were used solely to produce sidescan sonar (SSS) imagery, ignoring much of their environmental data collection capability. In realising the significant capability gap PO Faulkner has been instrumental in developing new guidelines for importing AUV bathymetric data into CARIS (and other hydrographic software) for processing, allowing the data to be fused with traditionally gathered sources such as multibeam data. He has also reviewed and developed operating instructions for a new version of Classiphi, processing SSS data for both the Mine Warfare (MW) and HM branches.

Maj Gen Fagan presents the RN prize to LS Richard Faulkner.

In using his initiative and ingenuity to develop these revised procedures PO Faulkner has laid the groundwork which will enable the RN to use AUVs to not only support normal survey operations; in addition he has also demonstrated the potential to covertly gather data from over the horizon and thereby facilitate intelligent preparation of the environment. This will also allow the seamless integration of beach data gathered by the Royal Marines Survey Reconnaissance Team with data gathered by AUVs, SVHOs and other units, providing safe navigation for amphibious forces from deep water onto the beach. He was the main driving force behind the initial work with AUV mounted multibeam echo sounders (MBES) systems (Geoswath+) which will provide the RN with a vastly increased capability over the current AUV mounted or Pre-Landing Force operated singlebeam systems for covert Rapid Environmental Assessment data gathering. Concurrent with this he has done much to foster greater integration between the HM and MW communities thereby supporting the future Mine Warfare, Hydrographic and Patrol Capability (MHPC).

In summary his work with AUVs has been key to integrating these off board systems into the hydrographic Orbat. This significant achievement is all the more impressive given that he has achieved this as an Acting Petty Officer and at the time had not completed his professional courses (IHO Cat B).

Royal Engineers (Geographic)

Corporal Robert Newbould

Cpl Newbould has been employed in the Geospatial Analysis Support Cell (GASC) within 16 Geo Sp Sqn, 42 Engr Regt (Geo) since January 2011. During that time he has led the way in developing a series of geospatial tools that have greatly improved the analytical techniques currently employed by RE(Geo) technicians in support of operations both in Afghanistan and the United Kingdom. His dedication, foresight and innovation in developing the GASC toolbox – a series of analytical tools utilised to standardise and improve geospatial analysis - has transformed the way in which information may be processed and exploited on operations.

Maj Gen Fagan presents the RE (Geo) prize to Cpl Robert Newbould.

The success of his achievements in developing and implementing new systems and integrating them into a military application are exemplified by his work on a specific analytical tool; developed at the request of HQ 3 (UK) Division, but with significantly wider utility. Having identified the need for feature classes created by Geographic Technicians in the field to be imported into ComBAT (the main C2 interface for users on the BOWMAN communications system), Cpl Newbould set to work on the challenge; not only designing, building and testing a tool capable of meeting the requirement, but in doing so reducing the processing time required from hours to a matter of minutes. This has had a significant impact on operational efficiency and saved busy Geo Cells, particularly those providing intimate command support to Formation HQs, valuable time that can now be more fruitfully used on other geospatial tasks. In addition, the value of his outstanding work has been acknowledged across Defence, and the script is now also being employed by ComBAT Application Specialists more widely to speed up the process of importing data into ComBAT. Additionally, Cpl Newbould's work eliminates the potential for errors due to the manual digitisation of the same features multiple times; a longstanding flaw in the geospatial aspects of the combat application and one that carries significant safety implications, risk and uncertainty for all soldiers on the ground.

Widely acknowledged amongst the RE (Geo) community (and most notably amongst his peers) as one of the finest technicians across the roster, this example represents just one illustration of the superb work completed by Cpl Newbould in his current role. His work has had a considerable effect on the efficiency of, and geospatial processes available to, RE(Geo) analysts deployed in Afghanistan and elsewhere. For his outstanding contribution to the improvement and efficiency of geospatial analytical techniques whilst working in the GASC, Cpl Newbould was awarded the Defence Surveyors' Association Prize.

Royal School of Military Survey

Staff Sergeant Mark Lanwarne RE

Staff Sergeant Mark Lanwarne has been employed as a technical instructor in the Geospatial Information Management (GIM) Wing of the Royal School of Military Survey (RSMS), Hermitage, since August 2009. He is the lead NCO geographic databases instructor for the Foundation Degree in Science (FDSc) courses and also contributes to the teaching of Information Systems related subjects at post-graduate level, including the MSc in Geospatial Intelligence Course.

His nomination is based on three aspects of his performance, his dedication to achieve the very best standards of teaching delivery for RSMS students, his commitment to achieve and maintain an 'industry level' of technical subject matter knowledge in his field and his determination to design training to emulate an Op Entirety (Afghanistan - Helmand) situational context. The training that SSgt Lanwarne has designed, prepared, delivered and assessed stands out as having added significant value by ensuring students acquire the very latest geodatabase technical and management skills necessary in support of operations.

On arrival at RSMS in late 2009, he was given responsibility for delivery of the FDSc Level 4 and 5 (ME(Geo) Class 2 and 1 courses respectively) database modules. Mindful of the capability developments that he had recently experienced first-hand whilst on operations himself, he conducted a review of the subject material and concluded that a complete redesign of the content was required. Tasked accordingly, he set about implementing these changes working tirelessly to redesign, from scratch, a new Level 5 FDSc geodatabase module. His design incorporated the most up to date

Maj Gen Fagan presents the RSMS prize to SSgt Mark Lanwarne RE.

Geographic technical doctrine including 'concept of use' of DATAMAN servers and GeoViewer applications deployed on Operation Herrick and the Afghan mission network - Overtask. SSgt Lanwarne took on the main technical co-ordination role for the team working on the task. He also incorporated new approaches to the delivery, learning and assessment strategies using teaching skills gained from a 14 month part-time Diploma in Teaching in the Lifelong Learning Sector (DTLLS) course that he also attended and graduated from in December 2011.

SSgt Lanwarne's contribution has made a significant impact to the development and improvement of geodatabase training for ME(Geo) soldiers on FdSc courses - thereby improving the effectiveness of Royal Engineer Military Geographic Technicians on Operations. For his outstanding contribution to the technical development of Geographic Database training in RSMS he was awarded the Defence Surveyors' Association prize.

Royal Airforce (Cartography)

WO Lee Scott

WO Lee Scott spent over 10 years in No 1 AIDU's Capability Development Flight and in Sep 2011 was promoted to be Warrant Officer Digital Production Flight at the age of just 41. He has instigated or overseen numerous technical projects, often doing the coding himself, but in particular he has been pivotal in the following: The development of AIDU's MilFLIP web site which allows 24/7, global access to AIDU's Aero Information data, products and web-map-services: Aero chart production from AIDU's 'GOTHIC' database which allows AIDU to move away from inefficient and obsolete desk-top publishing processes to a 'change once' digital production environment: Data exchange with NGA (Aero) which should shortly allow US/UK co-production of Aero Information data and products.

These developments are, collectively, the future of AIDU and without Scott's ongoing tenacity, leadership and unrivalled technical expertise they would not have been the undoubted success they have proved. He has made a disproportionately significant contribution to the MOD's operational capability. It is largely Scott's long-range vision, allied to his short-term structured, logical management approach, which has underpinned his considerable technical achievements. In particular, his leadership of the GOTHIC database project has been outstanding. This tool lies at the heart of AIDU's data production and had a troubled gestation. However, since 2007 through sheer hard work, WO Scott has pulled it around and has developed several additional capabilities which will see AIDU maintain its international reputation for innovation, as well as saving many thousands of pouinds through efficiencies.

Since his promotion to WO, despite taking on broader responsibilities, it is testament to Scott's desire for the very best result in all that he does that he has not rested on his laurels, but has continued to work tirelessly to introduce or improve capabilities on AIDU. In particular, he is leading on providing the Defence Aircraft Collision Avoidance Service (DACAS) via the MilFLIP web-site where MOD low-flying fixed-wing and rotary aircraft will be able to visualise and plan to avoid each others' routes before flight.

Throughout his RAF career Scott has always led by example, performed with the highest possible integrity, and has a deserved reputation for never compromising the search for excellence. Fiercely loyal to his Air Cartography roots, WO Scott has always been prepared to bring on those around him and he engenders the most enthusiastic team culture. Consequently, now that he is at the very top of his trade, he is seen as a consummate role model and is held in the highest possible regard on AIDU and more widely by officers and airmen alike.

For his contribution to successfully developing and implementing new systems, improving the efficiency of AIDU and raising the profile and reputation of AIDU with the US NGA WO Scott is an extremely worthy winner of a DSA prize.

Defence Geographic Centre

Mr Paul Gosling

Paul Gosling is the Desk Officer in Collection Division, Defence Geographic Centre, responsible for the collection of geospatial products over UK & Ireland to support Defence needs. Throughout the past 2 years he has focussed much of his effort to support Olympic Games 2012 planning and preparation. He has demonstrated exceptional initiative in tirelessly negotiating and collecting geospatial datasets required by Defence, OGDs and the Five Eyes community, most notably NGA, to support Olympic security needs.

From a readiness and planning perspective, he has collected large volumes of critical data from a range of new data sources – new in terms of either new organisations or organisations where no previous relationship existed. This includes the Olympic Delivery Authority, LOCOG, Transport for London, BAA and the Metropolitan Police Service (MPS).

To achieve this he has had to explain the need for the data and necessity for sharing it with the US and other nations, eventually gaining the required permissions to share. He has also ensured the collection of essential data from usual sources such as Ordnance Survey and imagery via the Pan-Government Agreement.

Maj Gen Fagan presents the DGC prize to Mr Paul Gosling.

In addition to his collection activities, Paul has played a major co-ordination role on behalf of Defence in the Production Co-ordination Group (PCG), an Olympic planning group set up specifically to ensure burden sharing, interoperability and avoidance of duplication of effort across the disparate Olympic geospatial community.

In support of this activity, his efforts to work with MPS and help them to understand the need for co-ordinated geospatial data early in the planning cycle are notable. In addition to his role on the PCG, he has led or been influential in various sub-groups within DGC supporting Olympics outputs.

He has worked virtually single-handedly and with minimal direction on the above tasks. As a result

of his effort, Paul has provided a major contribution to improving the efficiency of DGC's support to the Olympic Games and greatly raised the profile of the Defence Geospatial Community.

United Kingdom Hydrographic Office

Mr Robert Wheeler

Robert Wheeler has made a significant contribution to effective RN submarine navigation through the development and promotion of geospatial tools and techniques in support of training. He analysed the process of effective submarine navigation and identified a weakness in the trainee navigators' understanding of geospatial context and product capability. Through his own initiative, he developed a new element of training designed to remove the identified weakness.

The equipment operation function within this specialist submarine navigation arena is taught to RN specialists by Flag Officer Sea Training (FOST). However, navigation effectiveness is largely reliant upon an understanding of geospatial context, the geospatial products, their derivation, provenance and capability.

Mr Wheeler works in the DMGIC (Defence Maritime Geospatial Intelligence Centre) of the UKHO. He is part of the team, Submarine Operations and Surveys (SOS), which delivers a specialist navigation capability to RN submarines. The capability is adapted from established submarine navigation techniques but unique to specific submarine operational requirements. The SOS role is to identify data collection opportunities, assess new bathymetric survey data delivered by the RN survey fleet, analyse navigation data performance, produce and deliver updated geospatial products and provide a navigation briefing to the submarine navigator.

Maj Gen Fagan presents the UKHO prize to Mr Robert Wheeler.

He successfully demonstrated a trial package of material designed to train specialist submarine navigators in effective use of SOS products to interface with the navigation system. Having achieved buy-in from FOST, Mr Wheeler acquired MOD approval to design, build and deliver a new training module within the specialist Navigating Officers (NO) training course. Working closely with FOST staff, Mr Wheeler perfected the course design. As a geography graduate and maritime cartography expert, Mr Wheeler instinctively employed a geospatial framework to convey the key ideas in a clear and accessible way. He introduced several elements of contextual detail, again geospatially referenced and cartographically precise, to ensure a comprehensive and optimally effective learning experience for the NO students.

Mr Wheeler has now taught the specialist NO navigation module at FOST Faslane on four occasions. He is rightly regarded by FOST staff and navigation students as the national expert in this field. His success in use of geospatial presentation at the core of training delivery is such that the course has been opened-up to students beyond the submarine navigation community. Weapons engineers now regularly join their navigation colleagues to benefit from the enhanced 'situational awareness' afforded by this highly regarded training opportunity.

His achievements represent a significant benefit to the RN submarine navigation community, introduce important clarity to navigator contextual understanding and promote geospatial tools and techniques as a basis for effective learning.

Carrying the Torch - Again

Lance Corporal John Bickers RE stood in front of the Rising Sun pub in the village of Charlton two miles from Shaftesbury starring down the A30 towards Salisbury. He was dressed in Army PT kit of singlet, dark blue shorts and khaki plimsolls and he was waiting for Captain Don Wilde RE to appear. The date was the 1st of August 1948 and both men had been selected to carry the Olympic Torch for a leg of its journey from London to Torquay where the sailing events were to take place.

John carrying the 1948 torch.

Then a small motorcade came into view and there in its midst was Don Wilde holding the flaming torch aloft. The flame was passed to John's torch and off he set for Shaftesbury. There was a car in front of him, a motorcyclist on each side and another car behind which 'encouraged' John to keep up what was a very fast pace. John ran on towards the ancient hilltop town thankful that the weather was dry but aware of a slight wind in his face and getting warmer as the little entourage progressed along the road.

The final approach to Shaftesbury is a long uphill and after passing the ivy clad Grammar School on his left John was surprised at the large crowds that had gathered to cheer him on his way. The final two hundred yards was up the fairly steep main street ending at the top in front of the Town Hall where the flame was passed to next runner in the chain. John, now suffering a heat rash, doused his flame, got dressed back into uniform and returned to the Survey Training Centre RE which was then in the grounds of Longleat House.

And now, 64 years on, John Bickers was once again selected to carry an Olympic Torch, this time for 300 metres in York on the 19th of June.

John with both torches.

42 Engineer Regiment Survey the Bronze Age

31st May 2012

Wind, rain and grey skies typically sum up a typical February in Northern England. This was no different in February 2012 when a five man team from 42 Engineer Regiment (Geographic) headed north to County Durham to assist English Heritage with an atypical survey task. More specifically, a collection of Prehistoric Carvings on the Battle Hill Range near Warcop needed to be accurately positioned in 3D space. In order to capture the intricate detail of each carving, laser scanned point clouds of each ancient stone etching had to be generated before concealing the rocks with soil and turf - for ever! This would ensure the preservation of the ancient carvings by reducing their exposure to the weather. More importantly, the results generated by 42 Engineer Regiment's survey task would allow the archaeological community to locate their whereabouts in years to come!

The team was assembled from across the Regiment and included both regular and TA soldiers. LCpl Dan Mumford (13 Geo Sqn) was tasked to accurately position the locations of the eight rocks, with the assistance of Sgt Len Wendall and LBdr Becky Porter from the Regiment's TA unit, 135 Independent Geo Sqn(V). In addition to carrying out an accurate survey to position the carved rocks, the team were also tasked with capturing a high-resolution image using a Laser Scanner, operated by Sgt Leigh Leighton and LCpl Shawn Badcock (Special Support Team, 16 Geo Sp Sqn).

On arrival at the task site, the team were met with their first challenge, getting an eight tonne lorry to the top of Battle Hill. Sgt Leighton took to the "off road challenge" and carefully slid the once clean white DAF for a mile until he reached the end of the "road" in amongst a flock of sheep!

The team set about trying to find the first rock and managed to walk past it several times before it was identified. All the carvings appeared as faint indentations and as explained by English Heritage expert Mr Phil Abromson, these marks were around 5,000 years old and unsurprisingly on the English Heritage 'at risk' register.

The team set about surveying the first of the rocks. LCpl Mumford and his team established a GPS Base Station on high ground and more importantly, as far away from the sheep as humanly possible! The survey team then positioned the rock, laser scanner and the scanner targets in order to give the finished point cloud a real world position.

The Laser Scanning team had several teething problems with the scan, largely due to the weather. The strong winds were causing the head of the HDS 3000 scanner to move and this coupled with several downpours, prevented them from beginning the task. Previous experience with the scanner had highlighted how much rain can impair the images. Eventually, the weather settled and the first rock was positioned, scanned, and photographed, although this had now eaten into the teams limited 36 hour time frame for the task – the joys of tight timelines!

With changeable weather conditions and fast fading light, the team were unable to scan the second rock. Instead, the team were given a handheld GPS and a sketch map showing where the remaining

rocks were and then the following day, each of the rocks were accurately positioned prior to their everlasting concealment!

Unsurprisingly, on the second day, the weather made the survey task even more challenging, where the bitterly cold wind and rain provided a constant reminder of why 42 Engineer Regiment needed to record the position of the carvings before covering them up to preserve them. The carvings on the remaining rocks were much clearer and the team positioned 7 of the 8 carved rocks. Unfortunately, the outstanding rock was located underneath the remains of a large farm house and could not be found.

Over the course of the two days the task proved demanding and taxing, testing 42 Engineer Regiment's ability to apply high precision survey in gruelling conditions. The survey results were processed upon returning to Denison Barracks and the results of both the laser scan and the survey have since been forwarded to English Heritage – talk about making history!

Chartered Surveyor/Sapper Club

The Chartered Surveyor/Sapper Club is a dining club open to anyone who has served in the Royal Engineers or elsewhere in the Services, and who is also a Chartered Surveyor or a related professional. The Club provides opportunities for those with an interest in military matters and in the wider survey profession, to meet and mix in amenable surroundings. The social programme consists of a lunch, a dinner and an excursion each year. Most functions are in Central London messes or clubs. Anyone interested in joining the Club (which has raised over £40,000 for the Royal Engineers Museum since its foundation) should contact the Hon Sec, Martyn Kingsford at martyn.kingsford@blueyonder.co.uk.

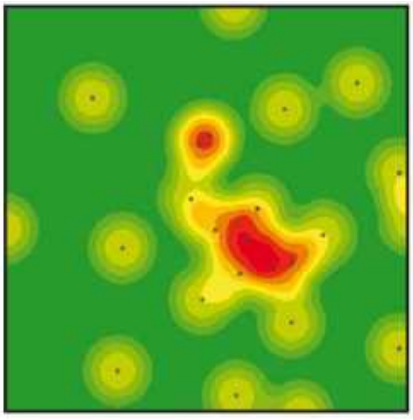
Providing Analytical Support to Operations

In 2009, the then Commander JAGO, Colonel Kedar, identified a shortfall within his organisation in respect to the analytical support provided to all RE (Geo) personnel, wherever they may be serving. Support for problems arising in areas such as hardware, software or data acquisition were firmly established through the formation of GST (Geospatial Support Team) and FSS (Field Support Section) but if our technicians are having analytical problems where could they go? Yes there is RSME, DGC and even their colleagues; however even if answers were provided, who was to say it was the correct one? The subjective nature of geospatial analysis can make processes very complex and at times difficult to comprehend, this coupled with the analyst supporting multiple, time sensitive operations or exercises; it is no wonder that mistakes occur from time to time. For these reasons the Geospatial Analysis Support Cell (GASC) was formed to provide the authoritative analytical solutions to RE(Geo) personnel, acting as a hub to collect all information and procedures adopted by the GIS industry and improving our analytical techniques before they are passed on to our analysts. The mission for the newly formed cell was set:

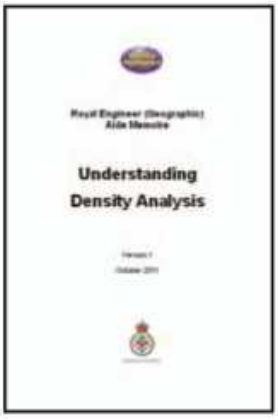
> *"...to provide authoritative GIS analytical support to all RE (Geo) personnel, in order to develop timely and effective analysis in order to achieve mission success.."*

As the cell was implemented to provide analytical support it would come under the responsibility of 16 Geographic Support Squadron and was established with a 5 man team. A WO1 would manage the cell with a SNCO detailed to manage the cells tasking, 2 x Cpl analysts and a D Grade civilian to compile the working. The cell was equipped with three GEOSYS and the most current Mission Specific Dataset (MSDS) being used in Afghanistan. Having this equipment ensured the cell mirrored what the analysts on Operations were using and as a result the cell would be able to replicate the analytical problems that were identified with solutions being found as quickly as possible.

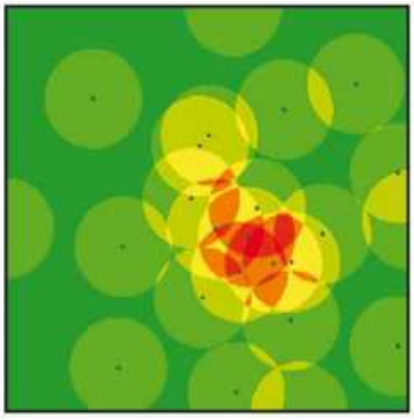
In January 2011, WO1 Hutton and Cpl Newbould set about establishing the GASC and raising awareness of it to the RE (Geo) community. Members were sent out to the Regiment's Pre Deployment/Mission Specific Training exercises to present the new capability, providing examples of the type of work and questions that the cell was expecting to undertake. Primarily the GASC was going to look into developing two areas of support to the RE (Geo) community; develop a number of aide memoires to raise the understanding of certain processes and secondly develop a GASC Toolbox that could be located within ArcGIS software and would standardise and simplify complex analytical processes. Initially requests for support were slow which allowed the GASC time to investigate common problems that had been recognised across the community. One area identified was the lack of understanding we have on certain analytical techniques; therefore it was decided to write some aide memoires that would expand the understanding of these areas; with the first one focusing on the subject of density analysis. This type of analysis is currently being heavily utilised throughout theatre and is used to identify vulnerable areas for counter improvised explosive device (C-IED) operations. The cell wanted to be certain that the analysis being conducted was correct and that the analyst was able to understand the results and how best to display them to the customer. Aide memoires provided the perfect platform to detail the various methods of carrying out density analysis, highlighting where a particular method was suited to a specific type of task. Conducting the analysis is only half the story and it became apparent in some cases that analysts did not fully understand the results; therefore it was necessary to reinforce this further.



Kernel Density Analysis

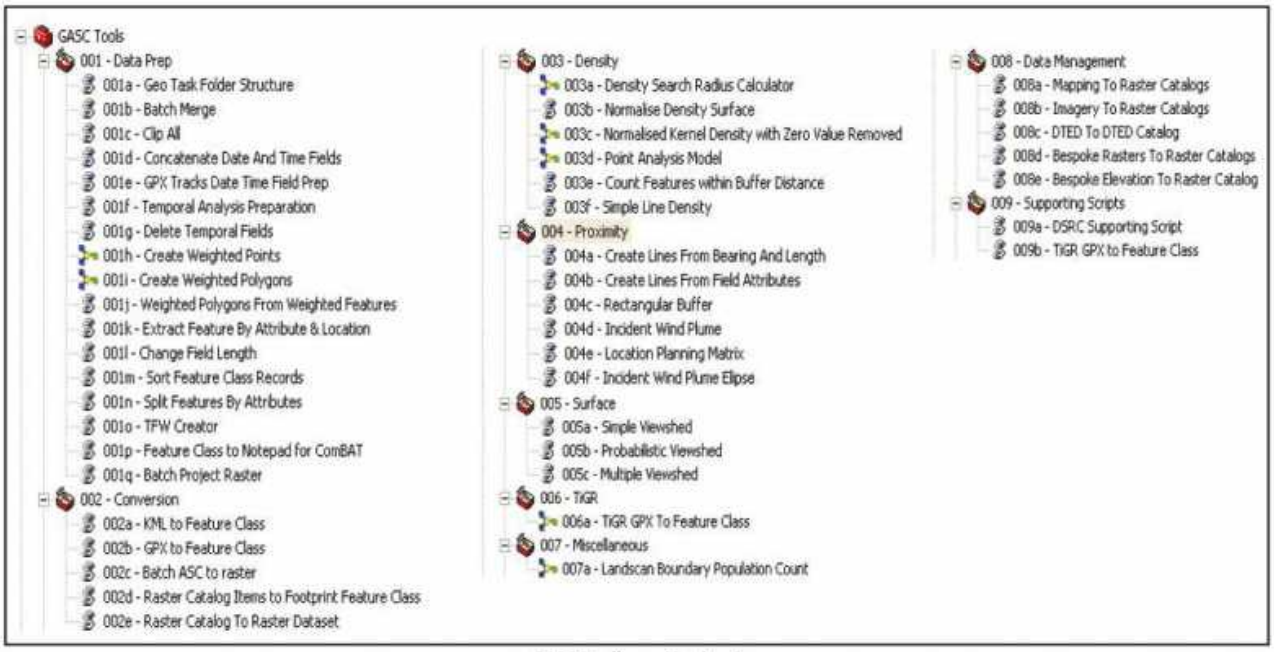


Aide Memoire



Point Density Analysis

Concurrently Cpl Newbould set about the creation of the GASC Toolbox. It was created to follow a format that the RE (Geo) community would be familiar with and for this reason was designed to be contained within the GIS software of choice for the military. Each tool created would be made to look and feel similar to existing tools, ensuring the analyst would feel comfortable using the new tools. To achieve this, members of the GASC needed to undergo some training that would allow them to use the same techniques employed by industry. This meant learning Python scripting, a type of programming software that ESRI were using and would enable the GASC to generate specific scripts. The generation of such scripts would simplify processes that would otherwise require the construction of complicated models. In addition it would also allow the standardisation of analysis, so that any Geospatial Analyst (GA) in any location could input the required parameters, and that analysis could easily be replicated in another location by someone else.



GASC Toolbox - Version 2

As this was a learning process for everyone only simple scripts/tools were created at first, this included the generation of a workspace folder structure and the ability to concatenate date and time fields into a single output. The potential that Python scripting offered the GASC was becoming more apparent. Cpl Newbould was the first to attend a python course, after which he was able to generate more complex scripts that would increase the level of support the GASC could offer. He keenly set about developing a new date/time tool that provided more comprehensive temporal information. After countless hours of research on the internet, he managed to generate twenty additional fields of information from a single date time group (DTG) field. This meant that users could now extract the following information; week of the year, day of the week, period of the day (sunrise, sunset etc) and many more, all adding temporal information which allowed a deeper level of analysis to be conducted.

StartDate	StartTime
05/01/2011	10:21:00
25/01/2011	06:49:00
02/02/2011	16:48:00
04/02/2011	03:15:00
26/02/2011	13:34:00
11/03/2011	18:20:00
20/03/2011	18:37:00
09/04/2011	22:00:00
13/04/2011	16:17:00
20/04/2011	04:01:00
25/04/2011	17:26:00
25/04/2011	11:11:00

StartDate	StartTime	Year	Quarter	Month	Month_Descr	Month_Descr_Full	WeekOfYear	DayOfMonth	DayOfWeek
05/01/2011	10:21:00	2011	1	1	Jan	January	2	5	4
25/01/2011	06:49:00	2011	1	1	Jan	January	5	25	3
02/02/2011	16:48:00	2011	1	2	Feb	Febuary	6	2	4
04/02/2011	03:15:00	2011	1	2	Feb	Febuary	6	4	6
26/02/2011	13:34:00	2011	1	2	Feb	Febuary	9	26	7
11/03/2011	18:20:00	2011	1	3	Mar	March	11	11	6
20/03/2011	18:37:00	2011	1	3	Mar	March	13	20	1
09/04/2011	22:00:00	2011	2	4	Apr	April	15	9	7
13/04/2011	16:17:00	2011	2	4	Apr	April	16	13	4
20/04/2011	04:01:00	2011	2	4	Apr	April	17	20	4
25/04/2011	17:26:00	2011	2	4	Apr	April	18	25	2
25/04/2011	11:11:00	2011	2	4	Apr	April	18	25	2

DayOfWeek_Descr	DayOfWeek_Descr_Full	HourOfDay	MinutesOfDay	Sunrise	Sunset	DailyZone	AM_PM	Morn_Aft
Wed	Wednesday	10	21	07:08:00	17:22:00	Day	AM	Morning
Tue	Tuesday	6	49	07:00:00	17:42:00	Dawn	AM	<Null>
Wed	Wednesday	16	48	06:55:00	17:48:00	Day	PM	Afternoon
Fri	Friday	3	15	06:55:00	17:48:00	Night	AM	<Null>
Sat	Saturday	13	34	06:34:00	18:05:00	Day	PM	Afternoon
Fri	Friday	18	20	06:17:00	18:15:00	Dusk	PM	<Null>
Sun	Sunday	18	37	05:59:00	18:25:00	Dusk	PM	<Null>
Sat	Saturday	22	0	05:42:00	18:34:00	Night	PM	<Null>
Wed	Wednesday	16	17	05:34:00	18:39:00	Day	PM	Afternoon
Wed	Wednesday	4	1	05:26:00	18:44:00	Night	AM	<Null>
Mon	Monday	17	26	05:20:00	18:49:00	Day	PM	Afternoon
Mon	Monday	11	11	05:20:00	18:49:00	Day	AM	Morning

GASC Script – Temporal Data Preparation Script

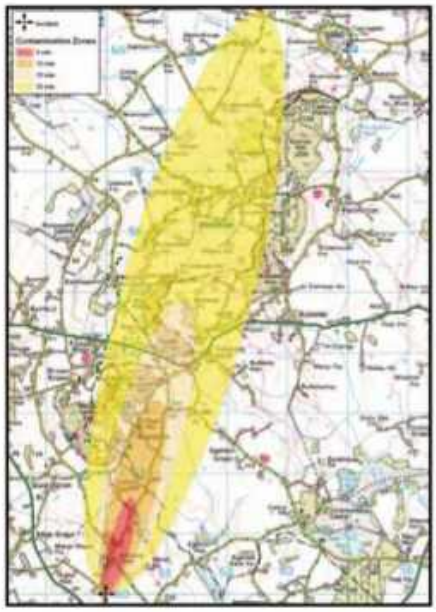
A further success for the GASC was instigated by Sgt Finch, working with TiGR implementation team who recognised that the information being captured could add great value to the type of analysis that was being undertaken by the GA's in support of ground operations. Each time a patrol left base, it would record its route using a Garmin Foretrex 301 GPS watch, as well as other geospatial information. Locations such as schools, shops and Mosques were pinpointed, details of compounds and their inhabitants recorded, all of which was downloaded to the TiGR system on the patrols return. All this information is extremely useful, but of particular interest to the GASC was the patrol route information captured on the GPS. Each track recorded the DTG along the length of the route which meant that the new temporal script could immediately add value. What the tracks data required was a way of identifying who had conducted the patrol and the patrols purpose. A TiGR specific script was created that would allow other data written in the associated patrol report to be extracted and added to the tracks information, improving the value of the data further. All this information combined meant that greater analysis could be conducted on patrols; pattern setting and the ability to identify new vulnerable points and areas all in the hope of increasing the safety of the patrol.

Since its inception, more and more queries have begun to make their way back to the GASC. Most are via a quick email from the likes of the Geo Cell in theatre or other Geo personnel, such as Sgt Carroll based with UN in Nicosia. The majority of these calls can generally be solved with a quick fix or some advice over the phone about the best method to tackle the problem however answers will not always be immediate, and passing on these issues frees up valuable time for the analysts to concentrate on other pressing tasks.

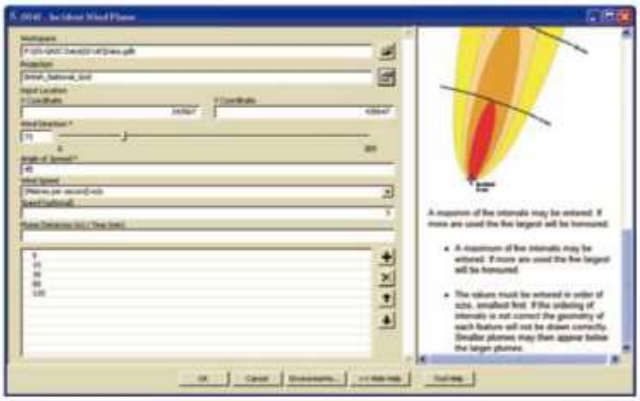
GASC Script – Feature Class to ComBAT

As well as these quicker tasks, units such as the Geo Cell at HQ 3 Div, have approached the GASC looking for assistance in solving larger issues. One such issue was data transfer between Geosys and ComBAT on BOWMAN. 3 Div had to spend large amounts of time manipulating the data through various processes until it was suitable to add to ComBAT. Python programming was ideally suited to combine the multiple processes into a single script that would enable the user to input the feature class created in ArcGIS, with the output being in a data format that could be ingested into ComBAT using a fraction of the time.

Other questions from different departments soon followed: Special Support Team (SST) required a tool from which they could generate a worst case scenario Wind Plume. This task previously had also been time consuming and by forwarding the problem to the GASC the cell was able to combine the multiple processes into a single wizard. This wizard allowed the user to input certain parameters such as the point of origin, direction of the wind, wind speed and the assumed angle of spread. From the results the team were able to rapidly identify which areas could be affected, where to apply cordons to restrict the amount of damage/contamination, again in only a fraction of the time taken initially.



Now that the GASC is becoming more established and is spreading its net further throughout the RE (Geo) community, it has been looking at other ways to disseminate the capability and support it develops. A large part of this will be captured with the introduction of a GASC Portal, an internet based interface that allows users to logon to the webpage and download the scripts or other information



GASC Script – Incident Wind Plume & Result Process

The GASC Portal Pages on ArmyNet

developed by the GASC. After looking into many different ways of delivering such a capability, the decision to use ArmyNet on the Worldwide Web was taken. All users have to do, is using their unique ID, logon to the main ArmyNet portal, from where they can then access the variety of information located on the GASC home page. The portal is broken down into several pages, each offering a different type of support from written documentation to video podcast instructions on how to implement each of the tools. Users will also be able to access the GASC Blog page and post any questions they have, not only to the GASC but also to their peers in the Geo world.

What next for the GASC? The GASC will continue to look for new and innovative ways to deliver support to Geo. Tasks such as migrating the Toolbox from 9.3 to 10 for the early part of 2013, devising a process by which all products from the GASC undergo validation prior to their delivery to RE (Geo) are being generated. As the first year or so has come and gone, awareness of this capability grows leading to more and more questions being asked with more and more people beginning to feel the benefit of the cell. There is no analytical problem that will not be attempted, an answer may not be possible but the cell will exhaust every possibility before returning that verdict.

The Worshipful Company of Scientific Instrument Makers

Admission Court Dinner - 20th October 2011

By Tony Keeley

The Royal School of Military Survey was once more the recipient of the Livery Company's hospitality at their hall in London. The Livery Company is affiliated to the Corps of Royal Engineers and historically this link has been managed by the Royal School of Military Survey. The Company has endowed two prizes to the Corps, the best Royal Engineer officer on the MSc in Geospatial Intelligence (formerly the Army Survey Course) and to the best Royal Engineer soldier Geographic Technician on the Class 1 Course. The MSc prize for 2011 was awarded to Captain Adam Morley RE who had just completed his course and the Geographic Technician prize was awarded to LCpl David Barrett who completed his Class 1 course in April 2011, the Master of the Company, Mr Keith Etherington, presenting the prizes. David was not able to be present to accept his award as he was then deployed on operations in Afghanistan, his prize being accepted on his behalf by WO1 Pietro Framalicco. The Principal of the Royal School of Military Survey, Mr John Knight, and the Training Coordinator, Major (Retd) Tony Keeley also attended. The citations for the prize winners are given below. As always the hospitality of the Livery Company was superb.

Capt Adam Morley RE

With hands on geophysical related field experience in both Canada and Antarctica, Capt Adam Morley graduated from the University of Leeds with a first class Masters degree in Geophysics before joining the Army in January 2006. On commissioning into the Royal Engineers, he was posted to 38 Engineer Regiment where he deployed to Northern Ireland and Kenya as a Field Troop Commander and to Afghanistan as a Battle Group Engineer for the Danish Army. He later used this operational experience to train phase two soldiers at the Royal School of Military Engineering in Surrey before commencing an MSc in Geospatial Intelligence at the Royal School of Military Survey in August 2010.

On the 3 October 2011, Capt Morley began his new posting at 42 Engineer Regiment in Hermitage, West Berkshire, where he works as the Special Support Team Commander in 16 Geographic Support Squadron. This involves the provision of geographic support to Regional Brigades across the country and the sustainment of specialist technical capabilities to assist the Nuclear Accident Response Organisation and the Technical Response Force. Rumour has it that he'll also get a roving ticket for the Olympics! Capt Morley resides with his girlfriend Kelly in the country village of Deddington, North Oxfordshire, where he regularly enjoys swimming and playing squash. For his outstanding performance on No 2 MSc Course he was awarded the Worshipful Company of Scientific Instrument Makers' prize, the exam board also ratifying two other prizes, the Cranfield University prize and the Simpson-Leica prize.

LCpl David Barrett

LCpl Barrett enlisted in the Army in December 2006 and after completing his basic recruit training at Litchfield, combat engineering at Minley and driver training he undertook his Class 2 Geographic training at the Royal School of Military Survey, Hermitage. During this period of two years intensive training he was recognised as both an outstanding recruit and on his latter course as one of the best young technicians at Hermitage. He was then posted to an operational unit albeit an unusual one, the Joint Air Reconnaissance Intelligence Centre (JARIC) at RAF Brampton for two years. Following this posting he undertook his Class 1 Geographic training, again at the Royal School of Military Survey completing this year and being awarded his foundation degree. He was by far the best student this year, and for several years, achieving exceptionally high marks in all his work. He was then posted to 14 Geographic Squadron RE and as is all to typical very quickly deployed on operations to Afghanistan to provide geographic support to a task force in the vicinity of Camp Bastion, another shall we say more than interesting appointment. He is a single soldier, very keen on all sports, and representing the unit at rugby whenever he can. For his exceptional performance on his Class 1 Course he is awarded the Worshipful Company of Scientific Instrument Makers' prize in the geographic soldier category. He has also been awarded the following prizes, the Sheffield Hallam University prize and James Walke prizes for 2011 and the Royal Engineers Association prize for No 10 Geographic Technician Class 1 prize.

The Truth and Myths of Imagery Intelligence Training

By Flt Lt Nev Morgan, Head of Analytical Studies, Imagery Intelligence Wing, Royal School of Military Survey.

At the first mention of imagery intelligence training most people think of the now historical name Joint School of Photographic Interpretation (JSPI), and often the second thought is tank counting. Unfortunately these images, no pun intended, of the Wing's Cold War role have prevailed in some people's minds and could not be further from the truth. Since 2007, Imagery Intelligence Wing (IMINT Wing) has been one of the three Wings of the Royal School of Military Survey (RSMS). The Wing has continued to teach the 4 month UK Imagery Analyst Course (UK IAC) and has also significantly developed short courses to support the Royal Artillery UAV (Unmanned Aerial Vehicle) and Base ISTAR (Intelligence, Surveillance, Target Acquisition and Reconnaissance) courses. However the UK IAC remains the beating heart of the Wing.

A quad-service course, the UK IAC has been running since before the Second World War. The course is designed to teach, at foundation level, the principles and practices of Imagery Analysis, including the production of predictive intelligence products. Analysis is conducted using Electro-Optical, Infrared, Radar and Multi-Spectral Imagery acquired from a range of reconnaissance platforms. The digital age has significantly impacted on imagery intelligence and has revolutionised the way we do business. Long gone are the light tables of the past, with every student now sitting at a dual screen computer and having access to thousands of images at a touch of a button. However, the fundamentals of the course still remain generally the same and the learning environment is still very much 'hands on' exercises with summative testing.

The UK IAC comprises two learning phases. In the first phase, students are introduced to fundamental aspects of Imagery Analysis. The emphasis here is not only to develop competence in exploiting imagery but also to develop analytical reasoning and critical thinking over six stages. Each stage builds on the previous one, introducing new learning and reinforcing prior learning. On completion the students will have demonstrated fundamental synthesis and evaluation skills.

The second learning phase introduces more specialist knowledge whilst increasing the complexity of tasks. Each subject has an initial element of fundamental learning before all of the teaching points are brought together and practiced. By the end of each subject, tasking will have required the students to apply critical reasoning to imagery and collateral information (SIGINT, HUMINT and OSINT), to produce high quality and accurate intelligence products. The students' fundamental and applied application is assessed within each subject.

IMINT Wing conducts a number of multi-intelligence source exercises and summative tests. Our aim is to make the training as realistic as possible; to achieve this, the exercises are designed around all source intelligence material with imagery intelligence used as the primary source. The course uses a mixture of subjects to accomplish this and over the four months of the course we take the student, irrespective of rank and previous background, from photo readers to imagery analysts.

With the UK Armed Forces deployed on major operations, the receiving units of students from the UK IAC, such as JARIC, TIW, 5 (AC) Sqn, 39 Sqn (Reaper UAV) and 32 and 47 Regts RA have had many demands and challenges placed on them and their trained Image Analysts. This continual feedback has been the driving force behind the recent round of changes that has taken place in the Wing. One aspect of the changes made to the UK IAC has been receiving units requesting elements that directly relate to their current tasking to be included in the course. However, the often forgotten fact is the UK IAC is a foundation course in imagery intelligence and teaches the students to answer the 'so what' intelligence question by using imagery of ground, air and maritime subjects as their primary source. It does not teach them to be unit or sensor experts but does give them a full career grounding to be effective imagery intelligence analysts. Op ELLAMY, the recent Libyan operation, has confirmed that the subjects covered and the grounding provided by the UKIAC enables graduates of the course to operate effectively in any situation. That is to say, the graduating students will have the depth and breadth of knowledge and fundamental skills to be able to effectively deal with the unexpected in the future; and not be trained solely in one area, such as Counter Insurgency operations. The structure of the UK IAC also lays the foundation to produce adaptable and capable analysts that will be able to cope with a challenging and ever changing intelligence environment, no matter how long they serve for.

IMINT Wing continues to be the leading light and the centre of excellence for Imagery Intelligence Training in the UK and beyond. This is reaffirmed to the Wing every year when our international course could be filled many times over. We still maintain close ties with our Australian and Canadian counter

parts and are responsive to changing demands that our customers place on us, but at the same time are mindful that today's tasking will not necessary be tomorrow's. As all those currently working for or in support of defence will be aware, the goal is to achieve more with less. This has without doubt been achieved at IMINT Wing and is down to all the staff at the Wing, including the dedicated and world class imagery analysis instructors, whose passion and enthusiasm is the basis for our continuing success.

One of the future challenges for IMINT Wing is to fulfil the demand for increased imagery training and the Wing will continue to work at maximum capacity for the foreseeable future. We will continue to excel and strive for excellence and provide UK deployed forces with effective and force multiplying imagery intelligence analysts.

A Foundation for Intelligence

By John Seabourn, Geospatial Analyst, Defence Geographic Centre.

In times of austerity when staff numbers are falling, getting the most from limited resources becomes of vital importance. The Defence Geographic Centre (DGC) is responding to this need by providing geographic foundation data which can be built upon by multiple users in many different disciplines, whether this is to produce maps for ground forces, supply data to geo specialists in the field or simply to be re-used within our own organisation. This combined with a move away from labour intensive hardcopy mapping to more easily manipulated softcopy has resulted in DGC's 5K Geodatabase for Task Force Helmand.

The DGC's 5K Geodatabase is a prime example of a leaner approach to geospatial data. It covers an area of approximately 30km by 20km over the densely populated area of Nad Ali and Lashkar Gah. Within this area over 100 feature categories have been collected at a 5K (town plan) scale as centreline data. It is collected using stereo imagery coupled with mono imagery and a wide range of other intelligence sources to maintain currency and accuracy. All features are individually attributed with as much obtainable information as possible, leaving space for further attribution in the future either by theatre, other customers or ourselves (e.g. a building feature could detail number of occupants, address, number of floors, ethnicity, etc).

The result is an extensive 3D topologically accurate data set containing over 250,000 items with extensive attribution at a 5K scale *(Fig 1)*.

The completed 5K Geodatabase was made available to theatre in Apr 12 via Dataman and CD/DVD. DGC expects the primary use will be on the ground in Helmand to create bespoke products and be combined with real time datasets to generate informed geographic decisions. DGC has already utilised the Geodatabase to produce other products, such as 3D models *(Fig 2)* and paper mapping, which has significantly reduced production time scales.

It is hoped that DGC's 5K Geodatabase sets a standard for geographic foundation data over areas where UK Armed Forces are deployed.

Fig 1. Sample of Geodatabase shapefiles.

Fig 2. Example of a 3D product produced from DGC's Geodatabase.

The Eighth Annual Defence Geospatial Intelligence Conference

By Squadron Leader Nick Hall, OC Imagery Intelligence Wing, Royal School of Military Survey.

In the Age of Austerity, when every Defence penny is carefully scrutinised, you seldom get the opportunity to attend conferences. This is a great pity as conferences offer the opportunity to network with other professionals and to take the pulse of what is happening within your area. So when you are offered a pass to the Defence Geospatial Intelligence Conference (DGI) 2012, it is something to appreciatively accept. This is especially the case when the likes of Air Chief Marshal Sir Stuart Peach, Gp Capt Steve Thornber and John Knight are some of the main speakers. Hence, on a fresh January morning I headed to the Queen Elizabeth II Conference Centre in Westminster to attend DGI 2012.

This year was the 8th Annual DGI Conference, with the theme of "Empowering decisions through online on-demand access to multi-int knowledge and analysis". The event saw over 750 attendees from 45 different countries - more than in previous years and reflecting the developing nature and increasing value of geospatial intelligence within the Defence community. Also present were more than 30 companies showcasing their products.

The conference was chaired by Brigadier Jim Hockenhull, who is currently Director Intelligence, Surveillance, Target Acquisition, and Reconnaissance, Head Information Superiority Land Forces. He introduced the keynote speakers of the day, which included Major General Jerry Thomas (Assistant Chief of Defence Staff (Intelligence Capability), Air Chief Marshal Sir Stuart Peach (Commander Joint Forces Command), Baroness Eliza Manningham-Buller (former Head of the Security Service) and Barry Barlow (Head of Acquisitions at National Geospatial-Intelligence Agency (NGA). Keynote addresses were interspersed with panel discussions and the all important networking breaks.

Major General Thomas was guest speaker for the opening address entitled, "Creating a unified intelligence environment to help commanders and soldiers: the role of Geoint and multi-int in-theatre and in C2". He began by presenting the context of the war fighter, and described a landscape where there is no single enemy, no single vulnerable point and that effect is needed across all lines of operations. He expanded by looking at the complexity of the Afghanistan battle space and emphasised the need to gain "understanding", a common theme throughout the conference. He asserted that the GEOINT element was not enough by itself and that all the "Ints" must be brought together, with full collaboration with allies and partners - ultimately creating the Single Intelligence Environment.

Major General Thomas also gave the conference an interesting insight into the changing world of intelligence with over 80% of intelligence already being in the public domain. The problem he expressed is making sense of it all. It is no good just gathering all this information, it needs to be broken down and re-assembled in order for it to be meaningful; he illustrated this through the analogy of baking a cake - the ingredients on their own can taste awful but baked in the right way you have a good end result. As to the main challenges we now face, Major General Thomas talked of the need for common databases, with common formats and data standards, more analysis, the need to keep pace with technology, the challenge to the UK of not being left behind by the US, as well as the requirement for staff to embrace a culture of sharing data whilst ensuring security. It was a very well received brief which generated much discussion from the conference attendees and shone a light over some of the significant amount of work which needs to be undertaken if the Single Intelligence Environment is to be achieved.

Barry Barlow from NGA presented on the Agency's vision for the future including working towards building apps which will provide online on-demand information to the war fighter. He stated, "We are trying to change the face of GEOINT. It is about putting the power of GEOINT in your hands", and then gave a live demo of electronic Aeronautical Information Procedure on an iPad. Alongside this change Barry asserted that while there will be an increase in automated feature extraction due to the vast quantities of data we are collecting, the days of the human analysts are only just beginning, as it is only the human analyst that can draw the relevant "so what?". He positively concluded that the period of "big data" should be embraced alongside multi-intelligence fusion.

Next to address the conference was Air Chief Marshal Sir Peach, who presented on, "GEOINT and Defence". He started by outlining his new role as Commander Joint Forces Command (JFC) with the responsibility for commanding and generating the joint capabilities allocated to JFC and setting the framework for joint enablers that sit in the Single Services. His aim is to deliver the JFC to Initial Operating Capability, with a small headquarters in place by April 2012, and to establish it to Full Operating Capability by April 2013. As regards GEOINT he noted the need to get products to decision makers in a timely manner, using the National Security Council process as an example. As with Major General Thomas, he stated that we need to consider how we share information, noting that we may have something to learn from the younger iPad generation, who can sometimes be ahead of senior decision makers in sharing information.

The way the geospatial community presents products to decision makers was challenged by the Air Chief Marshal and how effective graphics can sometimes be over reams of text. He argued that some decision makers are put off by geospatial products and thus the need to ensure more accessibility to those at the top through better design of products; potentially substituting visualisation for perfect knowledge. He went on by stating that considering the customers' needs is essential, as is the requirement to simplify complexity, otherwise we'll be overwhelmed by the world we are in. During the following panel discussion, Air Chief Marshal Sir Peach touched on training and education, articulating the

need to make sure training was more than the sum of those who went before, and that what was delivered needed to be relevant for the present and the future – and thus the necessity to understand the needs of the next generation.

Finishing off the morning session was Baroness Manningham-Buller. She focused on leadership within an intelligence organisation and spoke about how she revamped the Security Service following 9/11, and how the agency was successful in averting major threats. Discussing the challenges she encountered, she said, "In intelligence, you must remember that by trying to manage risks, you cannot prevent all risk". Baroness Manningham-Buller went on to say that following 9/11 there was too much data and not enough analysts, observing that sometimes a crisis can be the best time for change, as there is a greater appetite for it. She gave some insightful leadership advice, which I do no justice by summarising: look after your staff, challenge processes and procedures, recognise the value of criticism (no matter what your role or experience), do not think you know it all, have humility and finally, and refreshingly, no matter how serious the situation have fun in what you do!

One of the highlights from the afternoon session was Andrew Watson, Deputy Director of Information at the Met Police who presented on, "Using GEOINT as an integral part of security operations: London 2012 Olympic update". Responsible for Geographic Information Systems (GIS) for the London 2012 Olympics, he gave the audience a laugh when he started by showing a photograph of himself aged 12 dressed in his Scout uniform and proudly wearing his map makers badge on his arm! Andrew began by giving the context to his task, outlining that the Olympic venues were widely spread out across the UK and security aspects such as transit routes and hubs also had to be considered. He noted that there was little appetite to spend money on GIS and that funding for GIS at the Olympics had only been secured since February 2011. The hardest part, he explained, was getting through to budget managers that GIS was a lot more than maps – but rather layers of spatial data such as locations of security personnel, intelligence reports, fire arms teams, crimes and many more. He eventually convinced them when he explained that it was like having multiple layers of annotated acetates placed on top of each other!

The GIS Andrew Watson has put in place in a short space of time includes live feeds from Twitter and transport networks, as well as imagery from a variety of platforms, including CSI and aerial imagery. The system will be used to assist in coordinating a response to an incident and ensures accountability by recording all decisions made. Now senior Police officers are calling it the "Killer App", and a potential game changer in the future due to its power and usefulness. The future would see the App on a hand held device so all officers could access the system. He concluded that whilst Astrium delivered the system, it was others, including 42 Engineer Regiment who helped build it.

The second day of the conference saw Vanessa Lawrence, Director General and Chief Executive of the Ordnance Survey (OS) continue the theme of the Olympics. She cited the demanding task that the OS faces in its routine work, including making 5000 changes to the OS maps of the UK every day. Work for the London Olympics was on top of this and key to success was getting all the key players together early to work out what was needed – some of which was non-standard such as local asset information and high resolution data (5cm level). The resulting products have been used by construction companies and security services amongst others. Vanessa Lawrence concluded by stating that a lasting legacy of the Olympics will be the collaborations which have been established in the process of the task. Talking to other attendees of the conference from other countries I was struck by how powerful the OS brand is in this community – truly world class.

Later on the second day Vice Admiral Robert B. Murrett, former Director of the NGA and deputy Director of the Institute for National Security and Counterterrorism spoke

on, “Global insecurity: using GEOINT to develop and broaden the analytic expertise of intelligence”. He began arguing that the international security landscape looks very different now than it did even 5 years ago, with economic matters a real strategic threat. He pointed to the growing importance of partnerships including the increasing significance of NATO, and noted that the intelligence community has frequently failed to predict where the next conflict will come, so to expect the unexpected! Current intelligence trends he believed included a shift in worldwide security missions, budgetary pressures, complex technology, impact of social media (highlighted by the Arab Spring) and change in the public and private security mix.

GEOINT is an increasingly vital component of the intelligence and interagency effort, the Vice Admiral went on to state. However, there is the need to focus the GEOINT effort where it has the greatest effect, such as providing intelligence on denied areas, for example Darfur, where HUMINT and SIGINT collect is difficult. He concluded that training personnel on the latest technology was especially important and advised that the GEOINT community should look outward, deploy forward and embed with customers.

With the Defence Geographic Intelligence Fusion Centre (DGIFC) standing up this year, it was a pertinent time for Gp Capt Steve Thornber, currently Officer Commanding the National Imagery Exploitation Centre (JARIC) to address the conference on, “GEOINT as a key component of multi-int and multi agency collaboration: potential and conceptual implications”. He discussed the multi-disciplinary intelligence teams that will be used within the DGIFC and how they will be able to see linkages which were not apparent before, and able to spark ideas off each other. He saw team members performing as excellent collaborators as key and from his experience he has seen that good collaborators are not born, but that most “get it” after about 3-5 months of the new way of working.

On the afternoon of the second day, the Principal of the Royal School of Military Survey, John Knight, talked on the adapting nature of GEOINT training to soldiers. He questioned whether the shift from specialist to generalist is right, and where the specialists of the future are going to come from. Noting the wide range of demanding tasks we are asking of our soldiers, he articulated that perhaps the emphasis on equipment at both the Conference and in Defence should be re-balanced to have increased importance placed on training and education. With a tightening of the purse strings in Defence it is clear that we are going to have to make better use of what we have, and to do this training our personnel is going to be essential.

Col Kedar, Chief of Staff Headquarters Engineer in Chief (Army), wrapped up the Conference outlining the changing nature of the GEOINT battle space and potential repercussions for the GEOINT community. He discussed a world with changing climate patterns, increasingly scarce resources and shifting global power structures. He exemplified by arguing that due to rapid urbanisation, future conflicts are likely to involve more focus on the urban environment. The data set required for this environment is specialised, with potential required information being the subterranean world, the energy layout, and a detailed population make-up. Analysis of such an environment would be very wide, such as the isolation of water supplies and the likelihood of riots in different areas; and perhaps interactive 3-D models that tie all the information together. It was a provocative presentation and showed more of the challenges the GEOINT Community may face in the near future.

After 2 days listening to the speakers and engaging with some of the attendees at the DGI 2012 Conference, I was left with the strong belief that these really are exciting times for the GEOINT community. A mixture of technological advance, operational experience and the requirement for better understanding have put GEOINT in a prominent spot. With the establishment of the JFC, dynamic new units being formed such as the DGIFC and the adaptive nature of training offered by the Royal School of Military Survey, the UK is now in a good position to overcome some of the obstacles in the way of progress and expand the utility and power of GEOINT.

Life After Military Survey

By Cllr Dr Tony Vickers, PhD, MSc (IS), BSc (Hons), MRICS, Lt Col RE (Ret'd).

My life after Military Survey makes sense if you know a bit about my life before I joined the Army at the ripe old age of 29.

My maternal grandmother married two successive Surveyors General of India and my father was the youngest Brigadier, at 33, in the WWII Burma Campaign. I always felt I was expected to follow his footsteps. But like many teenagers I wanted to make my own decisions.

On the way to passing five A-level GCEs, badly (one being Economics & Politics), I was returning officer in my school's mock 1965 general election, while my father – just retired from the Army – nearly became a real Liberal candidate! He settled for non-party parish politics – but it sowed a seed in me.

I had – and still have – a love of geography and maps, however my school regarded it as a dunce's subject. So I joined George Wimpeys as an indentured trainee, studying for a 'sandwich' degree in construction management and technology. Basic setting out skill - with theodolite, chain and level - was required.

Through Wimpeys, I met my wife Martha in Liverpool. Shortly after, I became a chartered builder. But with the recession of 1973-4 and arrival of two baby sons in 18 months, I was facing a not very promising future. Within weeks of the upper age limit, I passed Army Officer Selection.

Setting my sights on Military Survey from the start, I was encouraged by Roy Wood, whom I met at BAOR orienteering events. I first had to complete two tours with the mainstream Corps. ASC 63 formed up in Jan '80 and we were the last course to wear 'mufty' throughout. Civilian clothes continued to be my duty garb more often than not: from ASC I went to OS, then Australia, 42 Engineer Regiment (as it moved from Barton Stacey), MOD (Svy 4b), finally Hong Kong (BFHK Chief Geo). After most of my postings were over, I closed a door and threw away the key: nobody replaced me at OS, Bendigo (Aus) or BFHK.

Hong Kong Government Security Branch paid for me to acquire a Masters Degree in Information Systems: cover for studying how to prepare for a worst-case scenario withdrawal in 1997, which thankfully never looked likely. I visited every geodata-using part of HKG to establish their 'emergency response' systems, requirements and plans.

Most of the Chief Geo job was outward-looking, nothing to do with Hong Kong. A civilian SMRO and I separately visited around 16 Asia-Pacific countries every year, collecting maps and writing reports on the status of survey and mapping for MOD. The importance for national development of having both high quality professional surveyors and engagement between them and senior government officials became clear to me.

While I was in Hong Kong, the world changed for British defence forces. After 20 years in the Army without seeing active operations, I was told to expect another 8 years as Lt Col doing Majors' staff jobs. I decided to take early retirement as soon as my MSc was completed, in January 1995.

I felt I could combine any two of three futures: GIS consultancy, politics and orienteering (I'd made the Army Team and been Australian over-35 Champion). I failed interviews for the posts of Director of the British Orienteering Federation and Agent for Newbury's Liberal Democrat MP before returning home to Newbury a few months before elections to the District Council. I stood as candidate for the Tory 'safe' seat of Kintbury, painted my bike orange, put "Lt Col" on all my leaflets – and won by 140 votes! While I honed my political skills, I also kept up my GIS credentials by helping a small family-owned company acquire clients in emergency services, also serving on RICS' Geographic and Land Information Panel (GLIM), which wrote a report on the future of OS in the 21st century.

Berkshire local authorities were made to undergo reorganisation in 1995-8. It is said that John Redwood, MP for Wokingham and Tory Local Government Minister at the time, had it in for the County Council. I'd been appointed Chairman of the Reorganisation Committee on the Lib Dem

controlled Newbury DC, so was 'twiddling my thumbs' all through 1996, although Shire Hall became redundant two years later. Meanwhile I'd been selected as Parliamentary Candidate for next-door Devizes, standing against Northern Ireland Secretary Michael Ancram. On the same day in May 1997, I failed both to retain my Kintbury council seat and to gain a seat in Parliament. Briefly I was on the dole.

I turned to RICS' GLIM for networking opportunities to launch my GIS consulting career. It so happened that the 4-yearly World Congress of Surveyors (FIG) was due to convene in Brighton in September 1998. Having experienced forms of land value taxation (LVT) in Australia and Hong Kong and belonging to a Party which espoused a similar tax for the UK, I co-authored a paper on *'The Role of Surveyors in LVT'*, along with a recently retired professor and Head of the School of Surveying at Kingston University, Owen Connellan (a rating expert) and a colleague of his from Ulster, Prof Billy McCluskey. I also joined the FIG Congress organising team, chaired by recently retired OS Deputy Director John Leonard.

While writing the FIG paper (the first of three I submitted for successive FIG Congresses on related subjects) I continued to apply for jobs political. Much to my surprise, I was appointed to a job-share post as Head of Policy at the National Centre for Volunteering (now Volunteering England). It taught me how policy is made in Whitehall and a refreshing 'touchy feely' style of collaborative management, very different to the Army: my boss was a dynamic young woman and my female job-share colleague was married to a transvestite!

Soon after the FIG Congress, I was invited to apply for something more relevant to surveying: Chief Executive of a small national charitable think-tank, the Henry George Foundation (HGF), part of a world-wide network of similar organisations owing their name to a maverick nineteenth century American writer/politician. George's book Progress and Poverty was more widely read in its day that Das Kapital – and, until 1917, more influential. HGF's purpose was to help people understand the role of the natural world in political economy: the distinction, in economic and social terms, between what is made by humanity and what is given to us.

Through working at HGF, building up its contacts with active professionals in academia, the property industry, charities, political and economic think-tanks, I developed the idea that "landvaluescape" was as much a reality – and useful to be mapped and modelled spatially – as landscape. My academic contacts, especially Owen Connellan, persuaded me to turn this idea into a programme of doctoral study. In 2000, I was awarded a three-year fellowship with the Harvard-based Lincoln Institute of Land Policy to study how LVT might be introduced to Britain. This involved working with Liverpool City Council to pilot the idea of land value maps as a tool for conveying the dynamics of regeneration to non-professionals.

Owen Connellan's successor at Kingston University, Professor Sarah Sayce (a valuer, now a member of RICS' governing Council), agreed to take me on as an occasional lecturer in GIS and Green Taxes to her post-graduate students, in return for fee-free enrolment for a PhD. The title was Visualising Landvaluescape: developing the concept for Britain. My thesis, examined in summer 2009, can be downloaded from www.landvaluescape.org.

Twice my PhD studies were put on hold while Kingston used me on funded research projects for Government: a study of the National Land Use Database of Previously Developed Land (NLUD-PDL) in 2007-8; and a study of Back Garden Development in summer 2009. Earlier this year, I helped Kingston win another research contract: to evaluate the Government's pilot of the use of land auctions for awarding planning permission for housing. Coincidentally two of the sites in the pilot are well known to me from my earlier life: Catterick Camp (my father's last post was Deputy Garrison Commander there in 1960); and Skelmersdale New Town (my first home as a father myself, in 1970).

I continue to find local politics extremely fulfilling, despite many frustrations and disappointments. As one of very few councillors professionally involved in GIS, I have championed the cause as Chairman of the Association for Geographic Information's Local Government Special Interest Group (AGI LGSIG) and done a spell of four years as an AGI elected Director.

I like to think I've played a significant part in developing local planning policy for West Berkshire, especially Newbury Town Centre. I've chaired Newbury's Planning Committee and recently caused some controversy by proposing the motion, on its successor committee, to allow Newbury Racecourse permission to build up

to 1500 houses on its land. On the other hand, I've worked with the campaign group of residents trying to stop 2000 more homes being built in South Newbury on "Sandleford Park" (behind the Rugby Club).

Nationally, I may have influenced no less a figure than Vince Cable, my Party's highly respected Treasury Spokesman and now member of the Coalition Government Cabinet. That LVT was reaffirmed as our policy is largely due to my part in the Lib Dems' Tax Commission in 2006-7, as its only member with an understanding of the potential of GIS to make property taxation cheap and transparent to administer. I continue to advise Lib Dem Ministers in Government on GIS and property tax matters and have just been appointed to the Party's Tax Policy Working Group, which aims to further develop LVT policy.

Like many of the soldiers I had the privilege to serve with, I have Military Survey to thank for helping me towards as fulfilling a life after Service as during it. And it isn't over yet!

Triangulation and Altimetry during the Indonesian "Confrontation" with Malaysia 1965 - 66

By Roy Wood

Introduction

In 2011, the Royal Engineer Geographic community marked 20 years of continuous deployment on operations. However, before the first Gulf War in 1991, and apart from Northern Ireland, we have to look back to the early 1960s for the last time formed Military Survey units were on active service. Then regional conflicts saw Troops from 13 and 19 Squadrons deployed to Aden and from the Singapore based 84 Squadron to Borneo. This article describes the work of 1 Topo Troop of 84 in Sarawak during 1965 and 1966; similar challenges were tackled by 2 Topo Troop in Sabah.

Military Survey in the Far East before Confrontation

The communist insurgency in Malaya, which lasted from 1948 to 1960, kept Military Survey busy in supplying mapping support through 84 Survey Squadron and 556 Field Survey Depot which were then based in Kuala Lumpur. The Squadron capabilities covering the full gamut from field surveys, through static air survey (Multiplex plotters), cartography and photo to printing. After the emergency, the units moved to Singapore and priorities changed to "aid to the civil power" in helping the poorly mapped British territories of Sarawak and Sabah on the north coast of Borneo. The Field Survey Troops deployed with No 1 in Kuching, Sarawak and No 2 in Sabah where they operated in civilian clothes and worked in conjunction with the local Land and Survey Departments. An important part of this arrangement was a local government bank account which gave the Troop Commander a cheque book and the freedom to pay for whatever resources were needed to get the work done. The members of the Field Troops were on normal "married accompanied" terms of service.

Independence and Confrontation

In 1960 Harold Macmillan made his "wind of change" speech which signalled a rapid move to independence for almost all of the remaining British colonies. In the Far East, Peninsula Malaya had in fact been independent since 1957 but there were still questions over what to do with the remaining British interests in the area. Singapore had reached the halfway stage of self government but, in Borneo, Sabah, previously run by the North Borneo Company, and Sarawak, which had been ruled by the White Rajahs of the Brooke family, remained as dependencies considered too small for viable nationhood. There was also the Sultanate of Brunei sandwiched between Sarawak and Sabah which had become a British Protectorate in 1888. Negotiations started in 1959 and, in September 1963 these resulted in the creation of the single country of Malaysia from Malaya, Singapore, Sarawak and Sabah. Brunei opted to remain independent.

This seemingly tidy solution was not universally popular. The mainly Chinese population of Singapore objected to Malay dominated policies made in Kuala Lumpur and, following vicious race riots during 1964, Singapore left Malaysia and became independent in 1965. Before this, however, opposition to the proposed inclusion of the Borneo territories came from local dissenters, from The Philippines and, more importantly, from Indonesia and led to the Brunei Rebellion on 8 December 1962. This was dealt with quickly with the support of British forces based in Singapore but Indonesia then developed a policy of "Confrontation" with terrorist raids on the Malay Peninsula and incursions by regular forces over the border from Indonesian Borneo into Sarawak and Sabah. UK provided naval, land and air support to Malaysia which by the end of 1964 had grown to a land element of 3 Brigades and eventually grew to over 50,000 service personnel.

Command and Control during Confrontation

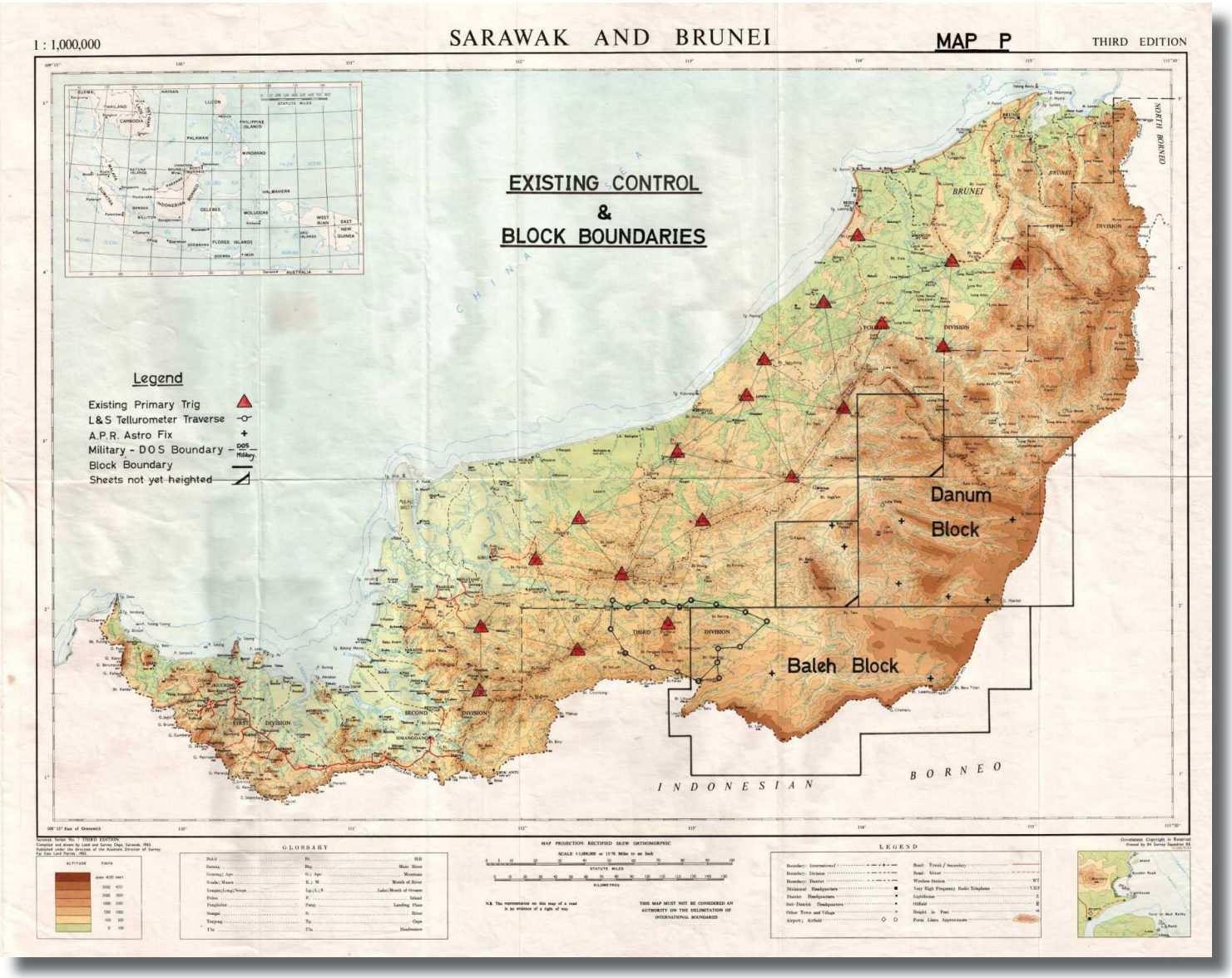
The arrival of Brigade Headquarters and a number of Battalions on active service in response to the Indonesian "Confrontation" incursions changed the pace of life for the surveyors. Uniform was dug out of kit bags and made to look sufficiently presentable to avoid the attentions of infantry RSMs and weapons were carried forward of the base. However, for the duration of Confrontation the Field Troops were not put under command or operational control of the local Brigade; they continued to enjoy married accompanied terms of service and most importantly, retained the Malaysian government cheque book. As will be imagined, all this caused some interesting discussions with commanders and staff on the ground.

Terrain

Sarawak covers virtually the same area as England, about 450 miles E-W and 200 miles N-S at its widest point. The coastal belt is mainly low lying but inland the land rises to nearly 8,000 feet in very broken terrain.

The population of just over 2m is nearly 50% Chinese or Malay and is concentrated in the capital Kuching, the second town Sibu and some coastal settlements including the oil fields around Miri. Inland there are settlements of Ibans – those "headhunters of Borneo" and other smaller tribes along the rivers but vast areas in the East are uninhabited.

There is very limited agriculture in the West but elsewhere everything is covered by vegetation, dense secondary jungle where areas of slash and burn hill rice have regrown and primary jungle with trees up to 200ft over the rest. At that time there were no roads outside the towns. Boats were used on the lower stretches of the major rivers while upstream rapids and waterfalls made



Map P Existing control and Block Boundaries.

progress extremely difficult. Otherwise movement was on foot or, if you were lucky, by air. Not surprisingly for tropical rainforest, Sarawak was very cloudy which hampered the survey work. The border was defined for most of its length and certainly for all of the part facing 1 Troop - by the watershed.

Existing Mapping and the Survey Task

Prior to 1965 the Troop had carried out a variety of survey work in the Western divisions of Sarawak together with some very challenging boat based forays into the almost uninhabited Eastern areas to establish astro fixes towards the heads of the major rivers. Some gravity observations had also been completed in support of a US Army Map Service project and field parties from the Directorate of Overseas Surveys were pushing Tellurometer traverses into the more accessible areas of the interior.

Otherwise there was a very large area covered by travellers' tales mapping with some uncontrolled detail from a few air photo sorties. Away from the more developed western areas and the coast there was no useful 1:50,000 coverage but an uncontoured 1:150,000 series showed most of the rivers. There were also some early, very incomplete and uncontoured Joint Operations Graphics. A 1:1 m layer tinted sheet produced by Lands and Surveys was one of the more useful maps but it and all the others contained major errors. As examples, I discovered 100 square miles shown on the wrong side of the border, a 5 mile slip in the detail across the border in another area and, near a frequently used helicopter route often flown in cloud, a peak shown at 3,600ft which we occupied at 5,200ft.

The new work priorities were to bring primary control firstly into the Danum and Baleh blocks shown on Map P and then into the Barum block to the East. Also to provide height control for air surveys using Multiplex plotters. In December 1964 the Troop rear base was moved from Kuching to Sibu which gave direct access to the priority area.

This was of course long before GPS and control was still established by triangulation and traverse using the rather new fangled Tellurometer distance measuring system. The plan was to work from three existing Land and Survey primaries in a series of Trig extensions measuring all possible angles and distances and then use altimeters for heighting.

Resources

As so often, the survey plan was simple; the challenge was logistics.

Access

The first problem was access to the area which, if the task was to be completed in a sensible timeframe, would require air support. Here the timing of an escalation in the Indonesian threat in January 1965 proved fortuitous as it led to the deployment of another Brigade HQ and a detachment of RN Wessex helicopters to Sibu. An Army Auster and a RAF Single Pioneer also operated from the town. However, as the Troop was not under command of the Brigade or any other HQ in Borneo, access to these air assets was by negotiation with the Brigade Staff. Fortunately they appreciated the need for better maps and realised that supporting the Troop was the only way to improve matters so, over the period January 1965 to June 1966, I was able to talk the SO3 Air into allocating us nearly 750 flying hours. The Sibu Brigade was responsible for the whole of the Rejang river catchment area with Company bases on the main infiltration routes from the border. One of these was also used as a forward operating base for the Wessex helicopters,120 miles upriver from Sibu at Nanga Gaat. We collocated our forward base there alongside the helicopters.

Another aspect of access was authority from Brigade to operate in its area. This required close liaison with the Brigade and Battalion Ops Rooms to fit our plans around their operations and to ensure that our current and future locations were clearly shown by the Topo pins on their maps. Emergency evacuation plans were agreed and helicopter fuel dumps established to enable us to reach trigs which were far from the usual helicopter routes.

Personnel

My surveyor strength through the tour was usually 2 SNCOs, 7 JNCOs and a Sapper plus a cook, a driver and a vehicle mechanic. For the first extension observations we were loaned an extra Field Tech from Squadron HQ and a member of the Sarawak L&S staff so, with the necessary helicopter support, we would be able to mount 4 or possibly 5 field parties. However, before any observations could take place, mountain tops had to be cleared of trees and trig points and helicopter pads built. Here that Sarawak government chequebook came into its own as I was able to engage about 25 Ibans who were outstanding jungle men.

In preparation for the survey task we carried out an intense period of technical and admin training to ensure that the JNCOs leading the field parties were fully ready for extended periods on the mountains with little immediate back up. They responded superbly to the challenge. We also ensured that the Ibans understood what was required of them and they were invaluable. As an example, when told that they would be building helicopter pads on the hill tops, they went off to inspect a Wessex at Nanga Gaat and came back with pieces of string with knots which gave them all the vital dimensions. These delivered accurate pads from jungle timber wherever they were needed.

Survey Equipment

The Squadron Equipment Table was quite inadequate to support a major primary control scheme so we scrounged. Theodolites were borrowed from Lands & Surveys in Kuching and DOS and Squadron HQ obtained one from Malaysian National Mapping in Kuala Lumpur; L&S and DOS also generously loaned Tellurometers, altimeters, lamps and helios and various other items. A few beers with various officers in the Brigade HQ resulted in the loan of necessary items such as battery charging sets.

Communications

If we were to work safely in this active service area for extended periods and make efficient use of our air support, reliable communications between our base and parties in the field would be essential. Once again the Squadron Equipment Table didn't help so again we scrounged. Time spent chatting up the Royal Malay Regiment battalion stationed in Sibu produced a number of HF sets and similar arrangements were made with the Police Field Force and Sarawak Border Scouts. We then went through a steepish learning curve on the mysteries of skip distances, HF aerials etc. The system didn't always work well but we got by except for one occasion when a set was hit by lightning and a casevac from the peak depended on a fortuitous helicopter visit.

It is perhaps also worth noting from our current age of instant information that telephone contact with Squadron HQ was almost impossible, Squadron HQ had no direct means of sending or receiving signals and most communication was by letter.

Other Stores

The Brigade HQ staff were generally helpful when I asked for the provision of Compo rations and other common military stores. They were somewhat bemused by my requests for sleeping bags and other colder weather kit. Hadn't I noticed the sweltering temperatures? Well it gets cold at 6,000ft I replied and eventually the system delivered. However, the chequebook enabled me to fast track any supporting goods or services which were difficult or slow through the military systems.

So, with logistics more or less in place, how did we tackle the survey work?

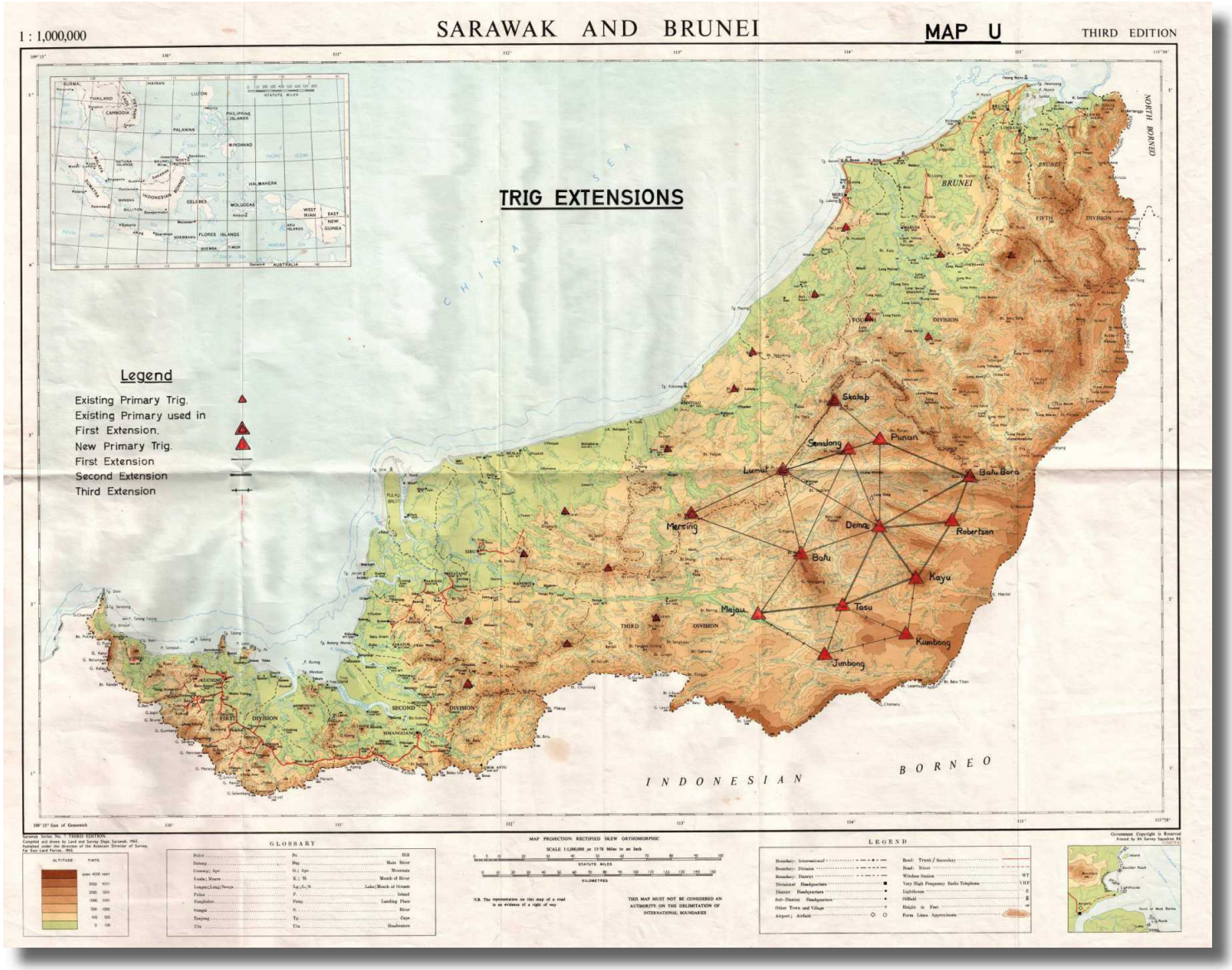
Trig Extensions

To make best use of the helicopters we decided to work by Brigade boundaries rather than by mapping blocks. We started with the Sibu based Midwest Brigade covering the catchment area of the Rejang River and then moved over the internal watershed to the Baram river controlled by Central Brigade. The task divided into recce, clearing/point and helicopter pad building and then observation.

Wessex Helicopter.

Recce was carried out using the Auster or Single Pioneer to identify likely points with intervisibility then checked by flying up and just over the tops on appropriate bearings. This was hairy at times but effective. Navigation could be difficult with seemingly interminable jungle covered ridges but there were occasional prominent features. Inter trig distances were in the range of 25 – 60 km.

The next problem was getting onto the jungle covered mountain tops. This was solved by a combination of skill and some daring by the Navy pilots and the jungle craft of our Ibans. With the Wessex hovering over the summit, the first man down, usually an Iban standing in the winch strop, would be lowered so that he could cut his way to the



Map U Trig extensions.

ground with his parang. At the height of the mountains we were using the trees were only 20 - 30 ft tall – not the giants lower down – so this system worked. The first man down would immediately start opening a hole so that the rest of the clearing party - normally 2 surveyors and up to 8 Ibans plus their kit could be winched directly to the ground. Their task was to clear the hill top, build a trig point and a helicopter pad. For the first extension this process took just over 2 months.

We then moved to the observation phase. Four parties each of 2 surveyors and 4 Ibans equipped for a month without resupply were flown out to occupy stations forming computable figures – triangles, braced quads or traverses. As the weather permitted, they cracked on with their observations to primary standards observing their angles usually to lamps by night but sometimes to helios during the day. When complete, their abstracted observations were radioed back to Nanga Gaat and computed on our hand cranked Facit calculators using Clarke's Medium line method on the spheroid to ensure that they were up to standard. We then tasked the helicopters to leapfrog 2 parties to new positions and the process was repeated until the observations were complete. For the first extension poor weather and some Tellurometer failures meant that the observation took 5 weeks.

Two further Extensions were completed in 1965 from Nanga Gaat as shown on Map U. The last of these and some extra points to the South and East not shown on this map nearly didn't happen as they were well in front of the forward infantry bases. Brigade said we couldn't work there without an infantry escort but were then unable to provide one. With tongue somewhat in cheek I suggested that my Ibans would be more useful in the jungle than the best British infantry and that, if I made it a condition of service that my Ibans brought their shotguns and I provided cartridges from Army sources or through my chequebook - then escort problem solved. As expected, Brigade baulked at the idea of this private army but, as they couldn't come up with anything better, agreement was reached. The photo shows No 1 Section ready to take on the Indonesian Army. The Ibans clearly needed to train for their new defensive role and their patrols produced pig, deer, monkey and python which all added welcome variety to the Compo rations.

Two more trig extensions were competed in the Baram block to the east during the first half of 1966 for which we used Bario as our forward base. We used the same phases of recce, clearing and observation and it was good to note that completion rates speeded up and our computational checks meant that no reobservations were needed. The points included Gunong Mulu which sits on top of the vast caves that are now a major tourist attraction. The caves were discovered by an RGS expedition in 1977 but in 1966 we had no idea what was beneath our feet.

Dawn on a trig.

One remaining technical problem was photo identification. Trigs were marked during the clearing or observation phases and photographed as best we could from helicopters flying as high as we could persuade the pilots to go. PR cover from the Canberras in Singapore was promised and I believe this was achieved.

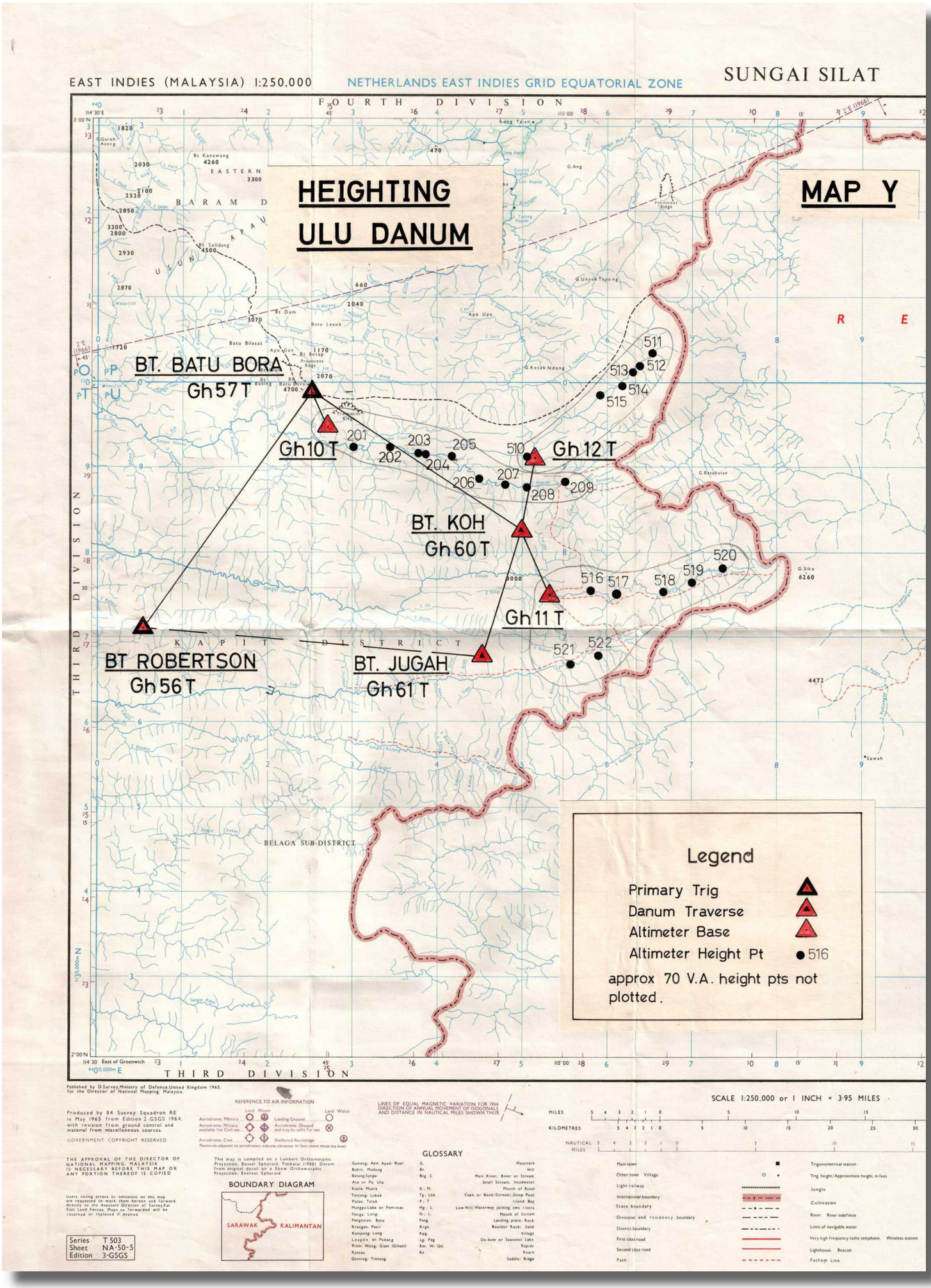
No.1 Section ready to take on the Indonesian Army.

Heighting

The heighting requirement given to us for the Danum and Baleh Blocks specified points in some fairly difficult terrain. It was mostly carried out with multiple base altimetry and the recently arrived Scout helicopters operated by the Army Air Corps provided an ideal vehicle for the purpose. By chance the OC was a Sapper and he was intrigued by the challenge of how to do it. The first and obvious approach was to land at each point and take the readings but it soon became clear that this would eat up far too many helicopter hours so we experimented with reading the altimeters in the hover. We proved that in a Scout without its doors there was no pressure effect from the rotors at a hover height of more than 40 feet. We then built a plumb line arrangement to fit into the back of the helicopter with a stout fishing line marked at 5 ft intervals to measure the hover height and we were ready to go.

Map Y gives an example of one of the areas with the black dots showing the points fixed. Photogrammetrists will know that the points needed to be on level, open areas which could be identified on the air photos. In practical terms in this terrain that meant sandbanks on the rivers.

As a preliminary, altimeter bases were established by traverse or bearing and distance from the newly established trigs above and below the points to be heighted. Then, as the Scouts were required to operate in pairs, the system was for one helicopter to drop off surveyors with 2 altimeters each at appropriate bases with the task



Map Y Altimeter Heighting.

of recording the readings every 5 minutes. The other Scout would then navigate to the point to be heighted and come into a steady hover at more than 40ft. One surveyor would then note the time and read the altimeters normally 3 to minimise error - while a second would wind down the plumb line until it touched the sandbank below and note the amount of line paid out. Meanwhile the base party Scout would be flying high overhead so that another member of the team could make the identification on the air photo.

This proved to be a efficient system which gave very consistent results. However, these remote areas often meant working towards the limits for the Scouts even with our carefully planned fuel dumps. On the plus side they brought us into contact with some of the other more rarely seen tribes in the interior.

There was one other less conventional heighting operation. Triggered we believe by our discovery of major height errors close to helicopter routes on the existing maps, Far East Air Force flew a sortie by a radar altimeter equipped Shackleton. The idea was to fly this over one of our trigs to get an opening reading then fly at a constant height over as many of the prominent mountains in the area as possible and close out on another of our trigs. This did work quite well but nearly came to grief as we had not been told that it was to happen and by chance we had a field party on the closing trig. Seeing this large aircraft flying straight for them at hill top heightl from the direction of the border caused some alarm and guns were grabbed and cocked. Thank goodness they held fire.

Ibans

So that has outlined the survey task and the way in which we tackled it. However, the Ibans merit a further mention. It was fascinating to work with them on the hills and also to be welcomed into their longhouses. These great wooden structures were built along the rivers, high enough up to avoid the frequent floods with one section for each family like a sinuous row of 40 or so terraced houses. Each family had a private living and sleeping room at the back, an open communal space under the roof in the front and a communal veranda for drying rice etc.

Iban Longhouse.

Access up a notched log from the river bank was precarious but visitors were greeted by a young woman dressed in a short skirt with a song and a large bowl of rice beer. If visitors were present, the evening meal would be preceded by a ceremonial offering to the gods of the earth, sky etc and, as an honoured guest, I had to assemble the offering from ingredients in many small bowls. Then a live cockerel would be produced and I would be handed a knife. Its blood provided the final garnish. And then looking up into the rafters there were the baskets of skulls. Yes, these really were the headhunters. But, they said, these are all Japanese heads from the war. But a number of the men sported the tattooed finger joint that was the mark of taking a head and not all of them looked quite old enough to have been around in 1945. I was pleased to have them on our side.

Conclusion

As a postscript, Confrontation ended in August 1966 with a change of government in Indonesia. That paved the way for the closure of the British bases in Singapore driven by the now familiar need for major cuts in Defence spending. Contoured 1:50,000 scale maps were produced from our observations and remain the basis for current maps of the area. One regret is that the Malaysian authorities have felt it necessary to keep these very ordinary topographic maps for official use only.

The task gave many technical and logistic challenges and it was a fascinating experience to operate with the urgency of active service and the flexibility provided by that chequebook. With what in retrospect was an amazing degree of autonomy it was certainly a memorable first tour.

Vectographs & Polarising Projectors

By Col (Retd) Mike Nolan

Vectographs

The use of polarization for three-dimensional viewing has been commonplace for many years in the Geographic and Image Analyst communities. Apart from recent demonstrations of systems at J.A.R.I.C. and R.S.M.S. my only early experience of the use of polarised light was in the examination of thin-section petrological slides when a student. I first came across the term vectograph when I visited Australia in 1985. There, either at Bonegilla or Bendigo I bought *'From Lebanon to Labuan'* by Brigadier Lawrence Fitzgerald, first published in 1980. At that time it was the only history of the work of the Royal Australian Survey Corps widely available. Turning to the part covering the Borneo operations of World War Two, one comes across a section in which vectographs are mentioned. Since it is suspected many will be unfamiliar with this campaign and its "geographic" support by the Royal Australian Survey Corps, relevant extracts are repeated in some detail.

Three separate operations took place in Borneo. Operation Oboe 1, launched in May 1945 was the amphibious assault on the island of Tarakan on the east coast of Dutch Borneo by 9 Aust Div.

In *'From Lebanon to Labuan'*, the geographic support for this operation was recorded thus:

> **Tarakan - Operation OBOE 1**
>
> Lambert reports that it was planned to produce 1 x 50,000 map, 2 x 25,000 maps, 5 x models and a limited number of map overprints. Kodatraces of survey plans of the greater part of the central portion of the island at 1:5,000 scale, contoured at 2.5 metre interval were supplied and from these 2 x 10,000 sheets were produced.

Operation Oboe 2, launched in July 1945 was the amphibious assault on Balikpapan on the east coast of Dutch Borneo by 7 Aust Div. The geographic support for this operation was recorded thus:

> **Balikpapan – Operation OBOE 2**
>
> Lambert reports that Corps resources were to produce 1 x 10,000 map, 7 x 25,000 maps, 5 x 50,000 sketch maps, 1 x 1:50,000 model, 1 x 1:1,250 model, 5 x 1:10,000 photomaps. Adv LHQ was to extend the basic 1:50,000 coverage of the area by including 2 extra maps and 6 copies of a 1:5,000 model; 1 x 1:10,000 and 3 x 1:25,000 Enemy Defence overprints; 1:1:10,000 sheet of town area of Balikpapan based on civil 1:5,000 cover. Also, to overprint topographic information from the latest large-scale photos on existing 1:50,000 maps of areas where no 1:25,000 scale cover was available and to produce various appendices to op and admin orders.
>
> 6 x 1:25,000 maps were produced. 8 sets of 15 vectographs at 1:10,000 scale were produced.
>
> A Kodatrace of the Penadjam area and 5 x 1:50,000 sketch maps of an area west of Riko were also produced and a further 1:25,000 sheets were commenced after hostilities.

Operation Oboe 6, launched on 10 June 1945 was the amphibious assault on the island of Labuan in British North Borneo by 24 Aust Bde, and at Muara in Brunei by 20 Aust Bde. The geographic support for this operation was recorded thus:

> **Labuan & Brunei – Operation OBOE 6**
>
> Basic 1:50,000 coverage was available and 30 x 1:25,000 sheets were planned. 1:50,000 areas not covered by the new 1:25000 sheets were to have red overprints to show all topographic information obtained from large-scale aerial photographs. Three 1:10,000 photomaps were made and Enemy Defence and Naval and Air Bombardment overprints of 1:25,000 maps were produced. Additionally, 3 x 1:50,000 models of landing areas were made and 3 x 1:25000 sheets with I(T) information were supplied by 9 Div. Track maps were made of the Beaufort, Ranau and Tenom areas and dyeline copies

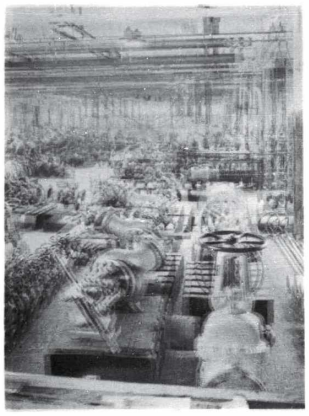
of 1:100,000 & 1:50,000 maps of Labi, Marudi Bintulu area were produced. A Riam Road sketch map and a Papar Estate area sketch map were made. Compilations, based on one-inch blueprints of the Brunei to Miri area were made using Oil Company base material.

Revisions of 5 x 1:50,000 sheets of the Jesselton – Kimanis area and 6 x 1:50,000 sheets in the Miri area were carried out and hasty maps of possible Japanese withdrawal routes from Miri into the interior were made. Borneo map production was summarised as, 25 x 1:253,440. 83 x 1:50,000 and 39 x 1:25,000, a total of 147 sheets.

At the time the term vectograph meant nothing to me however, more recently, while researching the mapping of Borneo I came across another reference to the use of vectographs during the Borneo Operations and it became clear that the vectographs were three-dimensional images, though still assumed to be another term for anaglyphs:

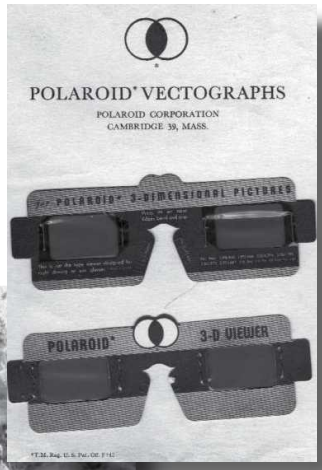
Vectographs

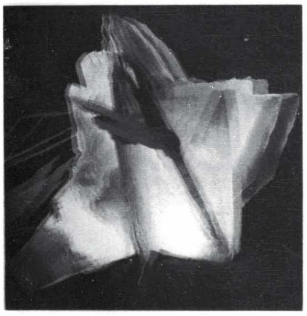
For the first time in operations by this formation, vectographs were issued to forward units. Owing to the late arrival of the necessary machinery OBOE TWO was the only operation that could be served prior to the landings. For this operation, 8 sets, each containing 15 vectographs of scale 1:10,000, were made available to 7 Aust Div for issue to platoon and company commanders operating in the areas covered. For 9 Aust Div, 4 sets, each of 26 vectographs, were produced of the Padas Gorge on scales of 1:5,000, 1:10,000, 1:20,000 and 1:40,000. The vectographs were favourably reported on by forward troops and proved of value in the briefing of commanders and men. The advantage of vectographs over stereoscopic examination of air photographs is that more than one person can view them at the same time, and still obtain the illusion of relief. It is not suggested that vectographs should replace stereoscopic air photographs for detailed study of terrain but, they do provide the most convenient method of briefing with the use of actual photographs. Of the scales supplied, 1:10,000 was found to be the most suitable for this purpose.

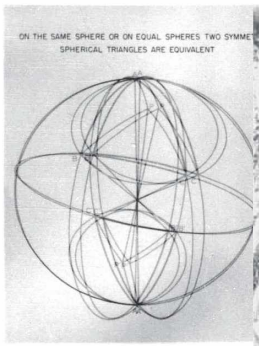


Typical applications of Polaroid 3-D Vectographs . . . in engineering and sales presentations (upper left) . . . in research reports and exhibits (the fly above, and the calcite crystal, lower left) . . . and in visual training (below).

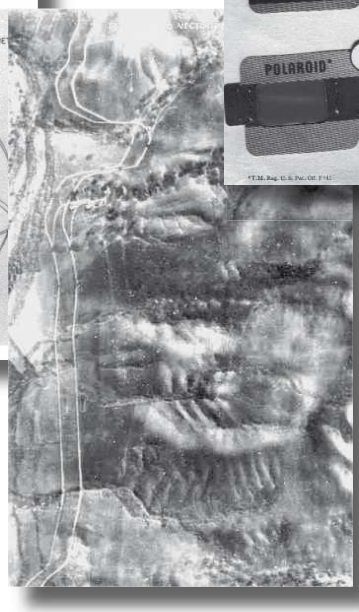
A Polaroid Corp. promotional image showing 3-D polaroid viewers.







A Polaroid Corp. promotional image showing typical 3-D Vectograph applications.



A Polaroid Corp. promotional image showing terrain in 3-D.

The Corps reproduction unit - 2/1 Aust Army Topo Svy Coy (less det) - proved to be capable of the tasks required of it, but two changes are recommended:

(a) Replacement of the obsolete hand-fed machines by smaller and faster automatically-fed printing presses.

(b) Addition of personnel and equipment for:

(i) The rapid reproduction, enlargement and reduction of photographic prints.
(ii) The production of vectographs.

(PRO WO 203/2690. From 1 Aust Corps Report on Operations Borneo Campaign 1 May to 15 August 1945).

Whatever they were, it seemed strange that there was no reference to them in "Maps and Survey" nor any obvious references in "Survey" literature covering World War Two operations. However, recently, found "buried" in the National Archives, is a file in which they are mentioned. The whole story is not told, but it appears that fairly early in the war an opinion on the use of vectographs was sought from Colonel Martin Hotine, head of the Geographical Section, General Staff. The pamphlet or *'book of words'* he examined and commented upon has not survived in the file but his hand-written memo has.

M.O. 1
"There is no doubt this is more convenient for non-technical users than the ordinary stereoscopic pair. It is also more convenient, and probably easier to prepare, than coloured "anaglyphs". But it has not yet been proved that screen projection for a large audience is feasible. All that the "book of words" with B, (Page 2 Foot) claims is that the process "may easily be adapted and that "it is expected that materials suitable for the preparation of lantern slides will be available shortly". I do not say this is impossible but it is wrong to assume that this extension is easy. It may require special materials which have not yet been developed and may also require special projection apparatus. Even without projection this gadget might dispense with models on many occasions and is certainly well worth following up.

I should say the process would be outside the capacity of A.C. Sqdn Photo Sections but inside the capacity of such fixed installations as C.I.U. However, the proposed experiments will settle that."

M. Hotine
GSGS Col G.S.
7/11/41

If the "proposed experiments" took place, the results may be buried in another file in the National Archives but as yet I have not found anything. The next day, a formal letter was despatched repeating virtually word-for-word what Hotine had memo'd:

57/Gen/2167 Polaroid Three Dimensional Vectograph photographs

D.S.D.

"I think that the normal stereoscopic pairs of air photographs will remain the ideal for detailed interpretation and the extraction of engineering information, but that the "Vectograph" will be most useful for handing on to a number of people results of general tactical reconnaissances. For this latter purpose they should be more convenient, and easier to prepare, than coloured anaglyphs.

In particular these new "Vectographs" may be most useful to the commander in a combined operation, who for security reasons has been unable to give tactical details to his subordinate commanders (right down to section leaders in some cases) until the actual voyage has begun.

In view of the information at the foot of page 2 of the instructional booklet (enclosed at 1B), I suggest that it should not be assumed that the extension of the principle of

projection on a screen will be easy. Even without a screen projection, however, this idea will be well worth pursuing.

This new process may be found, technically, to be beyond the capacity of the A.C. Squadrons photographic sections, but should be within that of the fixed installations, such as C.I.U. at any rate. The proposed experiments will no doubt settle this."

(Sgd) C.S. Sugden
8 November, 1941. D.M.O. & P."

On 8 Jan 1944, a conference was arranged to be held at the War Office on 21 Jan 1944 at which the whole question of the use of Vectographs by the various Arms of the Service was to be discussed and recommendations made, and a paper giving details of Vectographs was circulated.

External addressees included D.D. Photos Air Ministry, D.A.W.T. Admiralty, 21 Army Group, Combined Ops HQ, HQ Airborne Troops, HQ T.A.F., HQ A.E.A.F., School of Artillery and RAF School of Army Co-operation.

(PRO WO 193/202)

What the outcome of this conference was is not known. Clearly vectographs did not come into widespread use in the British forces thereafter, and there, as far as I know, the matter rested until recently when I sought advice from one or two "veterans" interested in photogrammetry. It was Ernie Wickens, to whom I am most grateful, who finally threw light on the matter in, perhaps, the most obvious of places, *'The Manual of Photogrammetry'*. However it is only in the 1944 Preliminary Edition that a section on vectographs is found which is set out below:

THREE DIMENSIONAL VECTOGRAPHY

Commander R.S. Quackenbush, Jr.

Vectography is a new medium for the presentation of stereoscopic views. It provides an easy way for non-experts to see – and to use – the three-dimensional visual model of the land previously restricted to the expert equipped with a stereoscope. Easy and quick to reproduce in quantity, requiring only a pair of spectacles for viewing, capable of presenting very large areas of terrain in a single view, and making no demands on the skill of the observer, the vectograph presents a number of new possibilities in the field of military and civil photography.

In military operations, the vectographs have accomplished what no other form of presentation has ever been able to do, as it has given the field commander a photographically precise scale model of the terrain, a model which needs no interpretation or special knowledge.

Tactically, the existence or nonexistence of a low hill or shallow ravine can be the key to the success or failure of an operation. The troop commander in the field has to know the lay of the land. In the past he has been able to extract information on land formation from maps and information on vegetation cover from photographs. For the first time it is now possible for him to get both types of information in the same picture. The vectograph shows him the whole situation at a glance. With no special knowledge or skill in interpretation, he can tell what he is running into on a strange beach, how his men can use natural land and vegetation cover, and how to lay out his communication lines.

Experience in the war theatres has indicated the value of the vectograph in combining the precise detail of the aerial photograph with the relative-elevation information conveyed by the contoured map; a value particularly important in areas where maps are likely to be crude.

Single Prints for Direct Viewing or Projection

To the casual glance, vectographs look very much like glossy paper prints. They can be held in the hand, mounted in books or reports, assembled on a plotting table and otherwise handled much as paper prints are handled. The viewing device is a pair of polarizing picture viewers, simple

spectacles fitted with polarizing disks. When viewed through the spectacles, the vectograph appears as a three-dimensional model of the terrain.

Vectographs may be prepared in several different forms, corresponding to the forms of the photograph: reflection prints, resembling photographic paper prints; transparencies, for direct viewing against a light box; lantern slides for projection on a screen for group viewing. Three-dimensional vectographic slides may be projected in any lantern slide projector. The vectograph is its own polarizer, so no polarizing filters are involved. Both images occupy the same film area, so there is no need for beam splitting attachments. The relationship of one image to the other is determined when the vectograph is made, so that beam-adjusting arrangements are neither desirable nor possible. The vectographic slide or film simply takes the place of the conventional slide.

The only requirements are that the screen MUST have a metallic surface in order to preserve the polarization of the light that forms the images and each person in the audience must have his polarizing viewers, either the simple card type or the spectacle variety. The stereoscopic model presented by the vectograph is essentially the same in appearance as that presented by paper prints viewed in the stereoscope, except that in vectographs made from current materials the image is sepia in colour rather than black. The process is capable of continuous tone reproduction with definition of about 50 lines per mm.

Vectographs may be made to cover any area of terrain the situation demands. Using an extremely rapid, simple technique developed through the joint efforts of Lt. Hubert Dogan (USMC), Commander Roswell Bolstad (USN), Clarence Romrell (Polaroid War School) and others, service photographers are producing vectograph mosaics as large as 7 x 8 feet, presenting complete stereoscopic models of many hundreds of square miles of terrain at original photographic scale. These large mosaics may be viewed as a whole, by a number of observers simultaneously; a feature of considerable interest in military staff work. A single set of paper prints of the terrain is laid down first, with the left-hand halves of the prints exposed, to form a “right-eye” view of the terrain; then by re-lapping, with right-hand halves exposed to for a left-eye view. The two views, recorded on copy-negatives, are then treated as if they were a simple stereo pair.

Processing

Almost all stereograms suitable for viewing in the stereoscope may be reproduced in vectographic form. Vectographs are made from negatives made according to standard mapping procedure, with 60% forward overlap and 30% sidelap. They may also be made, from obliques or from stereograms of nun-aerial subjects obtained with stereoscopic cameras or with a single camera moved between exposures.

A simple inhibition transfer process is being used at present in reproducing the views on the vectograph film. Each of the two stereoscopic negatives is printed photographically on wash-off relief film on which the picture images appear in relief in the gelatine emulsion, the degree of relief varying with the density of the photographic image. These relief films are placed in approximate register, emulsion sides together, soaked briefly in printing solution and then, with a sheet of vectograph film inserted between them, passed through a common clothes wringer. After the vectograph film has had an opportunity to imbibe the printing solution from the relief film, the relief films are stripped off and the vectograph is given a brief bath in a fixing solution. At this point, it is ready for use as a transparency or as a lantern slide.

For finishing as a reflection type print, it is painted with clear lacquer on the front and with aluminium lacquer on the back. Army and Navy photographers, after two practice runs through the process, are usually able to turn out a print, dried and finished, in about 35 minutes. Succeeding copies take about 1 minute each.

The process is the invention of Edwin H. Land, President and Director of Research of Polaroid Corporation, working in collaboration with Joseph Mahler. Announced as a laboratory achievement in 1939, it was quickly developed into practical form for war use with the encouragement of the Navy, Marine Corps and the Army Air Force.

Military Applications

Army, Navy and Marine photographic units are producing vectographs in the combat theatres for a number of uses. Lieutenant Colonel M.E. Parks describes the military uses of the vectographs as follows:

This new method is now an established service in the AAF, the Navy, Marine Corps, and the RAF. Air and ground force groups in the South Pacific, the Aleutians, Africa and Britain are having them made up by photo units already trained and equipped to do the job. Although new uses for vectographs will arise from time to time, their principal military value may be summed up as follows:

> *Briefing combat teams, such as bomber-crews, assault parties, landmining groups, engineers, air support groups, ship-to-shore artillery units and parachute troops.*
>
> *Staff work – for tactical planning over unmapped or sketchily-mapped territory. Intelligence reports – for conveying intelligence information to field officers who need not be equipped with stereoscopes in order to be thoroughly familiar with the location and appearance of enemy supply depots, dumps, road crossings, bridges, communication bottlenecks, fortifications, the effects of bombing and shellfire, disposition of enemy artillery and desirable target objectives.*
>
> *Training large classes of student mechanics, gunners, navigators, pilots and other personnel who must assimilate a lot of information rapidly on subjects and devices that are difficult to understand from a flat picture.*

For photographic interpretation, it appears that the stereoscope, in the hands of a skilled intelligence officer, is likely to hold its well-established place. The job of the vectograph is that of extending to all the non-experts, the advantages of stereoscopic viewing formerly available to a few experts.

After painstaking examination by intelligence officers, for example, the aerial reconnaissance photos covering the entire area of an enemy base have been reproduced in vectograph form, turned over to the naval, ground and air commanders involved in the operation for their tactical planning, and then passed along to lower unit commanders so that all of those taking part in the operation could have a clear grasp of the ground to be covered. A platoon sergeant with no skill at map reading or photo-interpretation gets the whole story at a glance.

Civilian Applications

Only recently have vectograph materials been made available for civilian applications, so that there have been few opportunities for actual trial on actual operations. It has been suggested, however, that a number of uses now served by the photomap may be served more effectively by the vectograph.

Dr. Ian Campbell, of California Institute of Technology, has made use of vectograph mosaics as map supplements in field work for the USGS.

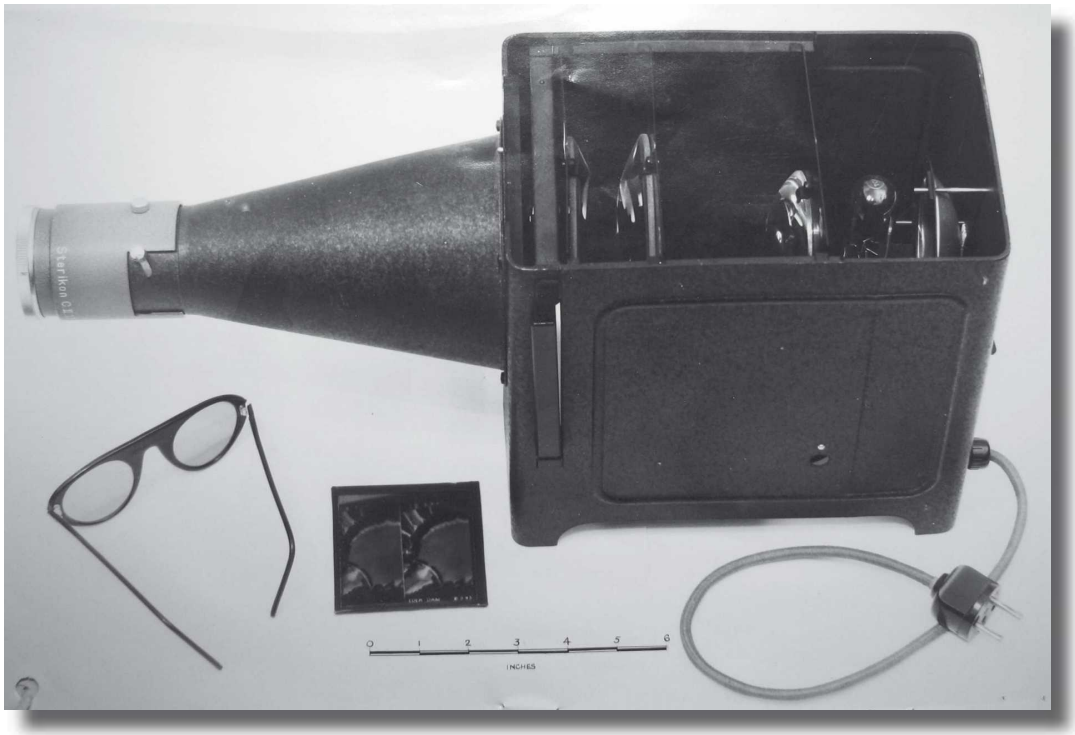
Mr. Louis A. Woodward has proposed the use of vectographs in soil conservation work. Many other possible applications suggest themselves: in the preliminary studies for siting of highways, power lines, flood-control and regional planning projects; recording of progress on construction projects; lumbering and reforestation operations; wherever, in fact, the lay-of-the-land is an important part of the message that the aerial photograph is expected to convey.

(Manual of Photogrammetry (Preliminary Edition) 1944, pages 327-330 Three-Dimensional Vectography.)

Polarising Projector

Another example of the early use of polarised light from the 1940's has come to light in the National Archives, Kew. In February 1947 a Major J.P. Barrie in the Research Section of the Central Photographic Establishment wrote a short paper on the possible use of a polarising stereo attachment on a Zeiss slide projector. In brief it was proposed that specially prepared stereo pairs could be projected through polarising filters on to a screen and the model viewed by students using polarising spectacles. Alternatively, it could be used as a briefing aide. The panchromatic model so viewed by a trainee would be similar to those viewed in practice. This polarised viewing system was considered more advantageous than an anaglyphic system "which gives a false impression of colour and suffers from loss of transmitted light".

The apparatus consisted of a standard Zeiss Ikon slide projector on the lens of which was an attachment consisting of two prisms which divided the emerging beam and overlapped the left and



A Zeiss Ikon slide projector with polarising attachment, polaroid spectacles and a standard 75mm slide showing one of the German dams breached by the R.A.F. in World War Two.

right hand views. Each prism had a polarising filter set at 90 degrees to the other and by means of spectacles consisting of similar filters the viewer could see the left and right images with the left and right eyes.

Since there is some loss of light through the filters, a screen with a high reflective quality was essential and matt aluminium was recommended. It was thought that the power of the lamp might be increased from the standard 100 watt if some heat dispersion could be effected. At a distance of 18 feet, the projector threw a three-foot square image on the screen.

For a standard 3.25-inch square (7 x 7 centimetre) format slide, the two stereo halves were to be 3.75 x 7 centimetres and the image was to be of a density to allow the maximum transmission of light.

In the image of the projector can be seen a glass slide on which can be made out one of the dams breached by the RAF Dambusters squadron.

The problems of projection of Vectographs, suggested by Hotine, might seem to be supported by the insistence on a suitable screen and the recommendation on increasing lamp wattage in the note above.

The recent resurgence of three-dimensional films in the cinema has caused a surge of interest in the methods and principles and there is now a considerable amount of material on the “web”.

In addition to developing Vectographs, Dr. E.H. Land, the founder of the Polaroid Corporation, was , of course, prominent in the design and manufacture of American aerial cameras in World War Two.

In conclusion, if one googles Cdr Quackenbush one is led to www.mcara.us and a journal of the U.S. Marine Corps Aviation Reconnaissance Association in which there is a fascinating article entitled “Quackenbush’s Gypsies”. In this is related the story of aerial photography and interpretation over Guadalcanal in the Solomon Islands in 1942.

Examples of Polaroid Vectographs were kindly provided by the Medmenham Collection.

The Defence Surveyors’ Association would be pleased to hear from any reader knowing the whereabouts of any surviving World War Two vectographs.

The use of material from The Manual of Photogrammetry, *'From Lebanon to Labuan'* and from The National Archives gratefully acknowledged.

Summary of Engineer and Signal Information

1929-1938 No. 5, 1932

By Col (Retd) Mike Nolan

Editor's Note – The following extract, which was provided by Col Mike Nolan, provides an interesting insight into surveying 80 years ago – some things have changed fundamentally but others seem very familiar!

Section X - Survey

Air Survey

Experiment and research in the application of air survey to mapping have continued. The surveys in Egypt and Trans-Jordan, referred to in Summary No. 4 of 1931, have been concluded, although lack of funds prevented the completion of the work in the manner originally intended. An area of about 800 sq. miles in the Jordan Valley, involving differences in height of as much as 1,500 metres, was successfully completed. A still larger area of about 2,000 sq. miles lying to the east of the Jordan and hitherto completely unmapped, was successfully photographed and has been partially plotted. Some valuable experience has been gained, but unfortunately sufficient funds were not available to enable this latter survey to be completed, and it has not been possible to check it in any way.

The experience gained in these two surveys indicates that satisfactory solutions of the air navigation problem can be found, and that, with the best navigation, air photographic strips, when assembled and dealt with in blocks can be plotted with sufficient accuracy for all normal military requirements on the basis of a ground point about every 20 miles. This applies to horizontal position only and to country of average difficulty. The problem of height is much more difficult, and although the shape of the ground can always be discovered, accurate heights and contours cannot be determined except with the aid of numerous ground points.

Considerable progress has also been made in the civil developments of this subject. Civil practice seems to be evolving along two distinct lines. The first produces accurate surveys on scales of 1/10,000 and upwards, making use of automatic plotting machines based on the principle first applied to stereoscopic photographic plotting by the late Brig. General F.V. Thompson, R.E. This type of work is being developed principally on the continent of Europe and most of the leading continental instrument makers have produced automatic plotting machines for it. The market for the output of these machines is roughly that catered for by the 1/2500 and 6-in. to one mile ordnance maps in this country. These maps have no counterpart abroad, but their existence in this country precludes the economic exploitation of this system in Great Britain.

The other system aims at producing small scale reconnaissance type maps of only sufficient accuracy to enable a new and unsurveyed country to be opened up. It has been used extensively in Canada and Rhodesia, and mainly in flat country. None of the maps produced in this way have hitherto been contoured.

Neither of these civil developments quite deals with the military problem, which is to produce accurate contoured maps on scales up to 3-in. to one mile, with the smallest possible amount of ground control and in the quickest possible time. The Canadian and Rhodesian systems, besides being unsuitable for the production of contoured maps, are not really accurate enough for modern military requirements. On the other hand, the drawback to all the continental systems, based on the use of automatic plotting machines, is the comparative slowness of operation and the cost, weight, and complication of these machines, each of which forms a kind of bottle-neck through which only a limited output can be delivered. All these machines, moreover, are designed to work with a comparatively dense ground control, and though it is possible that they might be adapted to other conditions, they have not been designed for them.

The experiments which have been proceeding under the direction of the Geographical Section, General Staff, have had in view the discovery of a technique which will give sufficient accuracy for military purposes, and which is, at the same time, sufficiently quick and simple to enable it to be used in the probable conditions of future warfare.

The method employed in the surveys of Egypt and Trans-Jordan, referred to above, are based on photography carried out in long straight strips, with a 60% fore and aft overlap between each photo. A strip of this kind can be plotted with the aid of comparatively simple apparatus in terms of any selected photograph in the strip, and any one strip can be plotted in terms of its neighbours on either side if these overlap it by a small amount. In this way a large block of country covered with suitable photographs can be plotted from photographic data alone, in such a way that exact scale and orientation alone remained to be determined from ground points. Two points suitable placed anywhere in such a block, fixed either after the block has been plotted or taken from antecedent work, are sufficient to enable the whole block to be scaled and oriented.

As regards the determination of heights, when it is realized that a height of say 20 ft. on a photograph scaling 1/20,000, if derived from photographic evidence alone, must be deduced from horizontal measurements of the order of one-thousandth of an inch, the difficulties in the way of really accurate work can be appreciated. Present experience suggests that accurate contouring is only possible when two or three heights can be fixed independently on each stereoscopic pair.

When the areas concerned are accessible, it is hoped that the aneroid barometer may prove a quick and cheap method of establishing a height control; the advantage of the aneroid in this connection being that it enables the height of a point to be measured without exact knowledge of its position. It can, therefore, be used to fix the height of a point directly it has been identified on a photograph. The design and method of use of a special survey aneroid is being investigated by a Service Committee. It is hoped that when a satisfactory specification has been got out, manufacturers will interest themselves in the matter and will be willing to undertake construction.

From a military point of view this system of mapping from straight strips of overlapping vertical photographs has the advantage that after a certain amount of preliminary work on laying out and adjusting the various strips has been done, the rest of the work can, if necessary, be divided up among as many draughtsmen as there are stereoscopes and stereoscopic pairs of photographs. Where this is possible, the time required for plotting, after the preliminary layout has been completed, is only that required to plot a single pair (which may cover perhaps 2 sq miles of country) and to assemble the different plots on a single drawing from which the whole can be reproduced. The time taken to complete the Jordan Valley Survey, referred to above, worked out at 1 sq. km, each man an hour, inclusive of all the office work.

As this method in its simplest form can be carried out with the Barr and Stroud "topographical" stereoscope, it lends itself far better to rapid production than any of the continental systems depending on the use of automatic plotters. The simplest forms of plotting require, however, a rather denser ground control than that stated above - that is to say, a point at least every four or five miles. For use with a more extended ground control it is necessary to use more precise patterns of stereoscope, in order to gain greater accuracy. Messrs. Barr & Stroud manufacture also a "precision" stereoscope, based on the same principle as the topographical stereoscope, which gives considerably increased accuracy and is yet sufficiently cheap and portable to be issued to individual draughtsmen if the circumstances require it. For still greater accuracy a special form of stereoscope, known as the Fourcade Stereogoniometer, has been produced by the same firm. This instrument was invented by Mr. H.G. Fourcade, the originator of the "stereocomparator", an instrument normally associated with the name of Pulfrich, of the firm of Zeiss. The Fourcade Stereogoniometer occupies in respect to air photography roughly the place of the ordinary small theodolite in relation to topographical surveying, its function being to gain greater accuracy in plotting, to enable computation to be substituted for graphic determinations and thus to enable a photographic block to be extended over larger areas, without loss of accuracy, for any given quantity of ground control.

The latest model of this instrument, which is now under construction, is designed to work in conjunction with an automatic plotter resembling in some respects the machines constructed on the continent. The actual mechanical and optical design of this plotter is, however, understood to be a completely new departure, as distinct from current continental practice, as was the design of the first Fourcade Stereogoniometer from those of corresponding continental instruments.

It is hoped that funds will be forthcoming to purchase one of these new models as soon as it is available. If it fulfils expectations the complete Fourcade machine should be able to deal quickly, easily, and effectively both with the military problem of supplying quickly control points on which to base rapid plotting with the topographical stereoscope, and with the civil problem of accurate and detailed plotting and contouring based on numerous ground points.

Field Survey Companies

Authority has been given for the formation of the Field Survey Company referred to in Summary No. 4, 1931, Article 22. Although the formation of this unit was authorized as from the 1st April, 1931, the unforeseen demands on the Ordnance Survey in connection with land valuation, made it impossible to find personnel for it at that date, and its formation was temporarily postponed. Land valuation was stopped in December, and the arrangements for the formation were then taken up again and are being pushed forward with all possible despatch.

This unit, which will be styled the 19th (Field Survey) Company, R.E., is intended for training purposes only, and will be broken up on mobilization. Its object is to enable the R.E. to take a fuller part in peace exercises and manoeuvres in which survey problems arise, and to study in a more practicable manner than has been possible hereto problems of co-operation with R.A. survey units. The interest of the R.A. in survey questions is increasing rapidly. The work of the R.A. survey units is supposed to be based on that of the R.E., but in the tactical situations usually envisaged, it is the R.A. surveyor who arrives, or is expected to arrive, on the ground first. This raises various problems of considerable difficulty. The necessity for clear definition of the relative responsibilities of R.A. and R.E. has been much in evidence, and arrangements for preventing duplication of work or loss of touch require working out and standardizing.

The formation of this unit will also enable experience to be gained, and practice to be given, in team working, which it has not been possible to deal with adequately in the course of training based solely on courses of instruction. It will also enable certain special forms of survey, like air photography, which are of exceptional military importance, to be studied in a more practical and more detailed manner than has been possible hitherto. The unit will work under the orders of the Director-General, Ordnance Survey, and will be quartered at or near Southampton. It will form part of the existing survey battalion, upon the strength of which all R.E. personnel serving with the Ordnance Survey are now borne.

Survey Equipment

(a) **Mobile Printing Equipment.** The formation of this field survey unit has enabled a step forward to be taken in the matter of mobile printing equipment. It has always been intended that the Field Survey Company, R.E., in war should be equipped for the production of maps in the field, but it has not been possible hitherto to proceed with designs for, or with the production of, the actual equipment which will be used. The developments of air photographic surveying referred to above have made it desirable to take this question in hand, more particularly since the theatres of war in which this air photography would be most valuable are so remote from existing printing establishments, that time would not be available to have any maps, based on photography done in the field, to be sent back for printing.

The various types of printing machine now on the market have been examined with a view to their suitability for mounting in a lorry, and one has been selected. The purchase of such a machine has been authorized, and the selection of a suitable chassis on which to mount it is in hand. Eventually it is intended to provide the Company with other vehicles carrying proving presses and photographic plant, which will enable it to carry out all the processes involved in map production with the minimum of preparation and delay.

(b) **The Tavistock Theodolite.** Further reports on this instrument are now coming in from the field. Although a few criticisms have been received, they mostly refer to constructional defects which can easily be remedied. The general opinion is that it is an exceptionally pleasant instrument to use, and one which gives a very satisfactory accuracy in proportion to weight and other factors.

Geodetic Triangulation in Africa

A very interesting enterprise has been inaugurated by the formation of a small R.E. party under Captain Hotine, R.E., to continue the geodetic triangulation of Africa, started by the late Sir David Gill, along the Arc of the 30th Meridian. This work, which is being carried out under the direction of the Colonial Office, was commenced many years ago and was financed largely by Cecil Rhodes. At his death, funds were no longer forthcoming, and the work languished, coming to a halt finally when it had approached the northern boundary of Rhodesia. Its continuation northwards is urgently necessary to co-ordinate and control the surveys of the various colonies and countries in Southern, Eastern and Central Africa. Its continuation, with this object, has for many years past been urged upon the various Governments concerned, not only by Sir David Gill himself but by other individuals, scientific committees, etc., and geographical societies. For one reason or another, it has

not been possible to secure the necessary co-operation between the various colonies and countries concerned, or to arrange for the necessary funds.

Efforts have, however, been continued, and despite the financial crisis, the difficulties have at last been overcome, at any rate for the moment, and a party has started work. It is hoped later on that it will be possible to secure the participation of the French and the Belgians through whose territory the 30th Meridian passes, so that when the Arc has been carried up to the Belgian frontier, they will undertake to continue it through their territories and connect up with further work which it is hoped may be undertaken by British surveyors further north.

As explained, the principal function of this triangulation is to co-ordinate the surveys of the various countries through which the arc passes, to give them a common origin and to prevent disputes over boundaries which are sure to arise when these surveys, commenced independently, begin to impinge on one another. Apart from its immediate value in this connection, this triangulation is of considerable scientific interest, for the 30th Meridian, besides being a part of the longest land arc of meridian in the world, will be the only meridional arc which has been measured in equatorial regions.

The party will be engaged in reconnaissance and building of stations for some months. Observation cannot be commenced until this necessary preliminary work has been completed. For the actual observing two special instruments are being constructed - one based on the design of the new Tavistock instrument, and the other to a design got out by Captain McCaw of the Geographical Section of the War Office. The latter instrument, especially, is a radical departure from present practice. Both instruments are being made by the firm of Cooke, Troughton & Simms.

Survey Beacons

Further trials were carried out during the year, in co-operation with the 1st A.A. Searchlight Battalion, of searchlight beams used as survey beacons. Very satisfactory results were obtained. No difficulty was experienced in laying a theodolite (provided with a diaphragm, specially designed for the purpose) upon the beam which could be observed up to a height of more that 600 ft. The maximum distance from which observation was attempted was about 6,000 yards, and no difficulty was experienced in seeing the beam at this range.

Although further trials under varying conditions are desirable, there is little doubt that a searchlight can be used as a beacon, and should prove very valuable on service for this purpose.

The future of Rapid Environmental Assessment within the RN?

Unmanned Underwater vehicles (UUV) are far from new technology and as well as being widely used within the civilian sector they have also been in use within the Royal Navy since the mid 2000's. The original role conceived for UUV within the RN was for employment within the mine warfare community and tactical development and trials have been conducted sufficiently to now utilise UUV for Very Shallow Water Mine Counter Measure Operations. As the use of UUV's grew it quickly became apparent that they had further potential for tactical development within the Fleet particularly in the field of Rapid Environmental Assessment (REA) and hydrographic survey. A further driver behind the UUV development in the RN is that the future of the Mine Warfare (MW) and Hydrographic branches is a *common* platform using deployable mission systems, Mine counter measures, Hydrographic and Patrol Capability (MCHP). These will be primarily offboard systems allowing the vessel to remain out of the threat area, therefore the utility and advantages of UUV which can be adapted to serve both the MW and H branches of the RN are obvious *(Fig 1)*.

Fig 1. REMUS 600 being launched from a HUNT.

Fig 2. A REMUS 100 being launched.

The current UUV systems in use within the RN are the Remote Environmental Measuring Units (REMUS) 100 and 600 vehicles *(built by Hydroid, part of the Kongsberg group)*. REMUS 100 is supplied as a complete system with the vehicle and supporting components coming in hardened plastic cases. Within these you find everything required, including acoustic navigation sources, floats and weights, vehicle tracking unit, laptop and spare parts kit and cables. Due to the size and weight of the REMUS 100 system 2 people can easily deploy and recover the vehicle from a small boat with no additional equipment *(Fig 2)*.

The length of time for a single mission and the area that can be covered is quite variable and depends on vehicle speed and required sonar coverage. As an example a standard REMUS 100 vehicle at 4kts with 100% sonar coverage will cover a 1km square of survey area at depths to 100m every 2hr 20min and will have an endurance of 11hrs 30mins. To increase mission coverage it is possible to deploy and track four vehicles simultaneously.

The type of data collected and displayed on mission playback includes current profile (ADCP), side scan sonar (SSS) images, heading, pitch and roll data, mission progress, conductivity and temperature, bathymetry (single beam and multibeam), sound speed, system status and navigation data including: Long baseline (LBL), Ultra Short baseline (USBL), and Dead reckoning accuracies. All of this data can be viewed in a variety of graphical structures through the REMUS Vehicle Interface Program (VIP) but is also available in its raw text format for exportation and further processing through CARIS, CLASSIPHI and ARC GIS.

In addition to the REMUS 100 the RN also operates the REMUS 600. This has been designed to operate to depths of 600 meters (although the RN version is limited to on shelf operations), allowing

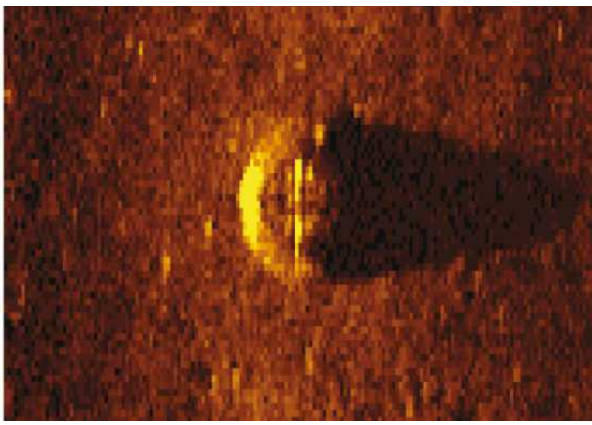
for greatly increased operational scope. The 600 also has far greater endurance, with mission duration capability of up to 70 hours. Its increased size and power capacity enable it to carry large payloads to meet mission requirements. The 600 has the same Vehicle Interface Program (VIP) as the REMUS 100 making it easy to train personnel in both systems. The REMUS 600 and, to a lesser extent, 100 vehicle is modular and can be easily reconfigured for different payloads. The vehicle is comprised of a series of hull sections that are quickly separated for vehicle reconfiguration, maintenance, and/or shipping. The additional modules that can be fitted include a GEOSWATH Multi Beam Echo Souder (MBES), a Blue View MBES to cover the 'gap' that occurs with side scan imagery in the nadir region and a camera to aid object identification. Although these modules can be used on the REMUS 100 system this greatly reduces the vehicle endurance. Due to the increased size of the REMUS 600 vehicle it requires a crane mechanism for launch and recovery from RN Ships. Although the REMUS 600 vehicle and support equipment is much larger and, therefore, less portable than the 100 system the ISO Container that the 600 equipment comes in is designed especially for military air freight movement and so is still easily deployable.

Having both the 100 and 600 systems in operation gives a great deal of flexibility to RN UUV operations. A specialist team can easily embark with REMUS 600 and deploy with a ship from its base port or the team and equipment can be flown into theatre to join a ship at short notice. The more portable 100 system can equally be deployed in the same manner as the 600 but has the added flexibility that the team and equipment can deploy independently when a ship is not required or is unavailable.

At present the Royal Navy REMUS systems are operated within the Mine Warfare Branch who conducted tactical development and trials to utilise UUV for Very Shallow Water Mine Counter Measure Operations (VSWMCM) *(Fig 3)*. The success of these trials led to the creation of the Fleet Unmanned Underwater Vehicle Unit (FUUVU) who, since forming, have been extensively employed in operation both at home and abroad. The concept of FUUVU operations is to deploy a small team of personnel either afloat or ashore to conduct UUV wide area object detection missions and then report back findings and allow further investigation to be conducted by Mine Countermeasure Vessels or diver teams as appropriate.

Fig 3. Typical REMUS 100 targets (Manta type mines).

As the use of UUV grew and the MHPC concept took shape it quickly became apparent that they had further potential for use within the fleet. As the system collects both detailed side scan sonar imagery and large amount of bathymetric data it clearly had potential for use in hydrographic survey *(Fig 4 & 5)*. Whilst at present the data gathered may not be at a consistently high enough level of accuracy for high order hydrographic survey it is of particular use for REA operations.



UK Rapid Environmental Assessment (REA) is defined as: "The direction, collection, processing and dissemination of relevant information relating to the physical environment of a battlespace and the development of products and databases for use by warfare commanders, in weapons and command support systems"[1].

In practice REA provides a timely assessment of the impact of environmental conditions and focuses on the overall suitability of an area for a proposed operation. This assessment is used to either make recommendations for the suitability of proposed sites or when only one area of operation is available it is used to advise the Command of how to tactically exploit the conditions for land, air and sea operations. The scope of operations that the RN may be asked to conduct ranges from humanitarian and disaster relief through to full amphibious assault by sea and air into enemy territories and everything else in between. Accordingly the nature of an REA will change depending on the objective. This ranges from a covert assessment conducted by Special Forces and/or Submarines able to collect a limited amount of data in as short a time as possible. Through to overt assessment being conducted by a Hydrographic Survey Vessel conducting high order survey operations at sea and ashore.

[1] BR (1806) British Maritime Doctrine (proposed definition change for next issue).

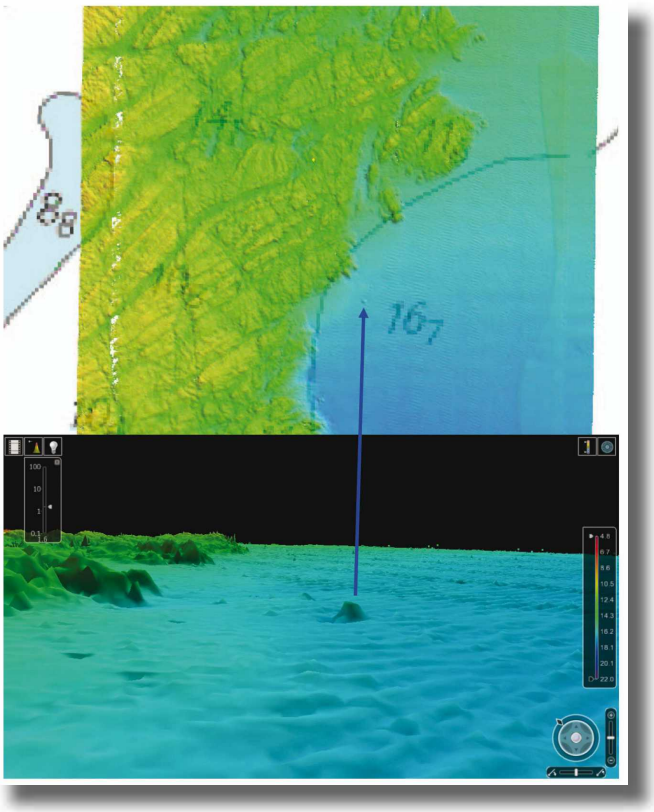


Fig 4. REMUS 100 Geoswath interferometric MBES data from south of Plymouth Breakwater, clearly showing areas of rock, sand ripples and a distinct contact.

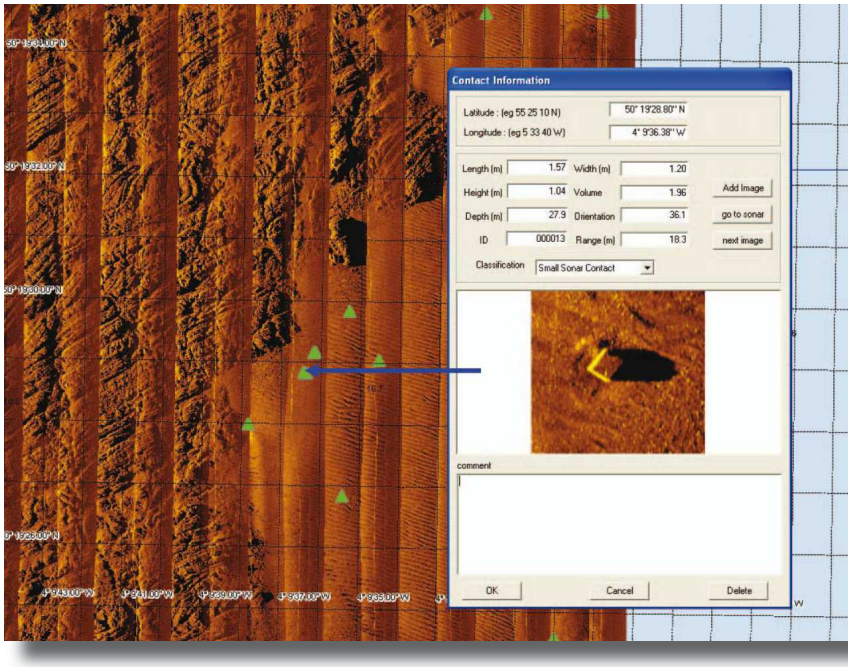


Fig 5. REMUS 100 900kHz SSS data from the same area as Fig 3 showing the same features. The contact is however much clearer and can be measured.

The UUV system provides a very useful bridge between these two extremes of capability. The nature of the system is innately covert; it can be deployed from range, over the horizon and provide bathymetric data and sonar imagery from depths of 300m all the way to the surf line. The data can then be used in the traditional manner of object detection and mine countermeasure operation. In addition to this the bathymetric data can be quickly processed to provide overlays and updates to electronic navigation systems. These updates open the area of operation and increase navigation safety and situational awareness for landing forces. But equally important it gives ships the option to move closer to shore so that they can deploy forces more quickly and offer more support to landing forces.

From use in a covert and/or offensive operation the system can also be employed in disaster relief efforts. Frequently in such scenarios harbours and other lading sites become unusable due to damage or the danger caused to ships by shifts in the seabed or debris fields washed out to sea. The REMUS system (both 100 & 600) can be rapidly deployed to conduct missions to help verify the safety of a harbour and harbour approaches so that it can be opened up to the wider relief effort *(Fig 6)*. With the ever increasing move towards joint capabilities and the progression of the MCHP project to produce a single vessel type that has 'bolt on' interchangeable systems that allow it to be adapted for a variety of missions the existence of UUV which can simultaneously conduct MCM and survey operation has clear advantages.

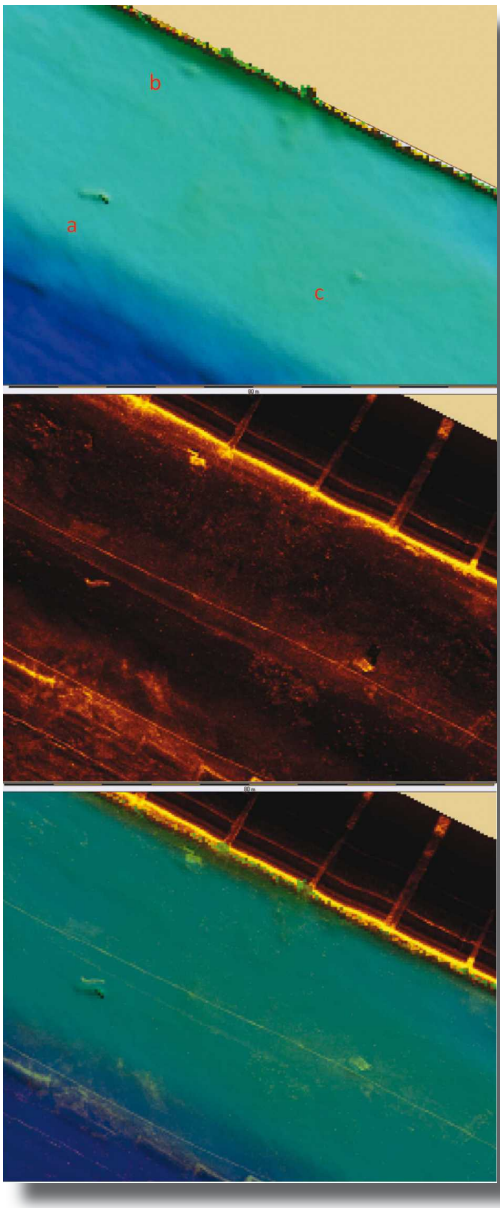


Fig 6. The top figure shows EM3002 data from a survey of the approaches to Marchwood with 3 contacts. The middle image shows 900kHz SSS data from a REMUS 100 with the same 3 contacts. When these are overlaid all of the positions from REMUS were within 2m of the EM3002 positions.

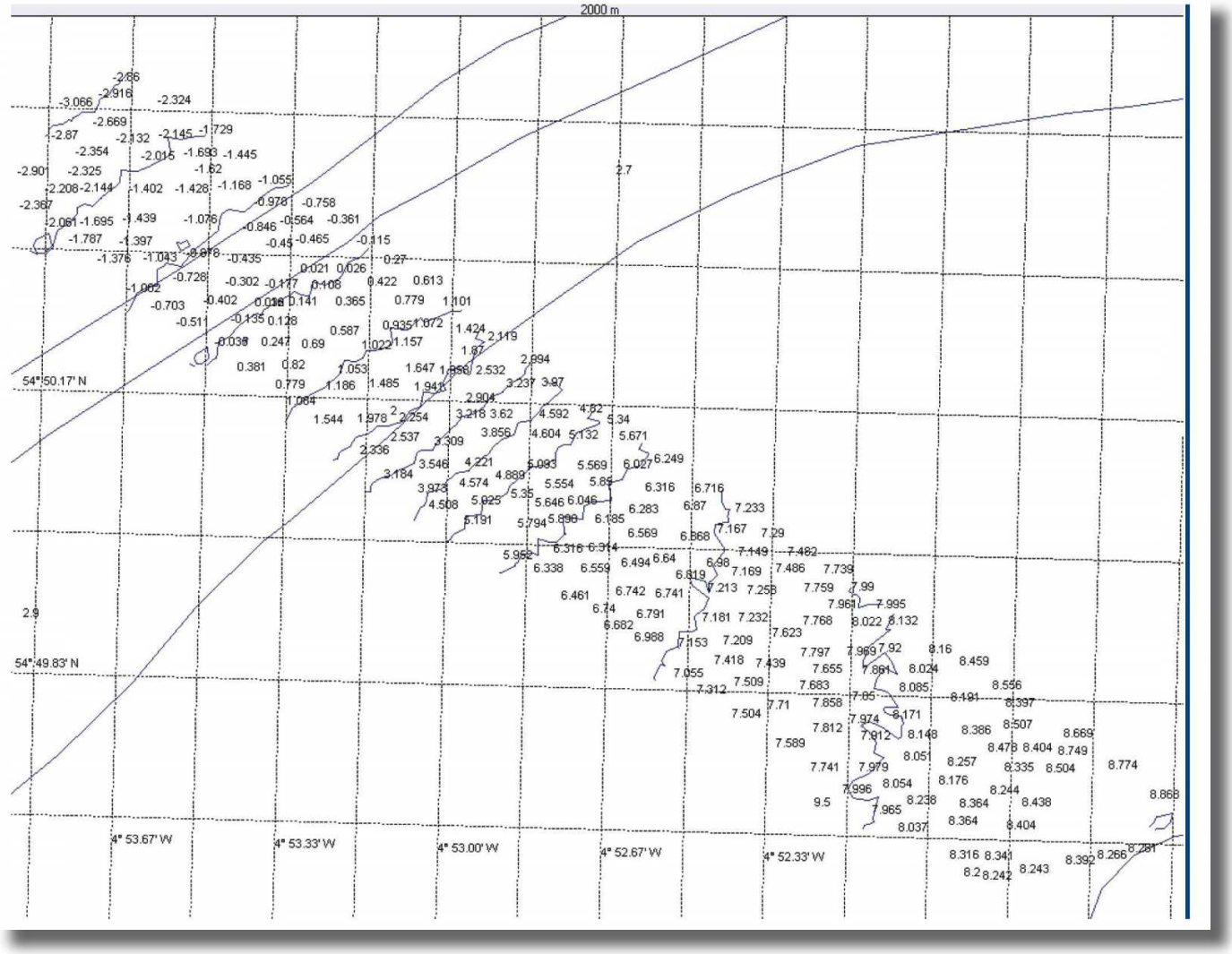


Fig 7. REMUS 100 beach lane data in S57 format overlaid onto an ENC of Luce Bay.

The use of UUV has already been successfully proven in MCM operations and far from being a future capability of REA it is a capability that exists now. During the spring the first of the bi-annual NATO maritime exercises, *Exercise Joint Warrior*, was hosted by the Royal Navy off the west coast of Scotland. In preparation for a potential amphibious landing in Luce Bay, Fleet Diving Unit 2 (FDU2) conducted VSW MCM with the REMUS 100. Bathymetric data was gathered concurrently and processed by Fleet HM Unit personnel to produce S57 layers (capable of being imported into WECDIS navigational system) of the boat lanes from the 10m contour to above the low water mark *(Fig 7)*. This was of particular relevance as much of the bay has not been surveyed since the mid 1800s and the Commanding Officers of the larger units, *HMS Bulwark* and *RFA Mounts Bay* were rightly concerned about navigating in such waters.

By opening up the area of navigable waterspace both boat and helo transit times could be greatly reduced and the availability of Naval Gunfire Support greatly increased. In conclusion UUV are a technology that is rapidly moving forward and they have the potential to provide a flexible means of rapidly deploying a survey capability anywhere in the world at very short notice. Although the reliability and the accuracy of the systems currently in use within the RN are only good enough for REA operations the next generation of REMUS system is claiming accuracy levels good enough for IHO Special Order, so should the question be *'Unmanned Underwater Vehicles (UUV), The future of Hydrographic Survey within the RN?'*

The Importance of Geography in Defence

By Jean Smith, Head Human GEOINT Branch Defence Geographic Centre.

Geography has always been critical in underpinning understanding in Defence. 21st century operations are, and will continue to be, executed amongst the population – the "white forces". But we need to understand more than just where the population is located, we need to understand how they are organised, how, where and why they interact. Human geography encompasses issues such as economics, infrastructure and how it functions, social structures, networks and human systems. All of these (and many more aspects) must be understood for military strategists to be able to conduct operations effectively.

Changing doctrine

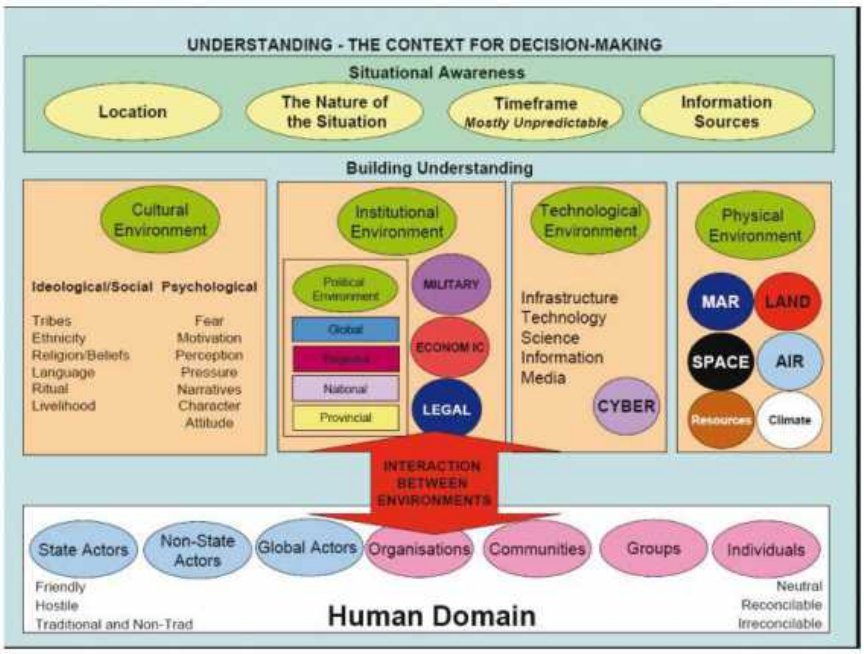
Revised UK doctrine has recognised the value of Understanding - the population, the environment they operate in, their culture, values and beliefs. The importance of place is critical: everything happens somewhere, and an understanding of 'place' will enhance all activity in the intelligence cycle.

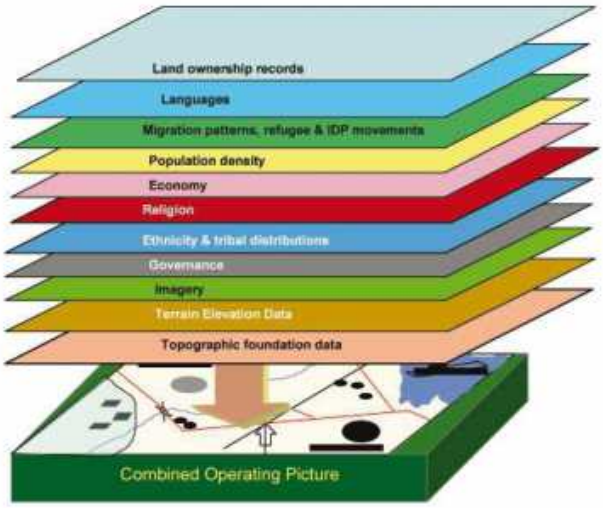
The challenge, however, is that the 'where' is not always apparent or easily depicted. Co-ordinates alone will not answer the 'where' question, or more importantly, provide the geographical context, eg, 'where in relation to ....' and 'why there..' questions.

Recent work on human geography attempts to identify and portray the human factors that influence the 'where' using methods that enable human influences to be combined with environmental aspects. Traditional geography still has an important role to play: it forms the framework for Defence operations and is thus the logical context for human geography.

At a strategic level, human geography products provide the contingency planner with an opportunity to identify potential flashpoints, monitor emerging situations and manage risks.

The events of the last year in the Middle East and North Africa have confirmed the value of human geography as a predictive tool. Analysis of demographic data allows prediction of potential flashpoints by combining age and sex profiles with criteria such as disenfranchisement, poverty, unemployment and illiteracy indicators in a spatial context which can provide some insight into the "angry young men" issue.





Foundation data – the complete geography

Geography in the age of GIS is increasingly provided as a series of geospatially referenced layers or themes. In combination, these build a picture for the planner, the commander and the soldier on the ground. This is what is now being described as foundation data.

Human geography is organised as a number of themes. The Defence Geographic Centre has been focusing initially on the portrayal of ethnicity, language, religion and demographics but other themes are also under development.

THE OPPORTUNITIES AND THE CHALLENGES PRESENTED BY HUMAN GEOGRAPHY

Information density

Human geography data is applicable across a range of densities or scales, providing context to the strategic planner, the commander at battle group level and the company commander. The data helps enhance understanding at all stages – from contingency planning to detailed operational planning. An understanding of tribal structures at country level can offer some explanation for the dynamics of the recent tensions in Libya, for example. At local level in the Helmand valley, understanding how the different tribal groups, clans and families interact and where they are located can help a troop commander understand the dynamics of his AOI and where he may be able to draw on support from the local population.

Understanding the granularity of human geography data raises a number of issues, particularly with developments in technology that have driven increasing demand for soft-copy data rather than traditional paper products which are fixed in scale and have been compiled with scale-appropriate content. Operational requirements and advances in technology have driven customer demand for softcopy outputs that can be manipulated for a number of purposes and overlaid on a variety of background data. While this raises issues for many geospatial outputs, it poses particular challenges for Human Geography outputs.

Generalisation methods are well understood and accepted in the production of topographic products. Topographic features can be seen and identified on the ground and the generalisation is apparent. Human Geography features are not always obvious or visible and not always easy to verify, therefore it is critical that the customer understands the basis on which human geography outputs have been produced to ensure appropriate use of the data at an appropriate scale.

Collection

Afghanistan has provided us with a comprehensive and detailed set of georeferenced (or georeference-able) data thanks to British involvement since the mid-19th century and this information has proved invaluable in establishing a baseline understanding of the situation on the ground. The picture is changing rapidly, however, and we must have access to current information to be able to generate useful products. The right connectivity to systems in theatre can provide access to source data in very short timescales, but much of this data is of a sensitivity and classification that it can't be incorporated easily into unclassified geo products. This data is unlikely to have been collected for the purpose that human geography analysts wish to use it which can introduce anomalies.

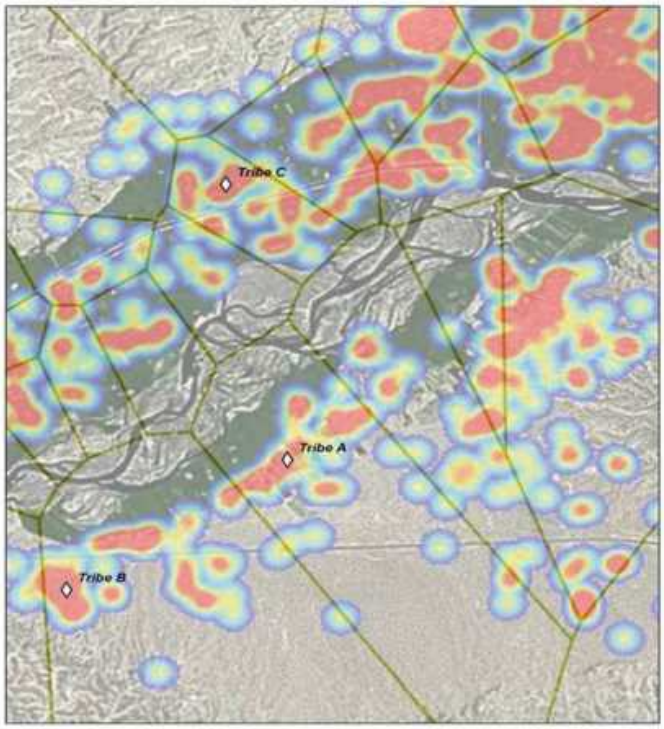
While much of our knowledge and understanding has developed from experience in Afghanistan, it will not be representative of future conflict locations and we must not be unduly influenced in the design of human geography outputs based on Afghan experience.

Depiction

The defence and academic mapping communities are developing and refining techniques to improve how human geography data is depicted. We can draw on techniques developed by other disciplines (the meteorological community for example), but there are some issues still at an early stage of development. How we combine point features that can be easily geo-located and plotted (for example hospitals, bazaars,

places of worship) with entities with imprecise locations and boundaries, for example religious or ethnic groups, is testing. Equally, illustrating highly complex socio-cultural relationships such as ethno linguistic, or ethno religious groups continues to offer challenges.

Feedback on early examples of human geography outputs has reinforced the requirement for producers to ensure that users understand what is being portrayed, and that they do not make assumptions based on incomplete understanding. The user needs to be educated as to how to read a human geography product, much as they were taught to use and recognise the symbols on a topographic map. Human geography data must be presented with associated metadata or readme files explaining what the data shows and ideally the context of that information. It is also important to appreciate what it does not show. Polygons indicating the presence of a tribal group in a particular location do only that – they cannot imply that the group is only represented in the area delineated by what can only be a hypothetical boundary, nor that no-one else from a different group lives in that area. The information can only be based on available source data which may be biased by collection methods or accessibility and may only be accurate for a short period of time.



Comparison between thiessen polygon outlines based on GNS populated points and Compound Mapping point kernel density.

Portraying intangible phenomena

The interest in, and demand for, human geography is providing us with opportunities to develop techniques to portray important intangible concepts in a geospatial context; mapping influence/ atmospherics, attitudes, views or opinions and displaying geospatially unstable or transient situations. This is reliant on the development of robust techniques and the availability of sufficiently detailed, representative and reliable data to be able to generate useful and meaningful products. This work is still at an early stage and is the subject of research across the academic and user communities.

Standardisation

The commitment to standardisation and the work already done within the Defence Geospatial Information Working Group (DGIWG) and NATO is driving collaborative work to develop human geography data models, describing the different aspects of the data content including features and attributes; data structures which will transform the data models into databases and data dictionaries which provide a detailed description of what each and every term means and how it is applied –important when working in a multi-national environment.

These issues, of course, apply more widely than just the geospatial community. Human geography is playing a very significant role in driving forward the use of data rather than the printed copy. In multidisciplinary environments it is becoming increasingly evident that understanding of the concepts underpinning human geography is required for users to be able to make use of the data safely and effectively and therefore is reinforcing the need for training in the use of geospatial outputs. There has been significant investment across the different defence communities, nationally and internationally, to ensure the data is comprehensible, useable and exchangeable.

Conclusion

Conflict results from a combination of human and environmental factors and the resolution of conflict requires the understanding of both. Traditional geographic products to represent the topographic environment are well-developed and well-understood. Human geography offers an additional, critically important perspective on comprehension. It allows the commander, planner, strategist to make better decisions based on the most accurate and comprehensive depiction possible. Human geography is complex, multilayered, and is not as tangible as topographic mapping - what you see is not necessarily precisely what is there. Effective use of human geography in Defence will require significant investment in users' training and awareness.

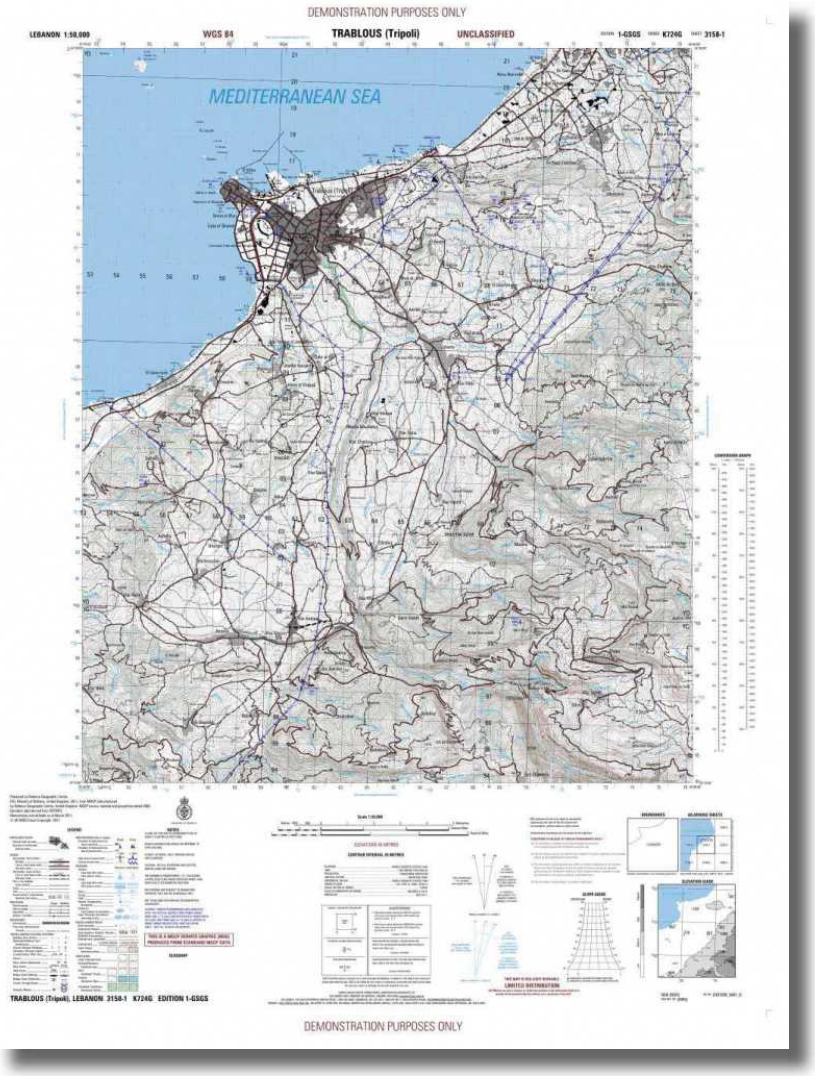
What's this got to do with mapping?

By Vicky Stuart and Steve Cornwell, Vector Production 2, Defence Geographic Centre.

The Defence Geographic Centre (DGC) has a worldwide reputation for providing high quality and timely geospatial data and advice to the UK Armed Forces, other Government departments and our allies in a wide variety of formats. In this present climate of unpredictability, the latest hot-spot requiring UK or multi-national intervention could literally be anywhere in the world. This alone causes great difficulty in trying to ensure that there is adequate geospatial information readily available over the required areas.

One of the initiatives the DGC is involved in to meet this increasing worldwide demand for high-resolution geospatial data, is by the co-operative production and maintenance of over 3000 one-degree cells (approx. 25% of the earth's Surface) of high-resolution, attribution rich, centre-line digital vector data (point, line, area). The majority of our data is captured by contractors at a density of either 1:50k or 1:100k, helping meet both the UK and multi-national medium scale mapping requirements.

This vector data capture is successfully achieved through a coalition of nations (currently 29 and growing), participating in the Multinational Geospatial Co-production Programme (MGCP). The member nations, some of which are 'lead nations' (the UK is one), all work to an agreed extraction guide (maintained by the UK) to enable 'standardised' attributed vector data capture to an accuracy of +/- 25m.



Sample MDG produced from CGIS data.

The Country Geospatial Information System or 'CGIS' program of work is the UK's contribution to this vast 'cost-effective' MGCP collection of vector data. CGIS comprises of 3 distinct workflows – Quality Assurance of contractor captured data (the QA flow); edge-matching and network connectivity of surrounding data (the ConMerge flow); finally conversion and packaging of the data to MGCP standards for uploading to the International Geospatial Warehouse (the IGW flow).

The International Geospatial Warehouse (IGW) enables member nations to upload and download the captured and certified MGCP vector data from a common web-based 'holding area' using a controlled exchange mechanism, thus enabling rapid data exchange (in shapefile format). As a 'lead nation' the UK has signed up to produce at least 200 one-degree cells for uploading to the IGW. This will then entitle us to download any of the 3000 cells we may subsequently require.

The MGCP vector data itself is not to be treated as a 'finished product' but more as 'foundation data', which can be updated and/or densified as required.

However, in these ever-changing times a new rapid response interim "product"

has emerged, the MGCP Derived Graphic or 'MDG' as it is commonly referred to. This process essentially takes the original captured vectors from the IGW and with minimal effort (hours and not weeks) a useable map can be produced. The currency can be further improved by using additional sources to update the existing data, thus making membership of the MGCP even more valuable to help meet UK medium scale requirements.

Due to the often seemingly complex methodologies used in the CGIS workflow, it seemed the ideal candidate to benefit from the Continuous Improvement (CI) initiative, especially in these cost-driven times. Supported by the DGC management team to help maximise efficiency, below is DGC's story of the implementation of Continuous Improvement ideology into the CGIS process and the resultant outcomes.

CI/LEAN overview

The application of LEAN techniques first began back in the 1950s at the Toyota Plant, where they felt that if there was an ideal way to perform every task, why not seek it out? This required developing a deeper understanding of the customer and their requirements, and the involvement of all employees, through the concept of 'Gemba', or simply in English 'going to the workplace'. Taking a step back from the day-to-day running of the shop floor allowed them to observe what was really going on, and produce a 'vision' of how they would ideally like to operate. Firstly they developed a vision, then the tools that would allow them to reach that vision. They had to ask themselves a number of questions: What is the ideal way to do it? What is preventing us from doing that? How can the barriers be removed? One of the main principles of LEAN is adding value to a flow and eliminating wasted effort. LEAN is not just a set of tools, but a system – how these tools are implemented to achieve a desired vision. One of the more popular tools within LEAN is the '5S' – Sort, Simplify, Scan (quick checks every now and then to ensure that everything is still as it should be), Standardise, and Sustain. Therefore a more appropriate name for LEAN would be Continuous Improvement (CI), as it becomes necessary to continuously revisit flowlines to make adjustments and additional improvements where necessary, to ensure that a process is being sustained to the highest standard it can be. With this in mind, other tools can then be applied to ensure that improvements to workplace practices are continuously being sought.

Why CGIS was a good model for CI testing

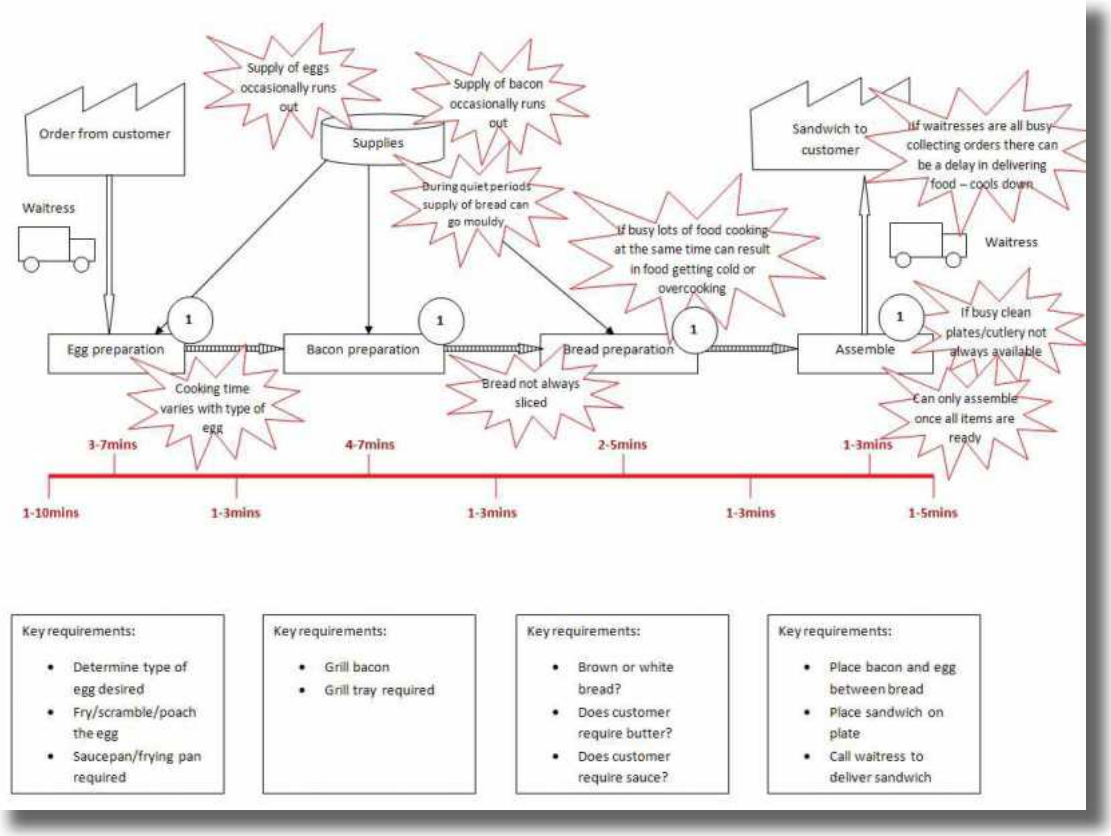
CGIS was therefore chosen as a good model to introduce CI ideas and techniques to, as it encompasses much more than one may initially think. This training was done in partnership with the Ordnance Survey, who have spent the past 10 years developing CI in their own workplace.

The overall CGIS flow is made up of three smaller flows, QA, Conmerge and IGW, as previously outlined, which each have a number of complicated steps, thus plenty of opportunities for issues to arise! Each of these three flows is influenced by sources and customers outside of our own immediate control, which can cause a range of problems. Then we have relatively complex software and systems, which have a tendency to 'play up' now and then and require assistance from our Support sections, so this created another list of issues. Other problems could arise from training needs, or guidance documentation not being up to date, and it was only through using CI tools and techniques that we could really look into and address all of the problems we encountered. At first we were very protective over our flows and as anybody would be, slightly defensive about someone coming in and seemingly 'criticising' the way we worked, but it didn't take long for us all to be converted and appreciate that these tools and the empowerment to take control of our own flows and processes would allow us to change them to how we wanted them to be, to maximise efficiency, work towards eliminating waste and adding value to our end product.

Main issues identified/tools used

To identify issues within our workflows we used two main tools. The first of these was the Value Stream Map, or VSM. A Value Stream Map is a visual representation of the actions required to bring a product through the main flow, with the opportunity to add issues associated with each process of the main flow to the map. Below is a basic everyday example of a VSM, which outlines the processes involved in making a bacon and egg sandwich in a café.

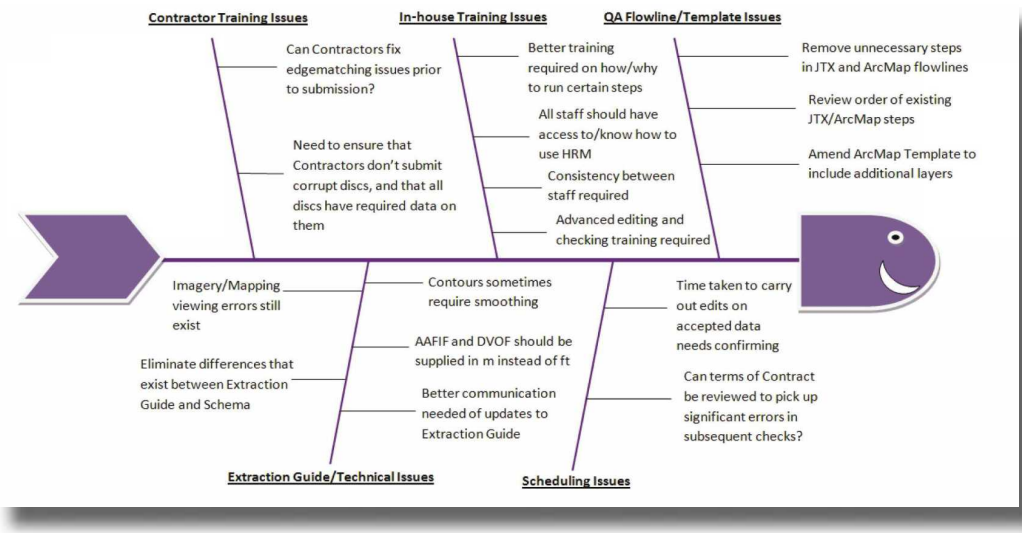
A VSM allows you to look at the bigger picture, not just an individual process, and allows you to improve the whole rather than optimising individual parts. It also helps identify sources of waste in the flow such as a build up of inventory or time delays between processes, and provides a common language for talking about workplace practices.



Flowline processes are mapped out in rectangular boxes left to right across the middle of the VSM. Process direction arrows are then added to connect processes, and solid arrows to connect inputs and outputs to/from factories. The factories at either end of the flow detail the start and end processes/ states of the flow, whilst the cylindrical shapes above the flow show any additional sources that have an interaction with or influence on various processes within the VSM. In the top right corner of each process box there is a circle symbol with a number next to it, which represents the number of resources required to carry out that process. Underneath the flowline a timeline is inserted, where times above the line represent the minimum to maximum times spent on that process, and below the timeline the times spent in between each process. At the bottom of the page 'Key Requirement' boxes are inserted in line with each process box, which list all of the necessary tasks or requirements for that step. Current issues are then added to the VSM in the form of red starbursts.

The second tool used was Fishbone Diagrams. These provided us with a way of grouping themes of issues together, as identified in the VSM exercise, and allowed us to start thinking about how we would resolve them and who would be responsible for each issue. Below is an example of our QA fishbone diagram.

The main types of issues we identified within CGIS included training issues, both in-house and with our external contractors. Many of these were due to guidance documents not being up to date to reflect updates to the software, and any updates to documentation not being effectively advertised. Another theme of issues was 'Communication', which included internal communication within our



own section and with other sections, and external communication with our Contractors and partner nations. A further theme was 'Flowline and Guidance' issues, which included documentation and flowlines not being up to date, and ambiguities in our Extraction Guide that needed clarification with our Support section. These, amongst others, were then added to a document of our own creation, the 'Action Plan'.

How issues were resolved

Each individual issue was added to our Action Plan, with columns listing the reason it was an issue, the owner(s) who would oversee that action to ensure a resolution was sought, the person/department that would resolve the action, dates the action was started and completed (with required by dates to make sure that an issue was not just left indefinitely), and a comments box to explain methods of resolving the action. The actions were shared out amongst the CGIS team members who would oversee the resolution of that action, even if they could not fix it themselves, and any that required a higher level of authority were passed up the management chain for resolution. It is largely due to the Senior Management buy-in and awareness across the DGC that we have been able to implement CI so effectively.

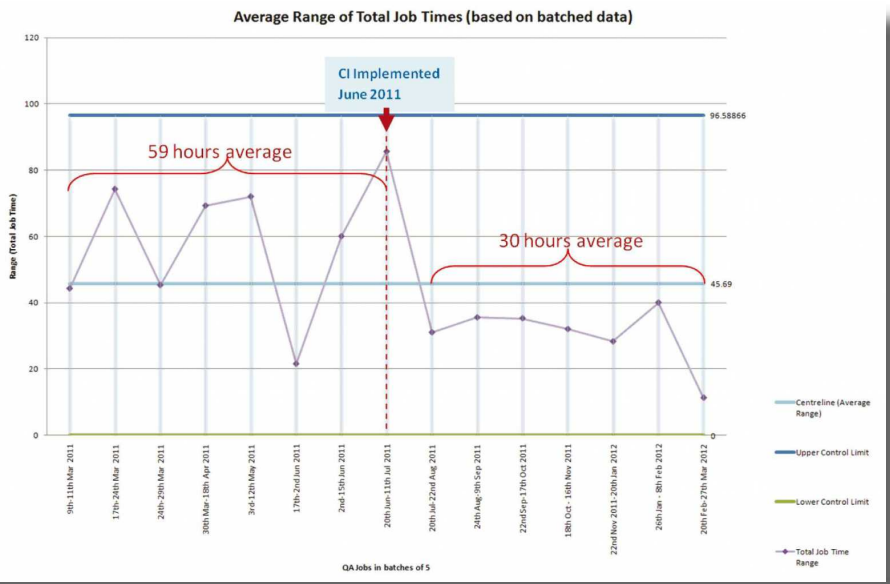
As well as the Action Plan a number of other documents were created to aid our Continuous Improvement. We set up a spreadsheet to record any technical issues or issues with our guidance documentation, which would then be visible to our Support section. They also had the opportunity to add their comments to this document, explaining either how a problem could be fixed, or reasons why it couldn't be. This allowed all issues to be documented with resolutions or restrictions recorded so that if the same issue arose in the future time would not be wasted duplicating effort.

We also set up spreadsheets for recording metrics for job times for all three flowlines, so that we could start to monitor whether the changes we were implementing were having a positive effect on the workflow. This was done by plotting the job times on various charts and running through statistical tests (known as Six Sigma) to find out whether job times were significantly improving and whether our processes were stable and consistent. All of these documents are live documents, and we are continuing to monitor and add to them on a regular basis.

Improvements achieved

The QA (first flow) and Conmerge (second) flows have shown large-scale improvements. In QA, up until June 2011 the overall turnaround time for a job (from when a cell is first received from one of our Contractors to when it is accepted into our database) was at a maximum of 60 days. From July 2011 onwards when changes started to be made to our flows, this maximum turnaround time reduced to 35 days by October 2011, and is currently at an average of 32 days. Carrying out statistical tests on the total QA job times, it was found that the average range of total job times (based on batching data into groups of 5) has significantly reduced since the implementation of CI, as shown in the diagram below.

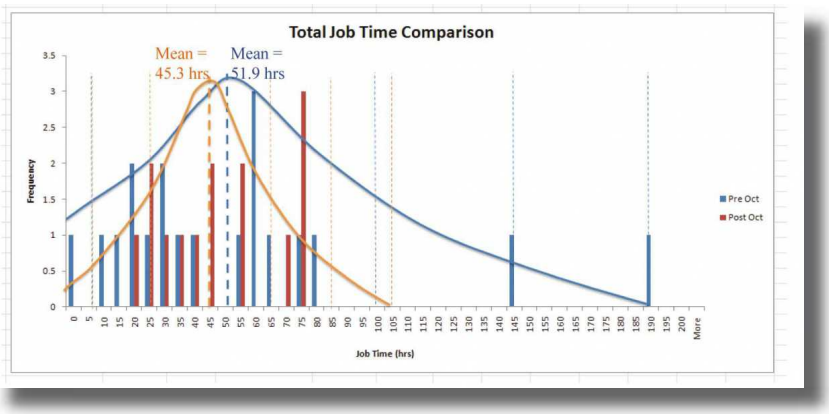
In Conmerge days have been knocked off the overall job times. This is due to a number of changes, but largely the removal of one of our validation steps that is duplicated later on, and the simplification of how we submit data to our internal database. Previously data had to be burned to



Average range of total job times has significantly reduced since the implementation of CI in June 2011. It now hovers around an approximate average of 30 hours, compared to an average of 59 hours prior to June 2011.

disc to be transferred to our internal database, now it can be transferred electronically, which sheds a number of days off the overall job time.

Our IGW flow (the third and final part of the overall workflow) has also become much more stable and consistent, and therefore more predictable. So far we have found significant improvements, which has shown that since October 2011 when serious changes started to be implemented, the average overall job time (from when it is first picked up after Conmerge (the second flow) to when it gets accepted into the IGW) has reduced by 26%, and the average range of job times has reduced by 82%. These were calculated by batching data together and running through a number of statistical tests. This means that the average job time is much lower than it was prior to October 2011, and the amount of variation between jobs is significantly less. This can also been seen in the histogram below, which shows the total job time for pre and post October. The blue curve and dotted vertical lines represent the distribution of data pre October based on the Mean and SD, whilst the orange curve and dotted vertical lines represent the distribution of data post October based on the Mean and SD. Pre October the mean was 51.9 hours and post October reduced to 45.3 hours. The maximum range reduced from 190.5 hours pre October to 104.8 hours post October. (N.B. the means vary slightly in this histogram compared to those used to calculate the 26% and 82% reductions due to being based on all results, rather than batches of data as with the statistical tests. When batching the data together the mean pre October 2011 was 63.8 hours, and reduced to 47.1 hours. The average range of the data reduced from 98.5 hours pre October to 17.7 hours post October. Batching the data together produces a more accurate result as it reduces the effect of outliers).



Improvements were achieved through factors such as better construction of process flows (rearranging steps or removing those that were no longer necessary), improving communication with our Contractors to improve data at the source, and removing time delays through transportation of data.

CI – DGC next steps

After implementing CI in our CGIS section for the past 8 months or so, we are now in a good position to assist other sections in applying CI to their flowlines and processes. A number of our team have been involved in presenting our results to senior management on a number of occasions through presentations and demos, and they have stated that they are very pleased with the progress made so far.

Two of our DGC staff, Lorna Pope and Vicky Stuart, have carried out a Greenbelt qualification in Six Sigma in partnership with the Ordnance Survey (OS). This covers a large quantity of statistical tools that can be used to analyse metrics to find out whether change is actually occurring, and the Capability of a process, i.e. the ability of a process to produce the required output, within an Upper and Lower specification limit. These limits are based on the amount of variation within a process, which can occur as 'common cause' or 'special cause' variation. Now qualified, Lorna and Vicky are on hand to aid all DGC sections in demonstrating that all savings and improvements made are statistically correct.

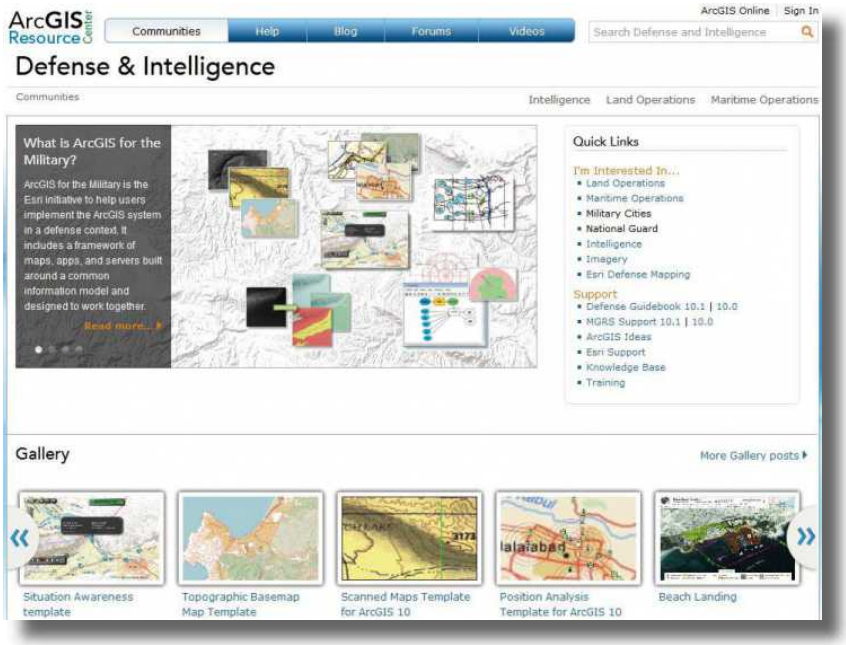
Lorna and Vicky have also developed a CI training package, which has so far rolled out to several other sections at the DGC. This has been well received, and those sections are now working on their own Value Stream Maps and Action Plans, with major issues being brought to the attention of senior management. We will therefore be rolling the course out to other departments across the DGC on a monthly basis, training a number of other 'experts' along the way.

Our rapport with the Ordnance Survey remains high, and they have offered their assistance in any CI queries we may have. Recently twelve of our staff at the DGC went down to visit the OS and see CI in practice at their workplace. This CI process has proven beneficial to both the DGC and the OS, in the way training has been delivered and the results achieved so far.

ESRI Launches New Defence Community Resource

Geospatial Information Systems (GIS) software specialists Esri have recently launched a new online resource, designed to provide fast and easy access to a wealth of GIS content, templates and advice on best practice for the Defence community.

Doing what it says on the tin, the *ArcGIS Resource Center* is a free online portal where visitors can find a wealth of maps and applications, blog posts, forum threads, videos, documentation and tweets from across the Defence community. Visitors can also access content from other sectors and see how others are tackling specific challenges. You can also use the Defence and Intelligence Discussion forum to communicate with other community members, and with the teams within Esri that support the ArcGIS suite of products.



A key feature of the new portal is the Template gallery. This contains a fast-growing range of web templates or apps, freely downloadable for use by ArcGIS 10.0 users. Some have been created by Esri and follow current US Military Fieldcraft doctrine; others have been created and uploaded from within the Defence community to cover a wide range of common tasks. Current templates include:

- Vehicle Checkpoint Planner
- HLS Suitability
- Route Analysis
- Beach Landing
- Patrol Data Capture
- Situation Awareness
- Position Analysis

Visitors can also search the template library by key words, for example entering the words Social Media brings up a range of discussion and materials on the subject, including an app that uses ArcGIS Online basemaps combined with custom hooks into Social media streams, such as YouTube, Twitter, and Flickr.

In each case, the templates come with usage instructions and are easily configurable, enabling the basemaps, symbology etc to be changed where necessary to meet specific requirements.

The ArcGIS Resource Center will be constantly updated so well worth visiting on a regular basis and your comments and suggestions are always welcome. If you have external access to the internet, please visit http://resources.arcgis.com/en/communities/defense-and-intelligence. Alternatively, please contact Esri UK's Daran Scarlett at dscarlett@esriuk.com who can arrange a run through at Esri's Aylesbury HQ.

Beach Landing template from the ArcGIS resource Center.

Social media feed mapping application.

‘Geological’ Maps for The British Army: Innovations from World War One

By Colonel (Ret’d) Ted Rose FInstRE.

The modern British Army may make operational use of geologists in a variety of ways. One is by the compilation of specialist geotechnical maps to help guide military planning. Such maps for recent operations are generally not yet in the public domain, but the principles were established during the First World War and developed in the Second. Long clouded in secrecy, details of that process are now being progressively revealed, especially in recent publications of the Geological and the British Cartographic Societies.

Some military applications of geology have been apparent for over 200 years. Napoleon Bonaparte was the first general to take geologists as such on a military operation (the French invasion of Egypt in 1798), the future British Geological Survey was founded in 1835 and financed until 1845 under military (Board of Ordnance) auspices, and geology was taught intermittently during the 19th century at all army officer-training institutions in the UK. However, not until World War I were geologists deployed as such to serve on a battlefield: the Western Front.

Geology and the Western Front

For most of the 1914-18 War, the Western Front extended from the North Sea coast south across Belgium and northern France to the frontier of Switzerland: some 740 km. A British Expeditionary Force (BEF) deployed to its northern sector from August 1914. Its front line position fluctuated with the ebb and flow of battle, but once the Front had largely stabilized into a zone of trench warfare in late 1914, the BEF held the ground approximately from Nieuport on the Belgian coast south to Amiens in France *(Fig. 1)*, a distance of about 130 km.

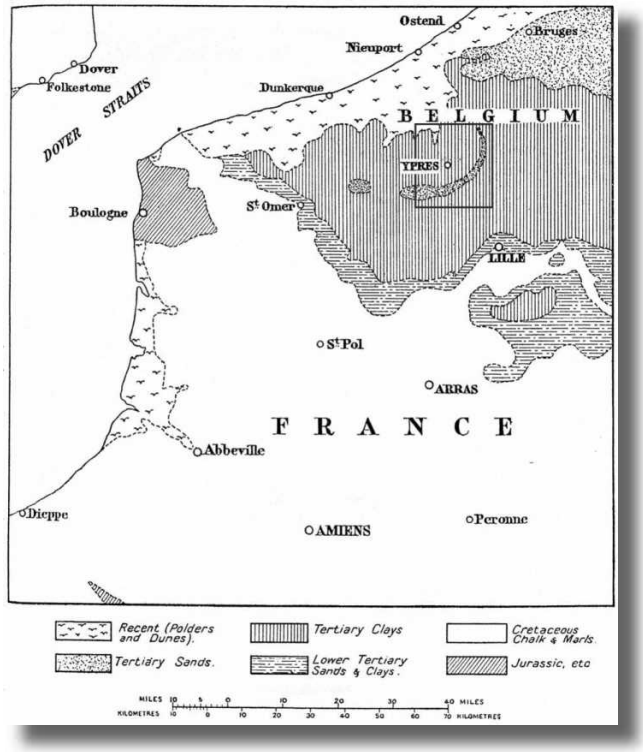


Fig 1.

Geologically, the BEF occupied land of three terrains:

(1) a coastal zone of contemporary sand dunes, and Quaternary sediments reclaimed (as ‘polders’) from the sea;

(2) the Flanders Plain, mostly underlain by a bedrock sequence of alternating (mostly Lower Eocene) mudrocks and weakly cemented sandstones (similar to the London and Hampshire Basins in England); and

(3) the plateaux of Picardy and Artois, underlain by bedrock of Upper Cretaceous Chalk (similar also to that of southern England).

The scale and intensity of largely static warfare on the Western Front stimulated development of many technical innovations. The German Army was quicker than the British Army to make use of geological expertise, from 1914. By 1916 it had developed a military geological organization as such, with 29 teams of geologists, one for each section of the ‘military mapping and survey’ service as then constituted. The British Army made slower use of geologists, as two particular problems became evident.

Water supply

The BEF expanded progressively from one to five armies. At its peak in 1916 it comprised some 1.5 million men and 0.5 million horses/mules (mostly animals to transport stores forward from the railheads rather than to provide mounts for cavalry). As numbers of men and animals increased, water supply became a problem. Each man/animal was calculated to require 10 gallons (45 litres) of water per day to meet all requirements. However, near the front line both surface and ground

Fig 2.

waters were vulnerable to pollution by munitions, ordure and dead men/animals, and pipelines to damage. Water from civilian wells was usually insufficient to support the high concentration of troops.

The problem was solved by innovations that included the operational deployment of mobile rigs, bought from the USA, to drill deep boreholes; deployment of air lift pumps, to raise water quickly and in quantity from these depths; formation of Well Boring Sections in the Royal Engineers (one per army) to operate the new drilling equipment; and appointment of a geologist to serve as a staff officer at BEF General Headquarters, to guide drilling for potable water: Lieutenant (later Captain) W. B. R. King *(Fig. 2)*.

Born in Yorkshire in 1889, 'Bill' King had graduated from the University of Cambridge with 1st class honours in geology in 1912, and joined the Geological Survey of Great Britain. On the outbreak of war he was undertaking fieldwork in Wales, but volunteered for service as an infantry officer in the Territorial Army. He was commissioned as a 2nd Lieutenant in the Royal Welsh Fusiliers in September 1914. When the Survey's Director (Aubrey Strahan) was asked by the BEF engineers to nominate a geologist to provide 'expert' advice on water supply, King was thus an obvious choice: young, physically fit, enthusiastic, and of proven geological ability. In April 1915 he was appointed to the War Office in London, to assist and be trained by Strahan in war-related hydrogeological work, before joining the staff of the BEF Chief Engineer (later re-titled Engineer-in-Chief) in France. He served with the BEF from June 1915 until hostilities ended, in November 1918. His role during this time was (where feasible) to supervise and direct the drilling of boreholes to supply drinking water to British forces, and to develop specialist water supply maps to be used by military planning staffs, or by water supply engineers in the many cases where it was impracticable for him to be present in person.

King compiled maps that included:

- From 1915, a set of 14 water supply maps at 1:100,000 for the whole of Belgium and the enemy-occupied territory of northern France, plotting all the information about existing civilian water supplies that could be gleaned from a variety of sources, including geological maps published before the war *(Fig. 3)*.
- In May 1916, a map at 1:250,000 for Belgium and northern France showing the relative abundance of water in the summer months: quality indicated by colour type (blue = good, purple = fair, red = poor), quantity by colour intensity (dark = abundant, medium = moderate, light = scarce) *(Fig. 4)*.
- In 1918, another map at 1:250,000 for Belgium and northern France showing the region divided into 15 areas according to the probable sources of water supply and the type of engineering plant required *(Fig. 5)*.
- Also in 1918 and at 1:250,000, a map for the Somme region of France (the southern region contested by the BEF, underlain mostly by Cretaceous Chalk, in which most British military boreholes were emplaced), showing contours of the surface of a marl horizon relatively impermeable to water as well as topographical contours – since to get a good yield from boreholes in this region, it was calculated that the bore should penetrate not less than 15 m of water-bearing Chalk. Potential drilling depths could be calculated from the map *(Fig. 6)*.

King guided emplacement of at least 470 British military boreholes during the war. Some of his maps (particularly at 1:40,000) assisted development of a water supply infrastructure within areas already occupied by the British armies. Other maps, such as those illustrated here, assisted planning and procurement of equipment for advance into new areas, e.g. that by the British Third Army, when between 21 August and 11 November 1918 some 300,000 men and 100,000 horses/mules crossed a zone about 20-25 km deep with almost no surface water to sustain them.

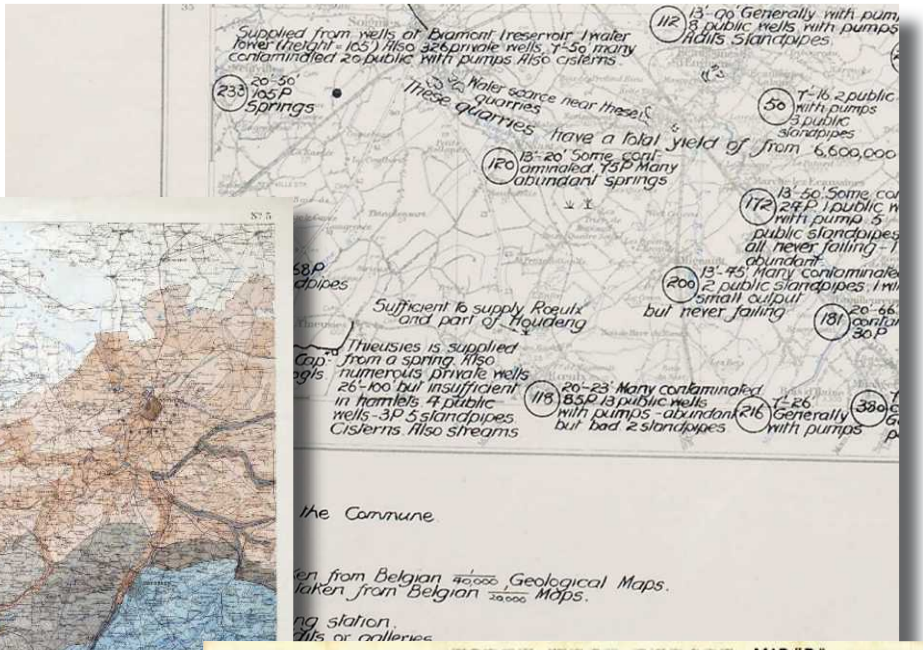


Fig 4.

Fig 5.

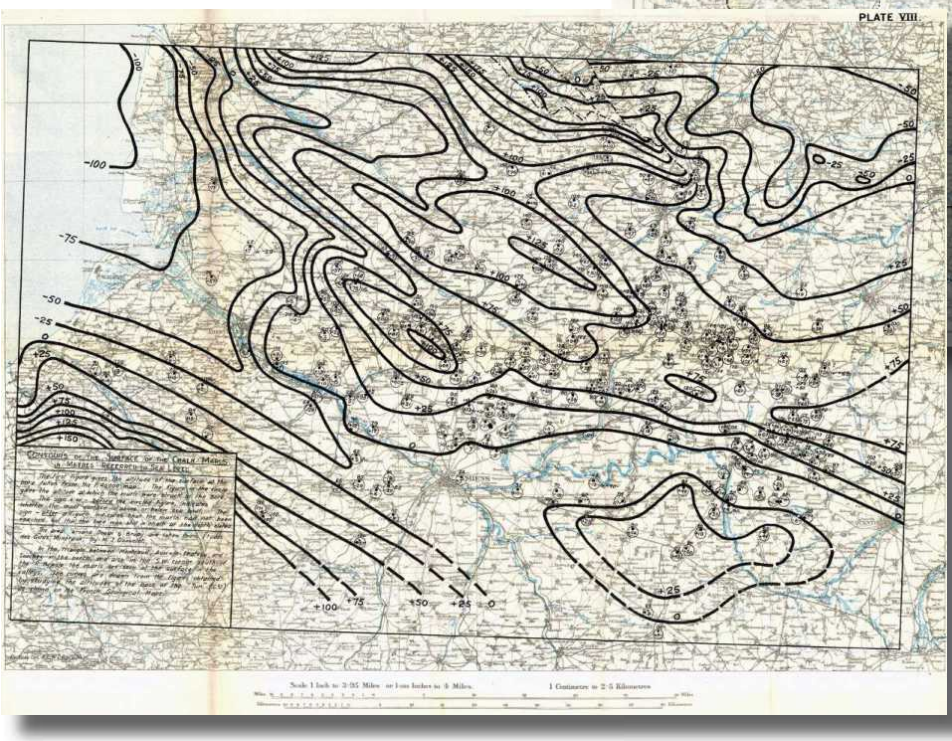


Fig 6.

Excavation of mine tunnels and bombardment-protective dug-outs

By 1915 the opposing forces were massively entrenched and the front line was increasingly fortified. Mining was therefore developed by both sides on an unprecedented scale as a means of breaching the fortifications. Tunnels were driven forward beneath enemy positions, charged with explosives, and detonated prior to infantry attack – thus effecting optimum surprise. In the British sector, such mine and countermine warfare reached a peak in 1916. The BEF raised nine Royal Engineers tunnelling companies in 1915, expanding these to a total of 25 plus three companies from Canada, three from Australia, and one from New Zealand, by the end of June 1916. The BEF thus had about 25,000 British and Commonwealth troops actively engaged in military mining. This phase of the war culminated in the Battle of Messines: an attack on German troops occupying the southern part of the Wytschaete-Passchendaele Ridge *(Fig. 7)*, to the SE of the town of Ypres (known as Ieper in Flemish). The attack was planned for the summer of 1916 but postponed to 7 June 1917. Near simultaneous discharge of 19 mines, whose tunnels in total contained nearly 450,000 kg of high explosive, across a front of 16 km, prior to massed infantry assault, ranks as the greatest and most successful operation ever carried out in mine warfare.

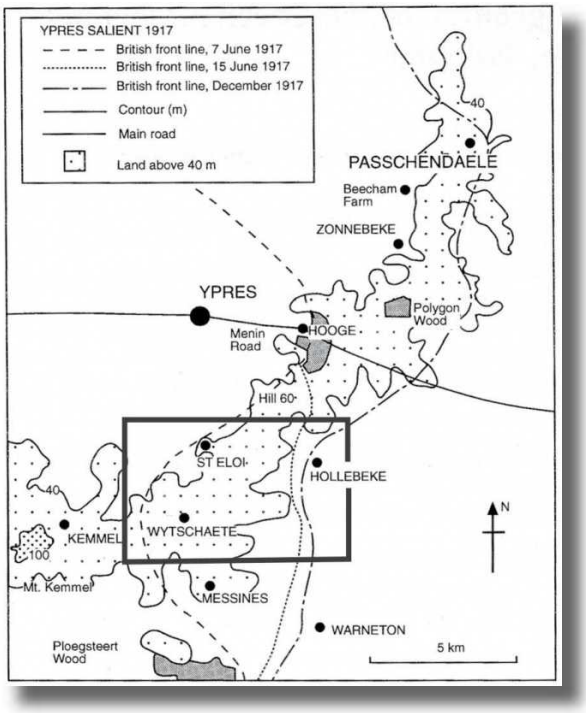


Fig 7.

Thereafter, mining activity gradually declined. Mining was effective only against a strongly held front line, and by the close of 1917 the front was held more by artillery firepower than infantry manpower. As mining declined, so BEF tunnelling companies were increasingly diverted to the construction of dug-outs, to shelter troops from artillery bombardment. To guide excavation, between September 1917 and June 1918 a series of twelve specialist geological maps *(e.g. Fig. 8)* was compiled and widely distributed to troops of the British Second and Fifth Armies. In total, these maps covered the whole of the Wytschaete-Passchendaele Ridge and adjacent areas, an area of

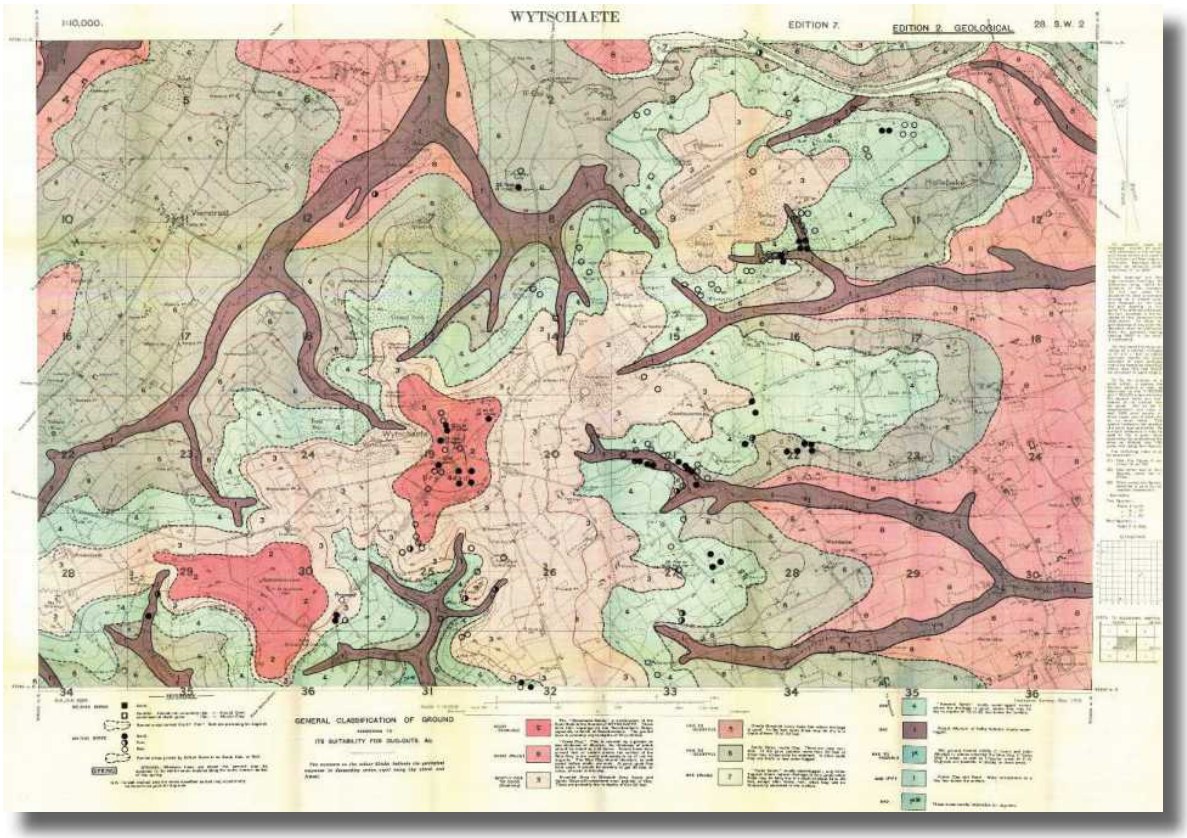


Fig 8.

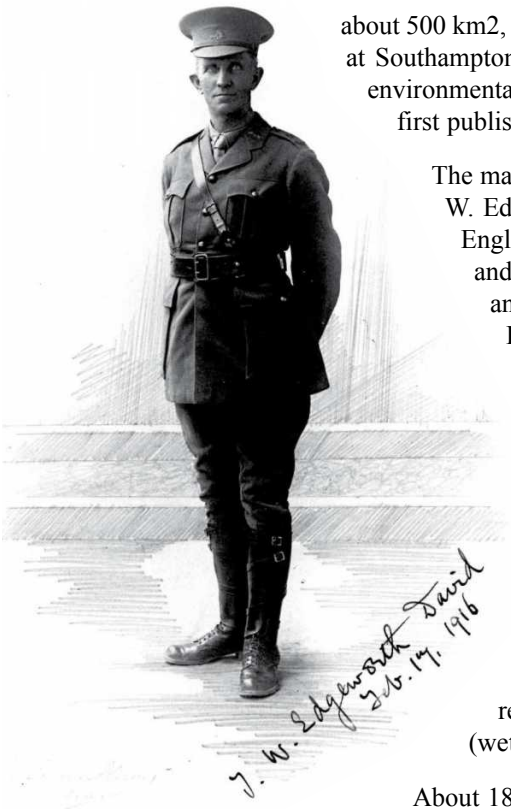


Fig 9.

about 500 km2, at a scale of 1:10,000. Printed in England by the Ordnance Survey at Southampton, they were the first series of relatively large-scale engineering-environmental geology maps to be published for British use, and arguably the first published large-scale engineering geology map series per se.

The maps were primarily the work of Major (later Lieutenant-Colonel) T. W. Edgeworth David *(Fig. 9)*. Born in Wales in 1858 and educated in England at the University of Oxford, David had emigrated to Australia and achieved considerable academic distinction. Professor of Geology and Geography at the University of Sydney, he arrived at the Western Front in May 1916 with the Australian Mining 'Battalion' he had helped to raise: a white-haired grandfather 58 years of age.

Initially David served as the geological adviser to guide BEF mining operations, but generated the new maps when military priorities changed. Using data transcribed from Belgian geological maps published before the war, which distinguished rock units according to their inferred geological (i.e. chronostratigraphic) age, and data from c. 1,000 British and Belgian boreholes, he compiled maps that classified the ground strictly according to its suitability for dug-out construction. Lithostratigraphical units were coloured primarily in shades of red to indicate relatively 'good' (dry) strata, contrasted with 'bad' (wet) units coloured in shades of blue-green.

About 180 British dug-outs were constructed in the Ypres region, of many types but typically with some 6 m of cover to be proof against heavy howitzer or mortar fire. Geology proved to be a significant influence on the depth of their construction along the whole of the Wytschaete-Passchendaele Ridge.

Legacy of WWI Geotechnical Maps

At the end of hostilities, Edgeworth David returned to Australia. He died in 1934 and was accorded a state funeral in recognition of his many accomplishments: a rare (perhaps unique?) honour for a geologist. Bill King returned to employment by the Geological Survey in the UK, before appointment in 1920 to a teaching post at the University of Cambridge, and in 1931 promotion as Professor of Geology at University College in the University of London.

King rejoined the British Army at the start of World War II, in September 1939. After distinguished service once more in France, he was evacuated with the new British Expeditionary Force via Dunkirk in 1940. Back in the UK, he was later to generate new types of geotechnical maps for military use. As the Staff Officer (Geologist) at 21st Army Group headquarters, helping to plan for the Allied liberation of Normandy, he influenced the decision not to invade via the Cotentin (Cherbourg) Peninsula but through the Calvados region, since the geological conditions there were more favourable for the rapid construction of temporary airfields deemed necessary to provide aerial superiority over the bridgehead. A simplified map compiled in mid 1943 *(Figs 10, 11)*,

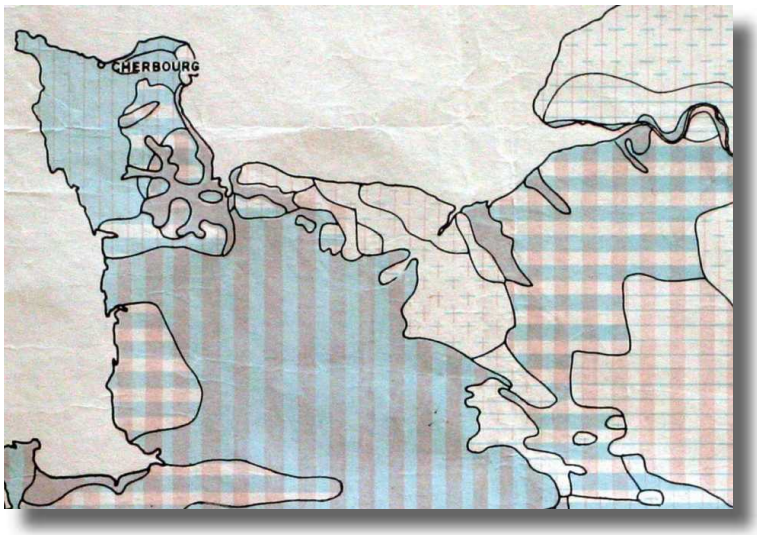


Fig 10.

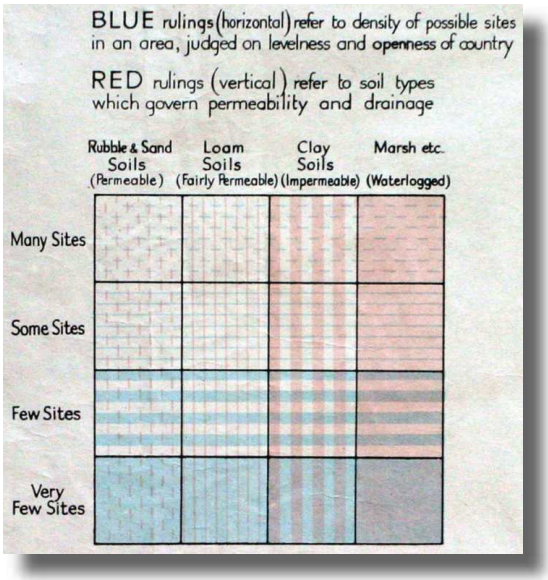


Fig 11.

using essentially the red/blue and colour intensity contrasts pioneered in water supply and dug-out suitability maps of World War I, made the distinction clear.

King was released from the Army (as a Lieutenant-Colonel) in October 1943 to become Woodwardian Professor of Geology at the University of Cambridge. By then he had guided foundation of the Geological Section of the Inter-Service Topographical Department: an 'intelligence' unit that was to generate numerous geotechnical maps and reports during the rest of the war. Also, he had groomed one of his pre-war undergraduate students at Cambridge, F. W. Shotton, to be his successor at 21st Army Group HQ. There Shotton compiled a wide range of specialist maps (notably for beach trafficability, suitability for rapid construction of airfields, and groundwater prospects). Even after release to Cambridge, King helped to compile a series of groundwater prospect maps that assisted the Allied campaign eastwards across northern France and the Low Countries to victory in Germany. Post war, he became (part-time) the geological adviser to the UK War Department (later Ministry of Defence), and helped to create a small pool of geologist reservist officers to maintain geological expertise for the British Army. King died in 1963, but the successors of his 'pool' still exist - in the TA component of 170 (Infrastructure Support) Engineer Group RE.

King's World War I experience generated an enduring legacy. He recognized that as a geologist advising non-geologists tasked with decisions involving the best use of ground, his advice had to be clearly relevant to the specific problem in hand (e.g. sites for boreholes to abstract potable groundwater, excavations for dug-outs, or rapid construction of temporary airfields); that it made more impact to communicate initially with simplified illustrations (e.g. maps) than technical words; and that in the military context at least, non-geologists seeking advice were interested fundamentally in just two concepts: 'go' and 'no-go'. It might be necessary to introduce a third (intermediate) category of 'slow-go', but anything more complex was likely to lose impact. These principles still apply.

Acknowledgement

This article is a revised version of that published in Geoscientist: the Fellowship Magazine of the Geological Society of London (volume 22, number 3) in April 2012, under the heading 'Officers with maps' (see www.geolsoc.org.uk/geoscientist for online version), and is re-published with the Society's kind permission.

Further reading

1 Robins, N.S., Rose, E.P.F. & Clatworthy, J.C. (2007): Water supply maps for northern France created by British military geologists during World War II: precursors of modern groundwater development potential maps. Quarterly Journal of Engineering Geology and Hydrogeology, 40, 47-65.

2 Rose, E.P.F. (2009a): Water supply maps for the Western Front (Belgium and northern France) developed by British, German and American military geologists during World War I: pioneering studies in hydrogeology from trench warfare. The Cartographic Journal, 46, 76-103.

3 Rose, E.P.F. (2009b): Military men: Napoleonic warfare and early members of the Geological Society. In: Lewis, C.L.E. & Knell, S.J. (eds) The making of the Geological Society of London. Geological Society, London, Special Publications, 317, 219-241.

4 Rose, E.P.F. & Clatworthy, J.C. (2007): Specialist maps of the Geological Section, Inter-Service Topographical Department: aids to British military planning during World War II. The Cartographic Journal, 44, 13-43.

5 Rose, E.P.F. & Clatworthy, J.C. (2008a): Fred Shotton: a 'hero' of military applications of geology during World War II. Quarterly Journal of Engineering Geology and Hydrogeology, 41, 171-188.

6 Rose, E.P.F. & Clatworthy, J.C. (2008b): Terrain evaluation for Allied military operations in Europe and the Far East during World War II: 'secret' British reports and specialist maps generated by the Geological Section, Inter-Service Topographical Department. Quarterly Journal of Engineering Geology and Hydrogeology, 41, 237-256.

7 Rose, E.P.F. & Mather, J.D. (eds) (2012): Military aspects of hydrogeology. Geological Society, London, Special Publications, 362, viii + 374 pp.

8 Rose, E.P.F. & Rosenbaum, M.S. (1993): British military geologists: the formative years to the end of the First World War. Proceedings of the Geologists' Association, 104, 41-49.

9 Rose, E.P.F. & Rosenbaum, M.S. (2011): British geological maps that guided excavation of military dug-outs in Belgium during World War I. Quarterly Journal of Engineering Geology and Hydrogeology, 44, 293-306.

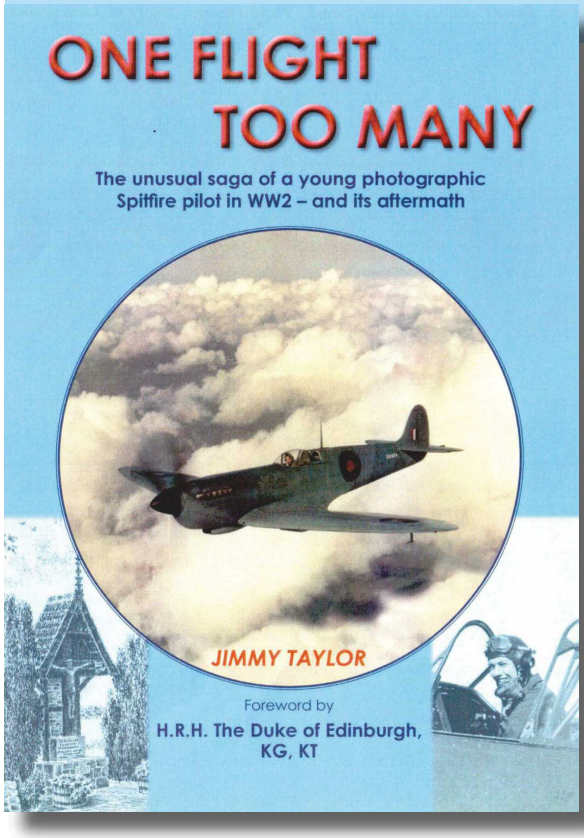
10 Rose, E.P.F., Clatworthy, J.C. & Nathanail, C.P. (2006): Specialist maps prepared by British military geologists for the D-Day landings and operations in Normandy, 1944. The Cartographic Journal, 43, 117-143.

11 Rose, E.P.F., Clatworthy, J.C. & Robins, N.S. (2010): Water supply maps for North-west Europe developed by British military geologists during World War II: innovative mapping for mobile warfare. The Cartographic Journal, 47, 55-91.

Sketch from 'The Guns of 6 A.G.R.A.'

The Editor would welcome input from any Ranger reader who can offer any background information about this sketch.

Book Review



Photographic Reconnaissance (PR) has recently caught public interest and this book, written by a former PR Spitfire pilot, gives a very clear description of what he had to do, the aircraft and cameras he was given, how he planned and took his photographs, and how he navigated his way, alone and unarmed under constant observation by enemy radar, to his distant targets in Occupied Europe and Germany, often in difficult weather conditions, and returned safely with the films containing information of vital importance to the photo-interpreters at RAF Medmenham and to the Allied commanders.

This is also Jimmy Taylor's autobiography, so the reader has access to his frank contemporary diary of autumn 1944 and goes with him on his exciting sorties, including when he was chased by a then-unknown German jet, and his last one, when his engine blew-up and forced him to parachute into a part of eastern Holland and led to his eventual capture. It also set in train a heart-rending German atrocity, which still calls him back every year to the families of the victims. It led to his meeting many historians, both Dutch and English, and so to his discovering the remarkable activities of his 16 Squadron during Operation 'Market Garden', the experiences, both cheerful and tragic, of his friends and colleagues in the RAF, and the heroic behaviour of the Dutch Resistance.

Jimmy Taylor's progress through his training in Britain and America, his wartime flying and treatment as a prisoner, his post-war career and subsequent involvement with gliding, with his wartime colleagues and their later successors flying modern aircraft, and with the media, is told with humour and modesty and makes for fascinating reading, and is enhanced with hundreds of photographs taken at the time, including some of his own sorties.

This is a great book in every sense: it will enlighten readers who are curious about the work of the PR squadrons and will fascinate aviation enthusiasts of all ages. It has appeared at the right moment and may well become a classic.

ISBN: 978-0-957221000

Specification

756 pages

Over 700 images

Hardback 297 x 210mm

Price £27.50

Putting South Georgia on the Map

A review by Ron Birch

Introduction

The recent publication of a 216 page book by the Australian geologist Alec Trendall covering the main surveys of the remote island of South Georgia should be of great interest to those who served on the island with 512 Specialist Team. However it is the wider community of military and past military surveyors to whom the book should be of real value.

The book describes in detail the hardships experienced by the survey team throughout the three expeditions—manhauling sledges, back packing, mountaineering and camping in primitive tenting for weeks on end, with virtually no radio communication. In fact their travelling techniques to reach peaks necessary as survey stations had barely changed from the heroic age of Antarctic exploration

The Island

The sub-Antarctic island of South Georgia lies some 2000miles due east of Cape Horn. It forms a gentle arc of 170 kilometres in length and some 40 kilometres wide with an icy mountain spine rising out of the Southern Ocean to 3000metres like a misplaced section of the Alps. It is a place of wild beauty and capricious inhospitable weather with all year round snow covering the mountainous interior.

The first journey across the interior was made, famously and involuntarily, by Sir Ernest Shackleton to bring help to other members of his ill-fated Trans-Antarctic Expedition in May 1916. His only mapping aid being that made by Filchner in 1911, barely sufficient for him to identify his direction and distance he needed to cover on his epic march towards an occupied whaling station.

A brief article appearing in 'The Times' captured the relationship between that explorer and the island, which witnessed both his salvation and his demise.

"South Georgia will always be remembered as journey's end for a great British polar explorer, Sir Earnest Shackleton, and that alone is enough to assure it a place in history. His grave lies adjacent to Gritviken whaling station whilst a Cairn and Cross, a memorial tribute set up by his former comrades, stands proudly on the tip of Hope Point at the mouth of the cove.

Objective

The primary objective of the exercise was to map the entire island of South Georgia, which to all intents and purposes had to be treated as unsurveyed. Prior to this only maps of a small part of the island and coastal waters existed, the interior was largely unknown. As no systematic records of earlier mapping attempts existed the new mapping had to commence from fundamental survey principles.

Personnel

In preparation for the expedition, the leader Duncan Carse decided that two surveyors would be needed for the task. To this aim Carse visited the School (now Royal) of Military Survey in the hope of securing the services of Tony Bomford, a senior survey instructor, to join his party. However, instead, a national service student, John Heany, volunteered and having undergone 18 months instruction under Tony was accepted alongside another national service surveyor Gordon Smilie. (Tony Bomford was later to figure as Survey leader of the 1955-56 survey).

Military Survey thus provided the expertise required to carry out the daunting task of mapping a complete country from 'scratch'.

Survey Expeditions

The first survey took place during 1951-1952 and certainly achieved a great deal but in hind sight the idea of mapping what was basically an unknown island in its entirety was over ambitious. For instance, to establish the initial accurately measured base line on which to construct a triangulation system took over one week. It must be appreciated that unlike modern techniques using distance measuring and global technology the only method available was by steel tape; finding a suitable level straight amongst snow covered ridges for a base line was a major task itself. However an accuracy of within two millimetres was obtained from a number of measures. Further surveys would now be required to complete the task and these took place during 1952-53, 1953-54 and again in 1955-56. It would be impractical to delve into great detail of the survey expeditions, even perhaps a breach of copyright, but without any doubt, through the endeavours and skill of the survey parties, the primary objective to map the island of South Georgia was accomplished.

Achievement

The first accurate map of the whole island was undoubtedly the prime achievement of the three South Georgia surveys. The coloured map (DOS 610) at a scale of 1:200,000 was published in 1958 and remained the definitive map of the island for forty-six years. Indeed it was the map used by the British and Argentinean forces during the Falklands war in 1982. The accuracy of the map was controlled by 88 trig stations, 8 base lines, 18 sun azimuths and 7 position line astro fixes.

Acknowledgements

Included in the acknowledgements printed on the face of the map were the names of A.G. Bomford, G. Smilie and J.B.Heaney, all of which had served with Military Survey.

Reference is also made of P. F. Fagan who retraced Shackleton's crossing circa 2003. Readers will know that he later achieved the rank and position of Major General, Director General Military Survey.

Surely accolade for the achievements of these gentlemen within our circles is long overdue.

The Book

The large format (A4) 216 page book describes the survey expeditions to South Georgia led by Duncan Carse in the 1950s resulting in 1958 of the first accurately surveyed map of the island. It contains no less than 98 photographs and eight maps depicted the various stages and routes of the surveys.

Unfortunately the book is only available from the author in Australia so postage is an added premium to the publication's price. Potential purchasers should be advised that sea mail can take over 4 months from order to receipt so airmail is the only sensible (but expensive) option.

The price:- Australian $Aus 40 plus $Aus20 (if airmail requested) equivalent to £25 plus £12.50 postage.

When one considers this an epic story and reference system combined it becomes essential reading for anyone interested not only surveying but also surviving in Antarctic conditions this is value for money.

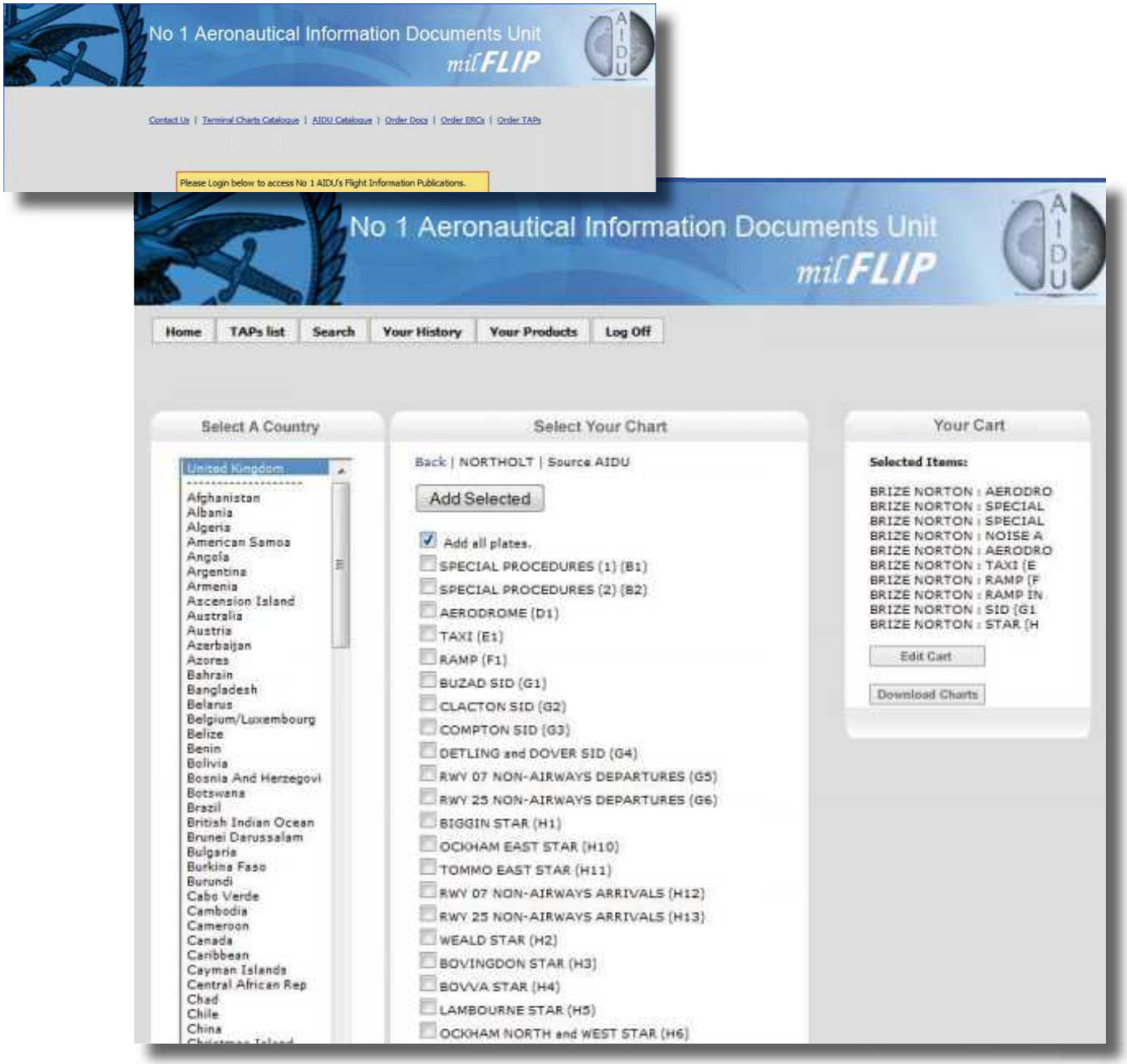
For payment details go to http//www.alectrendall.com.au or better to contact the author direct at info@alectrendall.com.au who will always reply promptly.

Future Options for Web-Based Flight Planning

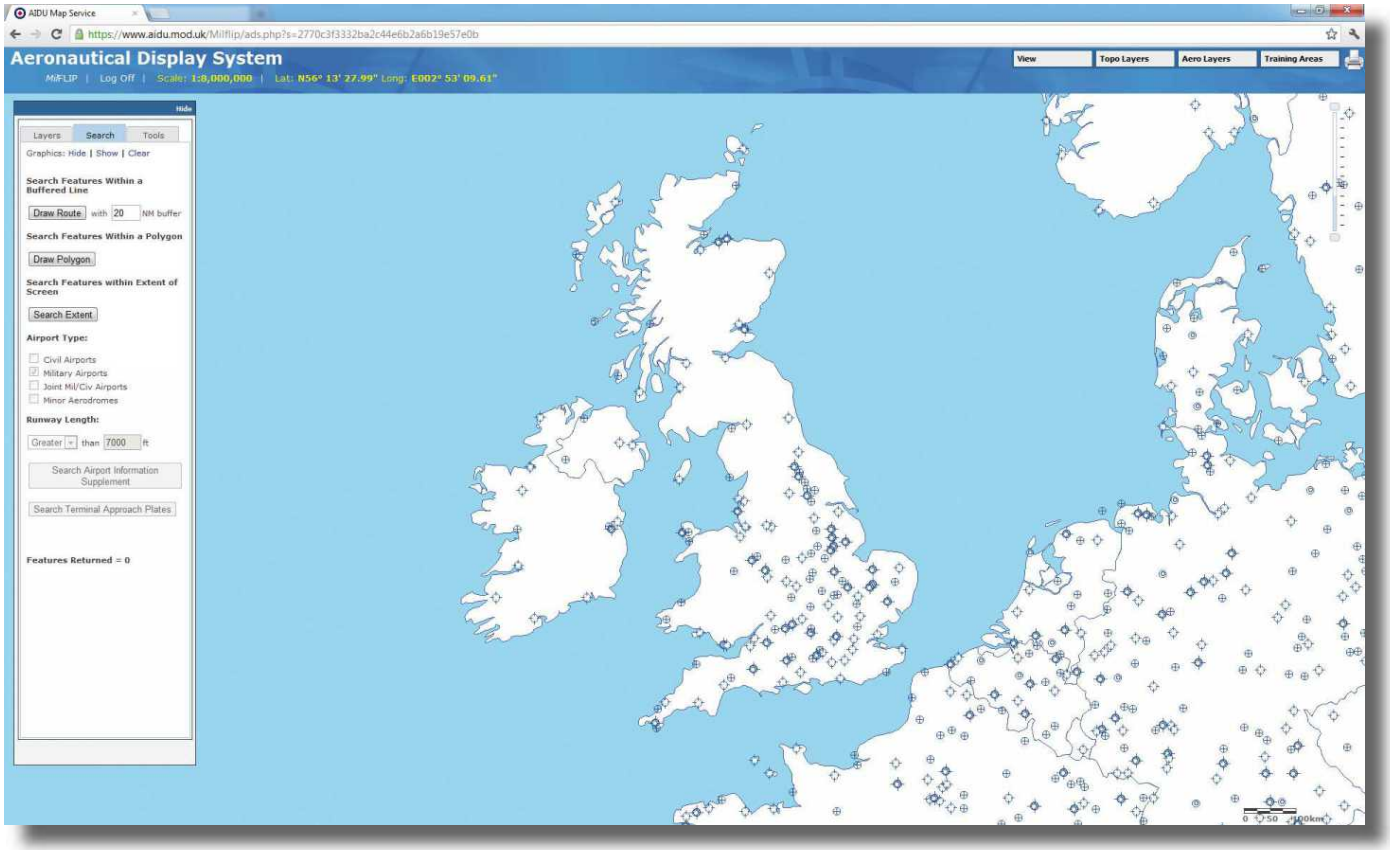
By SAC Marcus Rees-Whybrow - Innovation and System Support Section

Historically, paper has held the crown as the standard method of distributing and using Aeronautical Information (AI) amongst the RAF and the aviation community in general. The benefits of paper are obvious; it is tangible, it needs no special power supply or battery and due to its physical nature it can be transported anywhere. However, this last factor is also a critical weakness; as more data means more paper, the requirement for more physical products ultimately generates the need to print, transport and store more of it, leading to expensive production and logistics costs. Hence the Operations and Flight Planning rooms that we grew up with and still see today, full of paper charts and AI Reference Books, which may need to be updated every 28 days to keep the information current and safe and legal.

Whilst the consumption of AI in an Electronic Flight Bag[1] is in its infancy and somewhat of a dream to many aircrew; the distribution of AI is not. The RAF's Aeronautical Information Documents Unit's (AIDU) *mil*FLIP website has been distributing AI for well over 4 years now, with 100% of

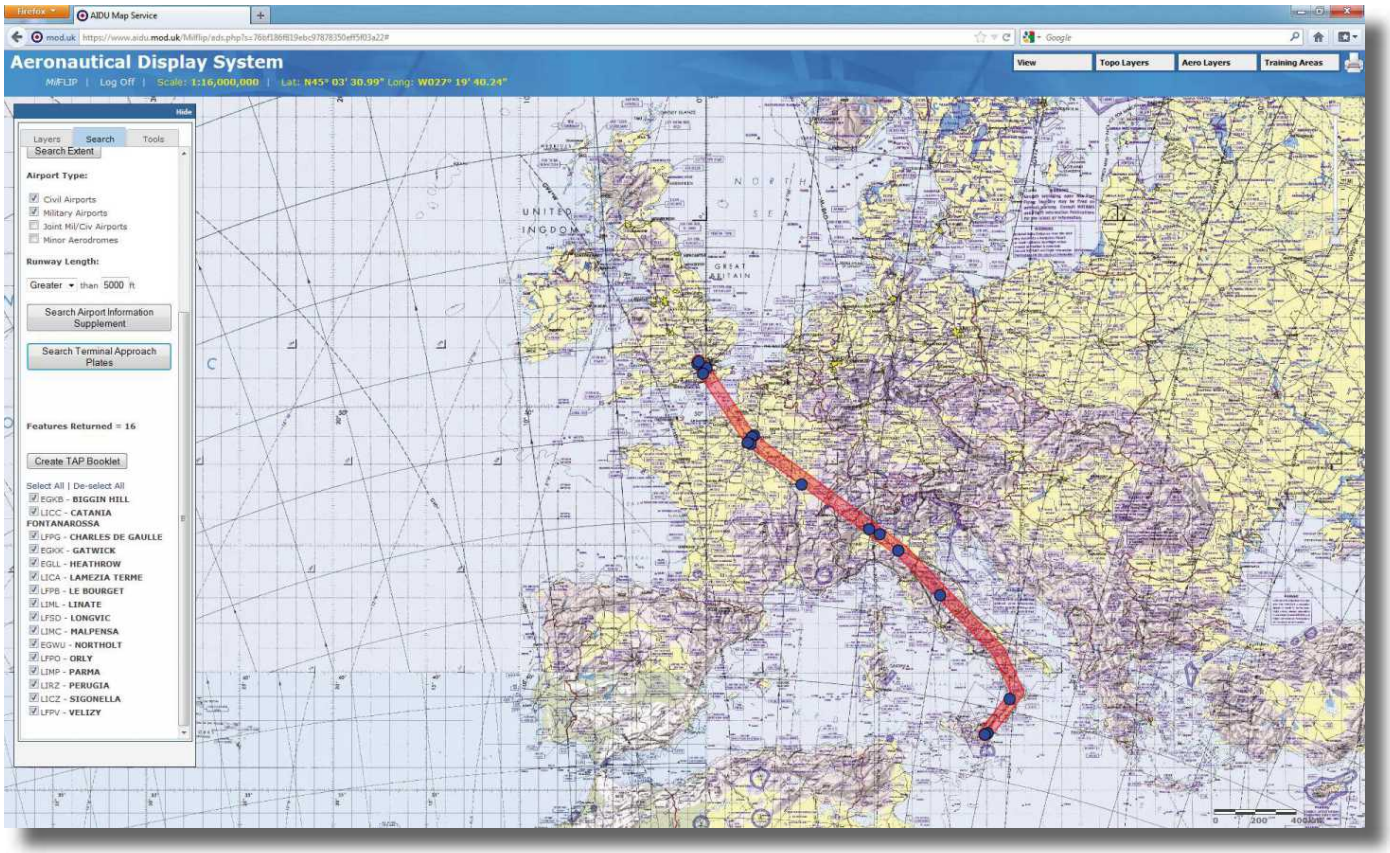


[1] **Electronic Flight Bag (EFB)** is an electronic information management device that helps air crews perform flight management tasks more easily and efficiently with less paper.

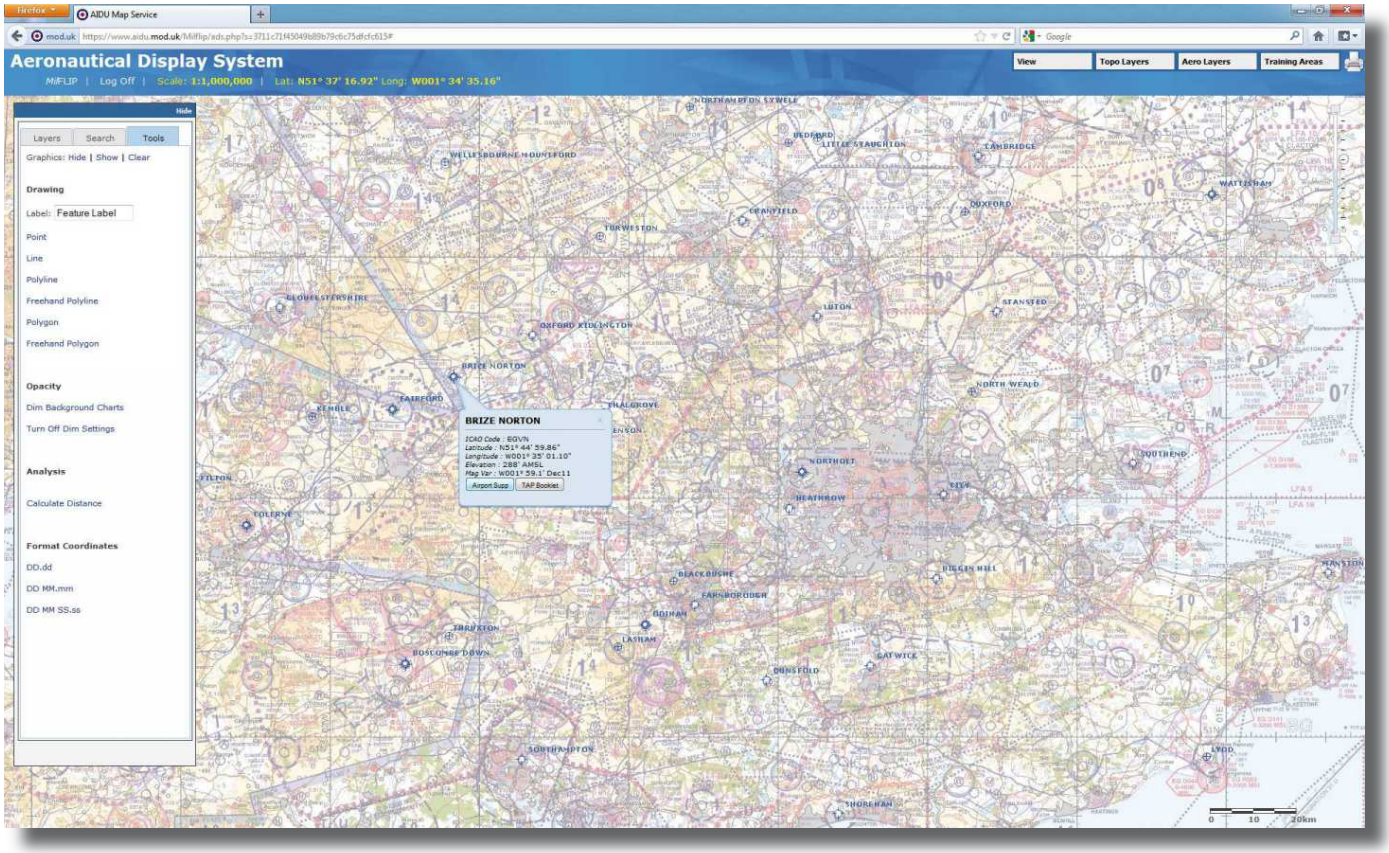


ADS_Home

the Unit's products being available for secure download from AIDU's servers over the internet every day. This has created a substantial economic and 'green' saving to the RAF. Products need no longer all be ordered on 28-day repeat and held in operations rooms 'just in case'. Every military user of the free and easy to use website can now access anything within a few clicks then print or consume the AI they need. No excess fat on their product, no need to carry a thousand pages when a user can often print the pages they require on demand.



ADS_Route



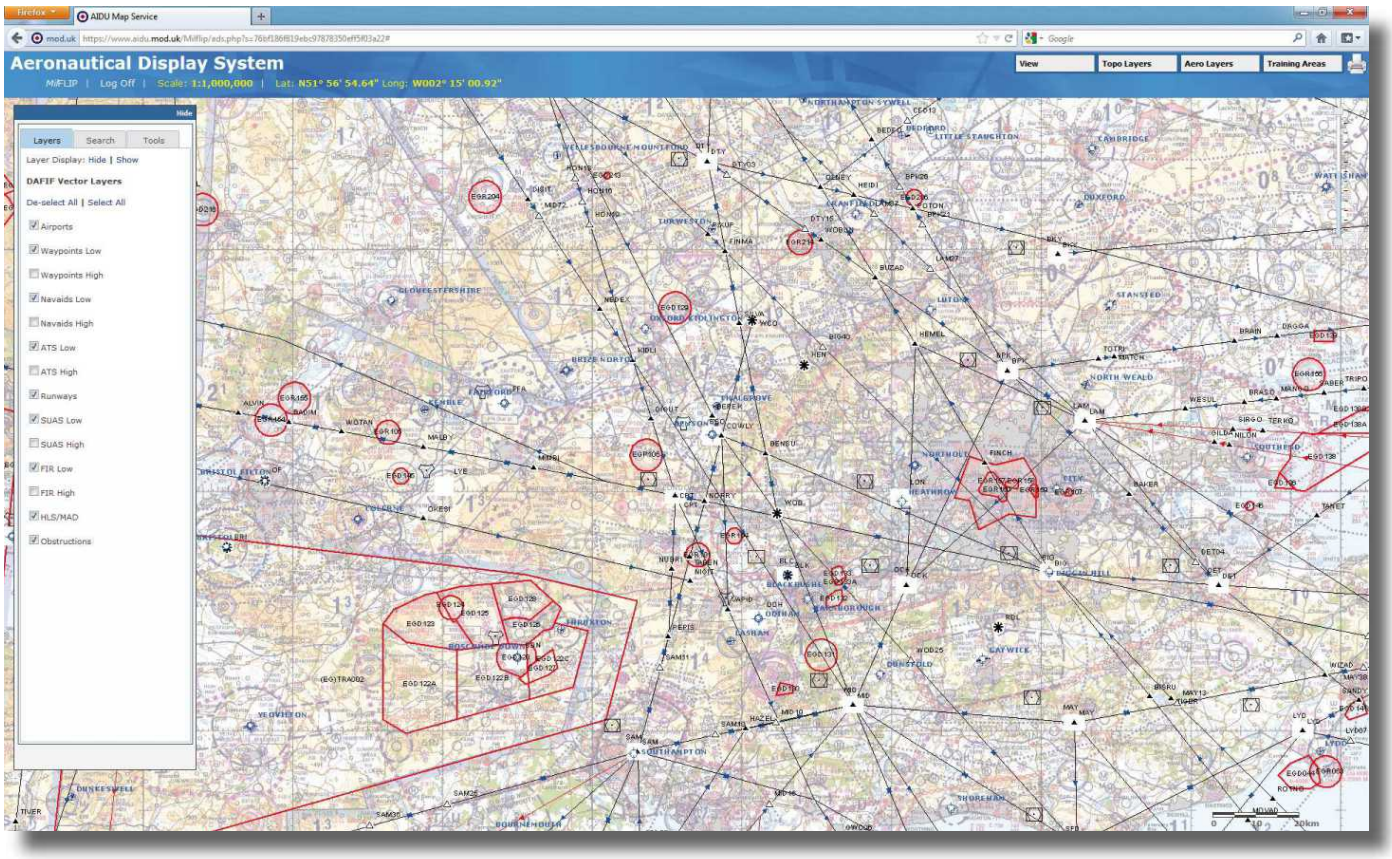
ADS_selectVectorArpt

The *mil*FLIP website was designed and written by a few eager Trade Group 14 Air Cartographers from AIDU's Innovation & System Support section, with an original aim of securely providing a few products, such as Terminal Approach Plates (TAPs) and some En-Route Supplement (ERS) books, all in PDF format. The website has grown, developed and evolved and it now stands on the basic web languages of HTML, JavaScript, PHP and CSS which means it can run on any modern browser on any internet computer in the world. It can be accessed by aircrew in a hotel room in the USA or an SAC on a Dii machine in Kandahar. A user can now select an individual Terminal Plate or quickly grab every En-route Chart for the globe. It is supplemented by our 4 Allied partner countries (Australia, Canada, New Zealand and the USA) and also commercial NAVTECH data, ensuring there is almost global AI coverage from one central server.

The *mil*FLIP website proved to be a great success in the Defence Aviation community, but as it grew it was rather more work than a section of only a few RAF developers could support. Therefore, a new Web Services section was established at AIDU to support and maintain the multitude of data and code being added to the site on a monthly basis.

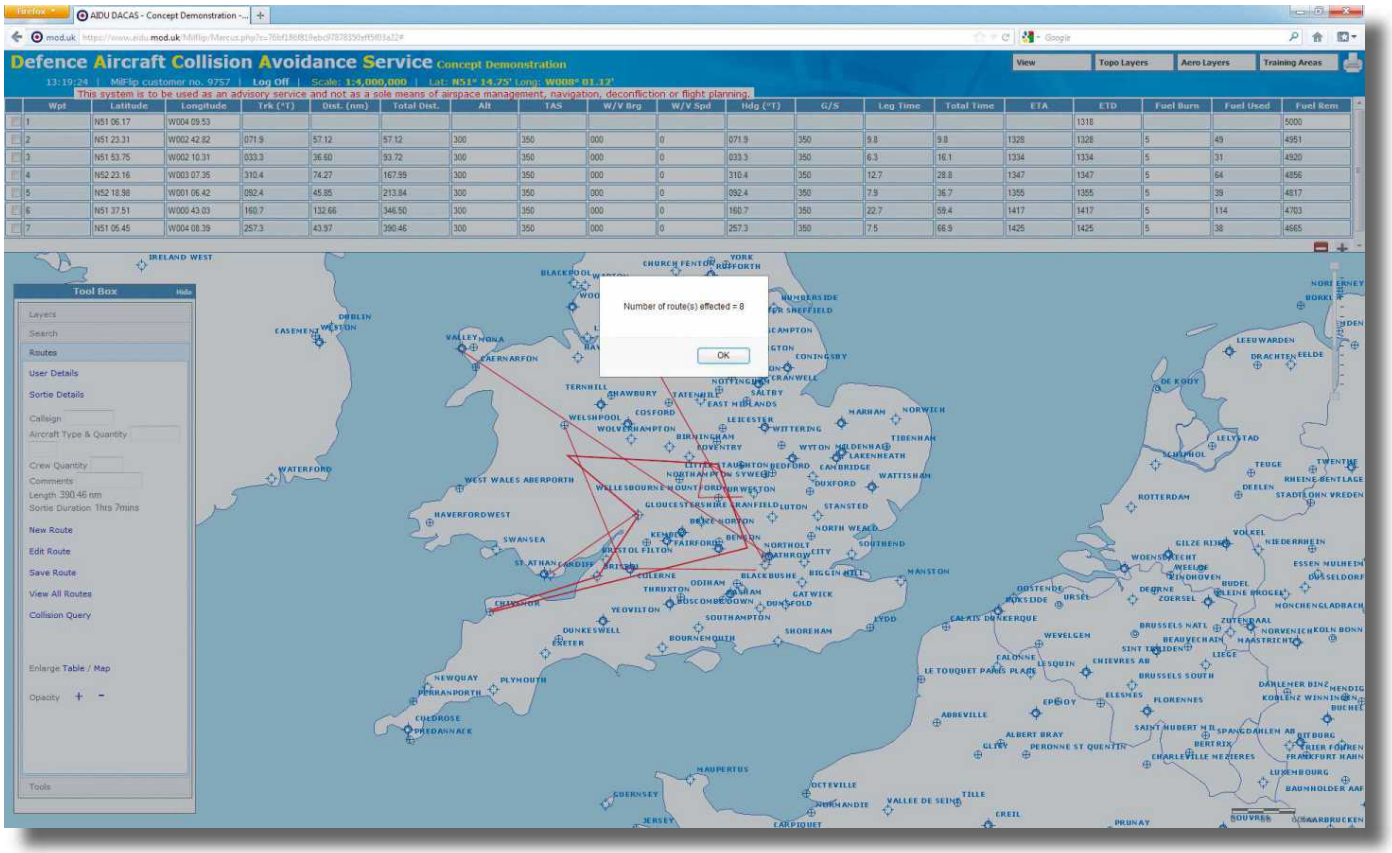
This however was not the end of the website's development as the original text based interface of the *mil*FLIP site had its limitations. For a user to know which terminal plates were required they would often have to consult a paper chart in order to see which airfields were required, then manually search through and download the relevant data. So a graphical, geospatial and context aware interface was needed in order to enhance the site's capabilities.

Thus the ideological child of *mil*FLIP was conceived and after a couple of years in development by the AIDU's Air Cartographers, the *mil*FLIP Aeronautical Display System (ADS) was born. The site was built using ESRI ArcGIS software, and uses no additional internet plug-ins. It simply uses JavaScript to provide all the extra functionality of a moving, scaling and feature selectable map. ADS in its current form has worldwide coverage of high level Defence Geographic Centre (DGC) charts, near worldwide coverage at most other levels all the way down to Ordnance Survey 50K, with overlay coverage of the UK, Cyprus and the Falklands, all of which are stitched and scale matched for ease of use. ADS has complete AIDU chart coverage, stitched into single charts cached to minimise loading times and enhance a user's experience. Most recently of all, some 50K training areas have been added. These charts, on a web based interactive site, are still somewhat limited, so from the start the aim has always been to include selectable and searchable aeronautical vector data. ADS now allows users to input a sortie route or area and will search the TAP library or create a database derived Airport Supplement document, based upon details entered; this makes the access to the relevant AI far easier and more appropriate to the actual requirement.

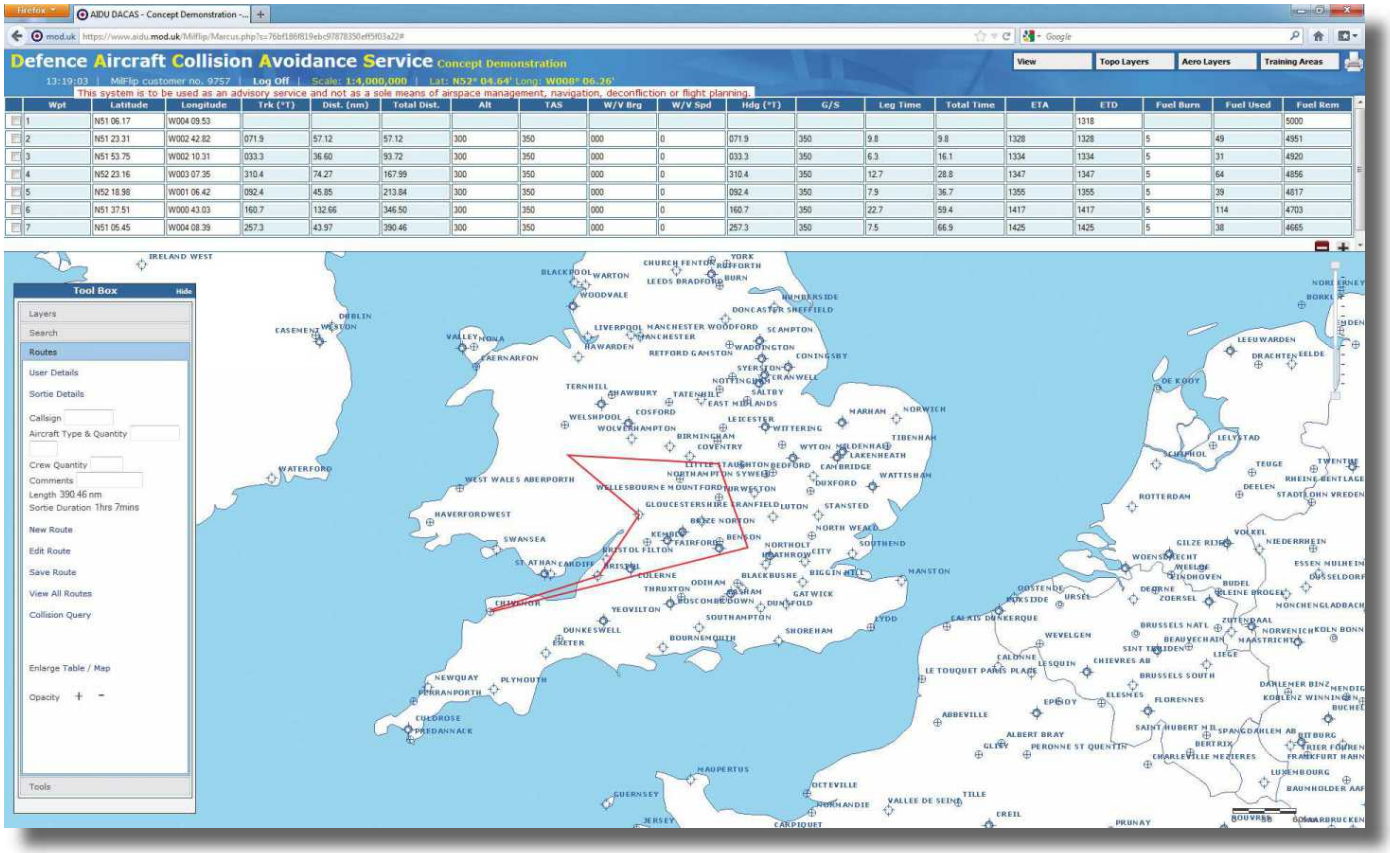


ADS_withVectorOverlayed

ADS became a service accessible to any military *mil*FLIP user in early June 2011. Shortly after this, during a demonstration at a Joint Force Intelligence Group Mission Planning Conference at Shrivenham, ADS was noticed by Capability Air & Littoral Manoeuvre (CAP ALM) staff who then engaged with the AIDU on whether the Unit could produce a customised development to cater for their needs. This lead to a new requirement to develop a service aimed at the "plan to avoid" aspect of flight planning; the Defence Aircraft Collision Avoidance Service (DACAS) is currently being



DACAS_collisionQuery



Wpt	Latitude	Longitude	Trk (°T)	Dist. (nm)	Total Dist.	Alt	TAS	W/V Brg	W/V Spd	Hdg (°T)	G/S	Leg Time	Total Time	ETA	ETD	Fuel Burn	Fuel Used	Fuel Rem
1	N51 06.17	W004 09.53													1318			5000
2	N51 23.31	W002 42.82	071.9	57.12	57.12	300	350	000	0	071.9	350	9.8	9.8	1328	1328	5	49	4951
3	N51 53.75	W002 10.31	033.3	36.60	93.72	300	350	000	0	033.3	350	6.3	16.1	1334	1334	5	31	4920
4	N52 23.16	W003 07.35	310.4	74.27	167.99	300	350	000	0	310.4	350	12.7	28.8	1347	1347	5	64	4856
5	N52 18.98	W001 06.42	092.4	45.85	213.84	300	350	000	0	092.4	350	7.9	36.7	1355	1355	5	39	4817
6	N51 37.51	W000 43.03	160.7	132.66	346.50	300	350	000	0	160.7	350	22.7	59.4	1417	1417	5	114	4703
7	N51 05.45	W004 08.39	257.3	43.97	390.46	300	350	000	0	257.3	350	7.5	66.9	1425	1425	5	38	4665

DACAS_Route

developed by AIDU to meet this need through leveraging the experience gained from the earlier ADS project. Currently, Joint Helicopter Command (JHC) uses its own rotary platform collision avoidance system; DACAS however, will aim to meet the requirements of the entire Defence Aviation community through integration of the service within the milFLIP website.

Over the coming months the DACAS project team will continue developing the emerging DACAS capability. Built on the fundamentals of ADS but requiring much more work than first envisaged, the Unit's Air Cartographers have been busy designing, coding and generally getting to grips with the abundance of formulae and maths dropped upon them; the site is now starting to take shape. A system concept demonstrator has been completed and the project continues to gather momentum whilst testing the boundaries of the RAF developer's skills. The JHC's current Centralised Aviation Data Service (CADS) system will remain in place until DACAS development has been completed and approved.

The beta site now produces a simple sortie plan and from a few clicks on a moveable map a user can calculate bearing, adjusted for wind, calculate departure and arrival times and estimate fuel burn for the sortie. The site allows for a manual input of latitude and longitude but mostly uses a simple point and click over the top of any chart available from AIDU or DGC. The aim of the site is to allow users to input their route, add a buffer for safety and check for conflicts with any other previously entered route by any other user, which is not necessarily limited to rotary users. The system is not complete yet and currently produces a basic collision query but will eventually produce a second-by-second calculation of potential conflicts; the end goal of course from a system like this is to then save lives by reducing the risk of mid-air collisions.

In many planning rooms around the Defence Aviation world, aircrews and flight planning staff are inputting routes and replicating inputs into multiple systems. For the future, the DACAS project has the potential to produce and file a flight plan, make a low flying booking on Carousel, check for Met information or collect all relevant Notice-To-Airmen (NOTAM) for a sortie. These results might then be delivered to a user, instantly collated and all from a series of graphical inputs, minimising human error and time whilst saving money and potentially human lives. Should this all come to fruition as a new operational capability, it will handsomely amplify the AIDU's motto ***"The more fully informed the safer"***.

DMGIC's Maritime Olympic Support Products

Defence Maritime Geospatial Intelligence Centre, DMGIC, at United Kingdom Hydrographic Office.

The requirement

When it was announced that the Olympics would be coming to UK shores, DMGIC,in its role as the recognised supplier of maritime geospatial information to UK defence, recognised that there would be a defence security requirement for maritime situational awareness products. The fact that Olympic sailing events are scheduled to take place in Weymouth and Portland dictated as much and guaranteed that as a bare minimum, UKHO baseline products (Nautical Charts and Pilots) would be needed. The driver for DMGIC to provide added value to these baseline products came with confirmation that a wide variety of RN elements would be operating in support of the security services during the Olympic sailing events:

- HMS BULWARK (Landing Platform Dock - LPD)
- RFA MOUNTS BAY (Landing Ship Dock Auxiliary – LSDA)
- P2000s (Patrol Boats)
- Royal Marine Offshore Raiding Craft (ORCs)
- Royal Marine Rigid Inflatable Boats (RIBs)
- Royal Navy Mine Clearance Diving Teams
- Air Assets: Sea King Airborne Early Warning, Merlin and Lynx Helicopters

Slightly less obvious was the requirement for maritime products in support of the security in and around London-based Olympics venues. The Thames is a major artery through London, is very much part of the maritime domain and its navigable length is covered by UKHO products. Such is the magnitude of the security task in and around London that again, Defence has been tasked to support the Metropolitan Maritime Police Unit on the Thames:

- HMS OCEAN (Landing Platform Helicopter)
- P2000s (Patrol Boats)
- Royal Marine ORCs & RIBs
- Royal Navy Mine Clearance Diving Teams

Products

In order to support the above, and with no additional financial budget allocated to the Olympics, DMGIC was eventually tasked through the Request for Information Process (RFI) with 539 Assault Squadron Royal Marines (539 ASRM) providing the driving need for a specialist product. Operating in ORCs and RIBs on both the Thames and in Weymouth, the combination of high-speed small boat operations and inability to handle multiple normal-sized charts meant an innovative charting solution was required.

The primary solution came in the form of A2-sized bound 'Chartbooks' printed on a waterproof, toughened paper (auto-bond advanced thermal lamination for the more specialist reader) which can be readily drawn on and rubbed out without damage. Able to fit on the chart table of the ORC, these chartbooks blend a combination of standard bathymetric data (drawn from UKHO charts/databases) with surrounding geospatial information (see next paragraph) which supports the user in his/her security task. Subsequently, at 539's request, the A0 product was supplemented with reduced-size A4 ('pocket-sized') versions of this product – Royal Marines appear to have big pockets.

In terms of additional geospatial information and starting with land-mapping, UKHO charts already contain some topography though this is perhaps better described as a selection of the more

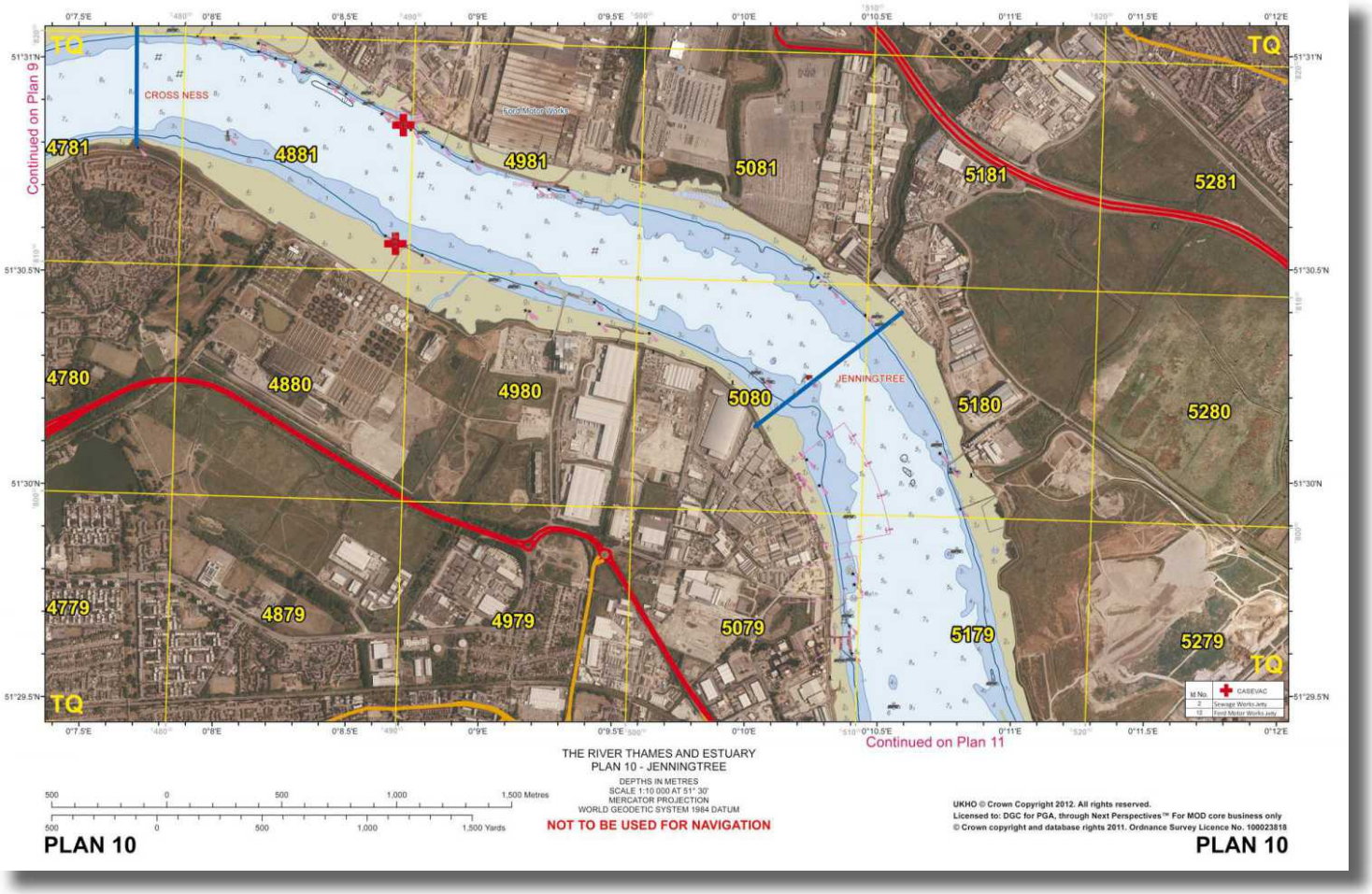
conspicous land-based features designed to permit the sea-based user to triangulate his/her position at sea. In relation to the Olympics and most particularly in London, the topography on UKHO charts was deemed insufficient to support RMs who might be expected to disembark from their ORCs/RIBs or who need a wider idea of the surrounding roads and infrastructure in dealing with an incident. In this regard, use of OS Map Data was considered, but due to the level of detail was felt by the RM customer to be too data-rich for rapid analysis.

Consequently, the decision was made to use satellite imagery which gave a broad overview, permitted the boat-based RM to identify surrounding features and infrastructure rapidly and most importantly to position him/herself intelligently in relation to emerging incidents.

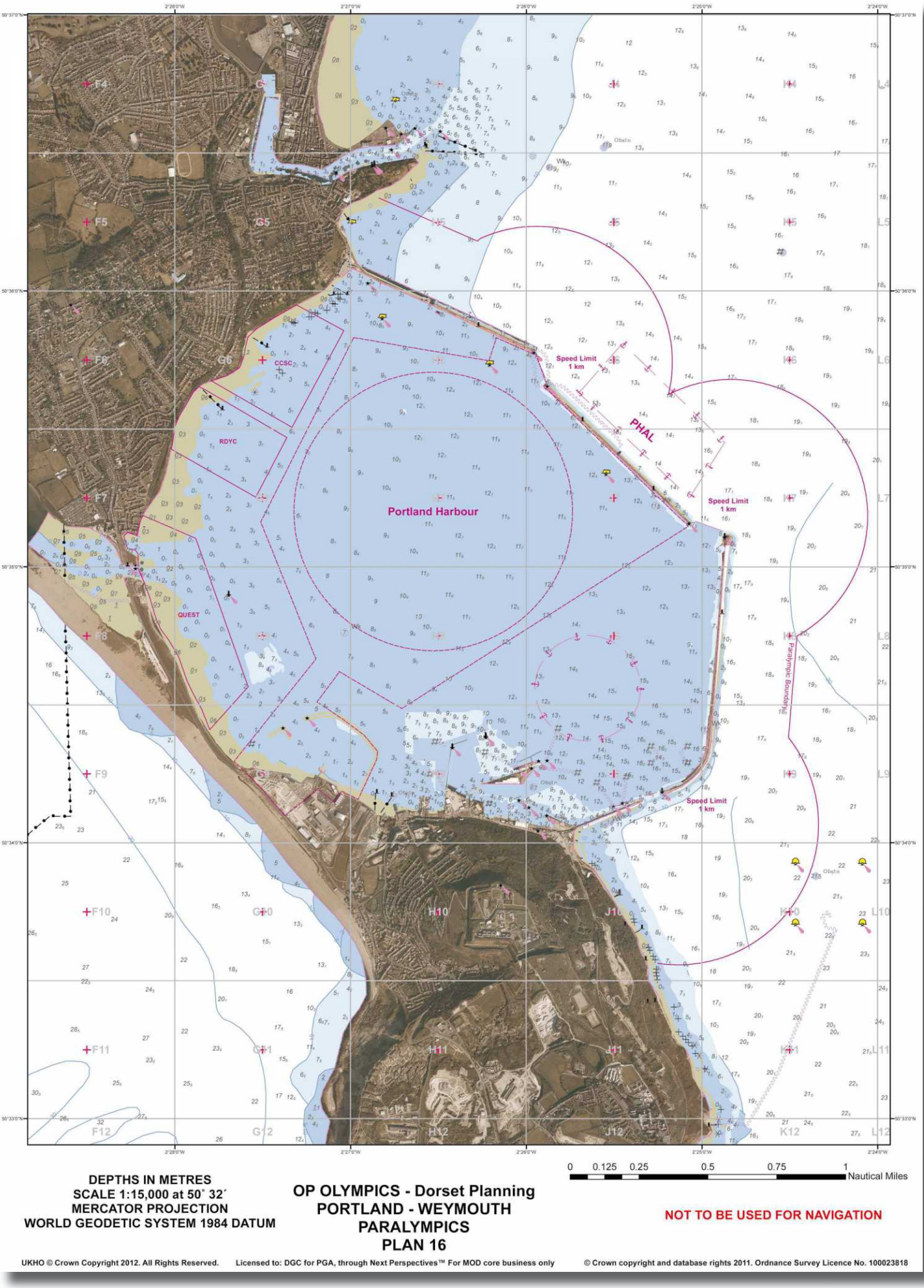
With bathymetry and topography covered, the final piece of the puzzle was to 'add value' to the chartbooks by ensuring commonality of reporting and awareness of surrounding security assets and features. In reporting terms, the decision to use the OS grid system meant that this grid has been overlaid on standard WGS-84 geographic co-ordinates permitting common reporting of incidents across the land and maritime domains in London. Additional features in the Thames chartbooks include reporting points, casevac stations, bridge names, access and egress points and key roads and arteries in the immediate vicinity of the Thames. Slightly differently, Portland Chartbooks continue with the theme of land imagery blended with standard nautical charts but also include a 4W reporting grid (better suited to the maritime environment), named reporting points and pre-planned positions of LOCOG and Dorset Maritime Police assets.

Wider Products – Paper versus Digital

Having assembled the chartbooks on behalf of 539 and the smaller units operating in and around Weymouth/Portland and London, there has obviously been demand for paper and digital products to support other units. These include the larger Landing Ships operating as Command Centres for the aforementioned smaller units and the various maritime HQs (Single Service, Joint, Air and Police) and NGOs involved in venue security; including but not limited to the Port of London Authority, the Maritime and Coastguard Agency and the Royal National Lifeboat Institution. Each of these has received multiple copies of chartbooks and most HQs have received digital equivalents (see below).



Example of Thames Chartbook Plan 10 showing the blend of bathymetry, topography and additional features requested by 539 ASRM.



It's not just about the Olympics. Weymouth Chartbook Plan 16 showing the blend of bathymetry, imagery and additional features but this time showing DMGIC's support to security for the Paralympics.

Although operating on the cusp of the digital age there has still been considerable demand for paper charts. Requests for Portland charts with additional features in the form of Olympic sailing areas and associated security zones and reporting grids overlaid have arrived on an almost daily basis at UKHO as the Olympics approach. DMGIC's Operational Graphics team has been particularly busy in support of these demands. The paper versus digital supply of products remains a live issue and notwithstanding the fact that much of DMGIC's material is now supplied digitally, the trend of demand for paper charts for operational planning shows no sign of abating.

With much of the chartbook data produced in ESRI ARC GIS software, transition of the Olympic support data into a series of digital formats for wider military users has proved a relatively straightforward process. The initial transition from paper products to digital products is most directly demonstrated in the demand for chartbooks in GeoPDF format, permitting both HQs and Ops rooms of Olympic units to access chartbook pages directly without the need for bulky copies at their stations. More widely, exact copies of the chartbook pages have been made in Geotiff format for ingestion into Ship Command Systems and Bridge displays where supported, or where it is deemed that a single page copy of the chartbook is all the user requires.

Most appropriately however, (almost) all Royal Navy platforms navigate with WECDIS (Warfare Electronic Chart Display Information System) and to support the 'W'(arfare) element, UKHO produces Additional Military Layers (AML) which are designed to contribute to environmental situational awareness. AMLs are a routine product in daily use by operational units and the associated Routes, Areas and Limits (RAL) layer which traditionally depicts Territorial Waters Limits and Exercise areas has been adapted to suit for the Olympics. AML layers have been produced for both Bridge systems (WECDIS) and Operations Room Command Systems (after a conversion process conducted by the Fleet Information Management Unit) which depict Olympic sailing areas, exclusion zones, reporting grids, reporting points and other unit locations (Weymouth). These layers will be exploited on all Patrol Boats (London and Portland) and in the operations rooms of HMS BULWARK and RFA MOUNTS BAY (Portland) in order to manage the surface picture and control allocated units. Similarly, these layers have been further translated into formats suitable for ingestion into Merlin helicopter command systems to permit them to contribute to both air and surface pictures from the air.

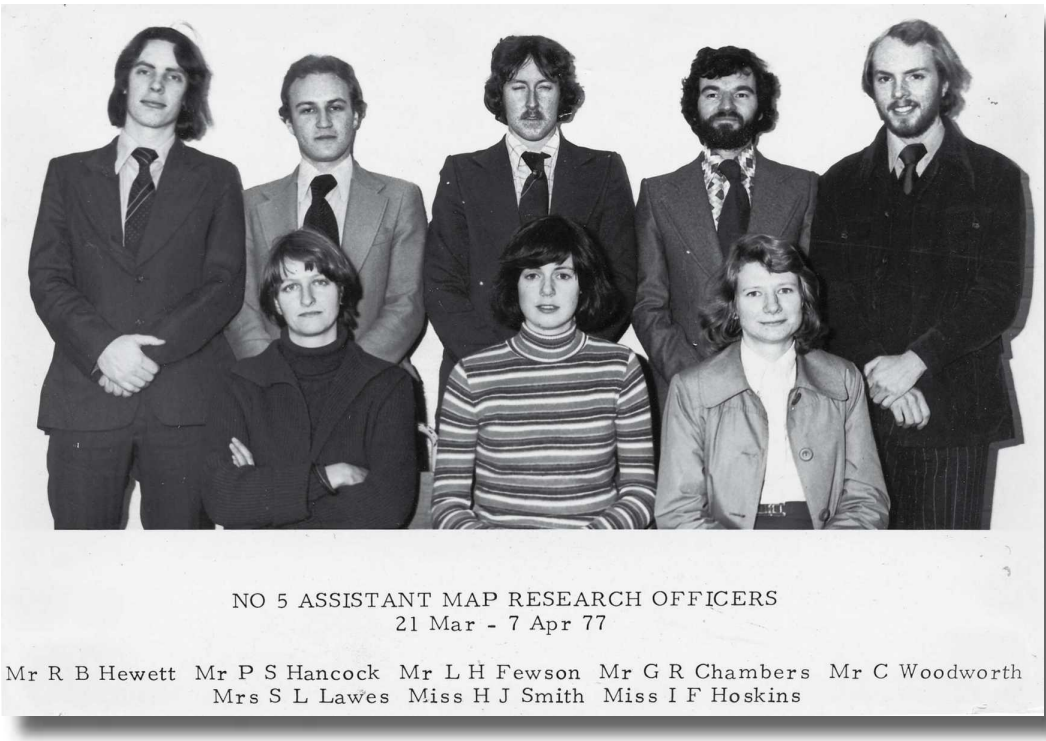
Summary

Whilst very much part of DMGIC's remit, generating bespoke maritime geospatial support for the purposes of Olympic Security has not been without its challenges. If any one challenge stands out, it is the coordination of constantly evolving customer requirements amongst the push-pull of a dynamic and politically sensitive global event. Moving from the statement of initial requirements through various iterations and post-LIVEX amends (including but not limited to mapping, grid, scale, symbology and projection changes) to delivering final locked-down versions to third parties for conversion and printing has pushed DMGIC against the stops when it comes to deadlines. That said, deadlines have been met, the chartbooks and digital products are on the streets (cue sigh of relief from production team) and initial feedback is positive. The remaining challenge is to capture final feedback, feed into geospatial community Olympics lessons and concurrently use the experience gained to further develop DMGIC products and services.

The Hermitage Course Photos Project

The Military Survey Association (a branch of the REA) has sponsored a project to produce a digital archive of all the available photographs of the Military Survey soldier trade courses held at Hermitage between the early 1960s and 1993, the main SMS/RSMS courses held for Military Survey's civilian staff during the same period and all the Long Survey/Army Survey Courses to date.

Any former military surveyor (uniformed or civilian) wanting details of how to obtain a copy of the CD should contact Alan Gordon on 07765 577 754 or email alan.gordon67@btinternet.com.



Joining The DSA

An application form to join the Defence Surveyors' Associaition can be found on the Association's website at www.defencesurveyors.org.uk. The completed form should be either emailed to the Membership Secretary at applications@defencesurveyors.org.uk or posted to:

Honorary Membership Secretary
114 Harnham Road
Salisbury
Wiltshire
SP2 8JW

Applications may be made by letter to the above address and should include the following information:

> Name, contact details, details of any service career, name of a sponsor and a short summary of relevant experience and courses with dates and/or details of professional, commercial or academic background in the Defence Surveying business.

In accordance with the Data Protection Act, the above information will only be held for administrative purposes by the DSA.

When accepted for membership, applicants will be informed by the Chairman and receive an introductory pack from the Honorary Membership Secretary.

Membership Fees. Do not send any money with the application. New members are required to pay an annual membership fee of £15 starting from the 2nd January after they join. You will be sent a standing order form in due course which you will be asked to complete and return to the Honorary Treasurer covering the fee for the next calendar year. Any member who wishes to do so may alternatively pay the annual subscription of £15 by cheque. Any such cheques should be made out to the 'The Defence Surveyors' Association', and reach the Honorary Treasurer by 2nd January each year (DSA Hon Treasurer, 9 The Chase, Donnington, Newbury, RG14 3AQ).