IRISH MINING &
QUARRYING SOCIETY

ANNUAL REVIEW

2017

THE FOREFRONT OF THE CONSTRUCTION INDUSTRY IN NORTHERN IRELAND

Norman Emerson Group Ltd has been at the forefront of the Northern Ireland construction industry for almost seven decades and is one of only five companies with a commercial licence to extract sand from Lough Neagh.

We spoke to George Emerson, Managing Director, about how Close Brothers Commercial Finance initially supported Norman Emerson through turbulent times and now supports its expansion, growth and profitability.

The business has been restructured following the recession, and began to grow again. Sales of Norman Emerson's ready mix and sand products are weather dependent, with sales peaking during the summer months and dropping in winter. The company relied upon an annual short term loan from its bank during the winter to ease cash flow. On addition to the annual short term loan, the company has a long term loan and invoice discounting facilities with the bank in December 2015, without warning, their bank informed the company that it was unable to provide the previously relied upon annual short term loan which supported the business through seasonal peaks and troughs.

Norman Emerson decided to seek advice form an independent financial services provider and engaged with Close Brothers Commercial Finance.

Solution

The provision of facilities would need to be structured to reimburse the incumbent lender in full. Facilities were structured to reduce the short-term burden on capital repayments on the long term, thereby easing the pressure on cash flow and assisting the company in the continued progress with its turnaround.

As a result, an innovative ABL arrangement was structured combining invoice discounting with funding against property. This provided an immediate cash injection to working capital which supported their seasonal demands, especially in the winter months.

George felt that the ability of his relationship manager to make swift funding decisions made a material difference to the day-to-day running of his business. George was particularly impressed with Close Brothers' flexibility and creativity in structuring the transaction.

The finance solutions Close Brothers Commercial Finance were able to offer has enable Norman Emerson Group to drive forward their vision for growth.

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Modern Merchant Banking

Notes from the Editors 2017

IRISH MINING & QUARRYING SOCIETY

In 1995, Tony Killian persuaded council member Leslie Sanderson to publish the first IMQS quarterly newsletter entitled "The Extractive Times". The pair continued to jointly edit the newsletter for a number of years and it developed into the current publication - "The Irish Mining and Quarrying Society Annual Review".

Tony Killian

Tony continued to research and prepare interesting feature articles for the Annual Review up to 2016. However, it is with great sadness that, within this current edition, we wish to pay tribute to Tony following his passing in July 2017.

Reflecting Tony's commitment to the publication, he provided a number of articles for the 2017 Annual Review and these papers take a special place in this edition. Furthermore, as detailed in the thoughtful Obituary prepared by Leslie Sanderson herein, Tony was already preparing a number of papers for the 2018 Annual Review. He really was an example to us all and a wonderful support to the Editorial Committee. This year's Annual Review is dedicated to Tony's memory.

As well as Tony's articles, this Review includes a range of articles from all sectors of the IMQS membership. Papers include case studies from representatives of the mining and quarrying sectors and from suppliers to these sectors. There are also a number of articles on recent regulatory changes, industry standards and the current public perception of the extractive industry in Ireland.

In order to provide a national overview of the industry, we are delighted to have personal perspectives from IMQS President Brendan Morris, Minister of State, Sean Kyne T.D. and Gerry Farrell, Chief Executive of the Irish Concrete Federation. In addition, Gordon Best, Regional Director of the Quarry Products Association of Northern Ireland has provided his considered thoughts on the potential consequences on the industry as a result of a hard Brexit deal.

This Review would not be possible without the support of our advertisers, our feature writers, our regular contributors and our publisher 4 Square Media - thank you to each and every one for their continuing support of the Irish Mining and Quarrying Society. A special words of Thanks to Brendan Morris, IMQS President, for his valuable contribution to this publication and to Elizabeth Murphy, TOBIN Consulting Engineers and Geoscience Ireland, for her editorial assistance.

the Editorial Team

Siobhán Tinnelly (Chairperson)

Sean Finlay

Keith McGrath

Ronan Griffin

The IMQS Council are delighted to announce that we are currently working on a revamp of the IMQS website (www.imqs.ie) in order to make the current version more user-friendly and accessible to our members and to industry colleagues.

It is intended that the new website will launch in Quarter 4, 2017. We welcome any industry photographs or industry news that members wish to add to this website, which will be routinely updated to ensure that the website remains relevant to our members in the long-term.

As part of this website update, we have made a decision to rebrand the society and introduce a new, modern website that will reflect the current IMQS membership. The rebrand includes a new logo, as shown below, which was selected by the IMQS council members after a considered selection process (including input from a marketing company who specialise in logo design and rebranding). The new logo represents the extractive industry with the use of a multi-faceted structure (similar to the shape of a mineral or a shard of rock) and the variety of colours on each face represent the various sectors that form the membership of the IMQS, which has expanded in recent years to include suppliers, regulatory bodies and technology companies as well as the traditional mining and quarrying companies. We trust our members will approve of this society rebranding and we look forward to the launch of the new IMQS website in the coming months.

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IRISH MINING & QUARRYING SOCIETY

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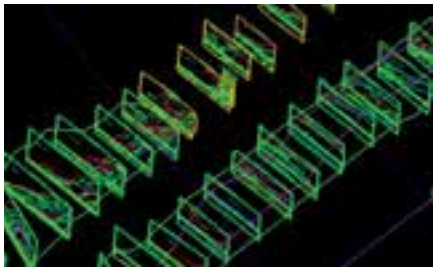

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Ministers Foreword

by Mr. Sean Kyne, T.D., Minister of State for Gaeltacht Affairs and Natural Resources

I am delighted once again to provide a foreword to the Irish Mining and Quarrying Society's Annual Review.

The extractive industry in Ireland has made and continues to make a valuable contribution to the economy of Ireland in terms of commerce, employment and the supply of raw materials. As Minister of State for the Department of Communications, Climate Action and Environment, I wish to confirm my support and commitment to maintain and promote an active mineral exploration and development industry in Ireland. This Government will continue to facilitate the responsible, environmentally sustainable exploration for and extraction of mineral resources and to promote Ireland as an attractive location for inward investment in the mineral sector.

Two underground mines operated in Ireland in 2016. Ireland produced 15% of European zinc mine output and 4.7% of European lead mine, ranking Ireland 3rd and 5th in Europe, respectively. According to data published by the International Lead and Zinc Study Group, in 2016, Ireland ranked 15th and 20th in the world in relation to zinc and lead mine output respectively. In recent years, there has been a fall in Ireland's rankings due to the closure of Galmoy and Lisheen Mines; however I am committed to encouraging further investment in this sector so that new mineral deposits may be found and developed.

The **Navan Mine**, operated by Boliden Tara Mines, is currently still the largest zinc mine in Europe. Over 90Mt has been mined since operations commenced in 1977, with 2.6Mt of ore being processed in 2016. I welcome the recent discovery of Tara Deep, which is hoped to extend the life of Tara Mine to 2026.

In 2016, **Irish Gypsum Ltd.**, a subsidiary of French multi-national Saint-Gobain, produced approximately 250kt of gypsum from its underground operation at Drummond in Co. Monaghan.

Mine safety is very important and in this regard, I wish to congratulate the Boliden Tara Mines Mine Rescue Team who were awarded the Silver medal in the 'Best Overall Team' category in the 2016 International Mines Rescue Competition held in Sudbury, Ontario last August. This was the first time an Irish team participated in the competition and this achievement demonstrates the commitment of the mining sector to high Health and Safety standards in Ireland.

Improving metal prices were reflected in the **strong growth of the mineral exploration sector in Ireland during 2016**. There were 567 active licences and 44 mineral exploration companies operating in Ireland at the end of 2016. In addition, there were 179 Prospecting Licence applications submitted to my Department in 2016, which represents a significant increase compared to recent years.

My Department continues to promote Ireland as an attractive country in which to explore and develop mineral deposits. Along with representatives from the Geological Survey of Northern Ireland and Department for Economy in Northern Ireland, my Department represented Ireland at the annual Prospectors and Developers Association of Canada (PDAC) Convention and Trade Show. A half day presentation on **"IRELAND – OPEN FOR BUSINESS"** was well attended and there was much positive feedback. Following a number of years with depressed metal prices, there was a decidedly more optimistic atmosphere at the trade show this year.

Ireland, once again, performed well in the Fraser Institute's 2016 survey of mining and exploration companies, coming first in the Policy Perception Index for the fourth successive year and ninth overall in the Investment Attractiveness Index from 104 jurisdictions worldwide.

In 2013, the Geological Survey of Ireland (GSI) completed its Aggregate Potential Mapping Programme for the country. These were carried out on a county by county basis and have now been combined into a single national map. Many local authorities now use these in drafting their development plans and in assessing planning applications for the development of either sand and gravel pits or crushed rock quarries. These will be made available on-line on the Geological Survey's new website due to be delivered late in 2017.

My Department continued to support **Geoscience Ireland**, a network of Irish companies collaborating to deliver geoscientific, environmental and engineering expertise to clients worldwide. I was delighted by the results of a survey that showed 179 new jobs had been created by GI companies in 2016. This Government will continue to support job creation initiatives, such as Geoscience Ireland, under the Action Plan for Jobs 2017.

The Government recognises the importance of Research and Development to secure and progress economic activity. My Department is actively promoting relevant research through the provision of free geoscience data available online from EMD and GSI, support of the Irish Centre for Research in Applied Geosciences **(iCRAG)** and the research programme of GSI. I am pleased to note that research in the important area of aggregate quality is the focus of a number of current and future projects.

The **TELLUS Programme**, a national ground and airborne geoscience mapping programme being undertaken by GSI, successfully completed a large phase of work in the west of Ireland in 2016. An airborne geophysical survey was flown over County Galway and southern Mayo, while ground-based geochemical sampling of soil, stream water and stream sediment was undertaken across Mayo and west Galway. TELLUS geochemical data for south east Leinster were published last year, with geophysical data for parts of Munster (mainly Co. Waterford) released at an event at the UNESCO Copper Coast Global Geopark in Co. Waterford. The data from this programme will be beneficial for and attracting interest in the mineral exploration, environmental management, agriculture, human health and research sectors across Ireland.

I wish the IMQS and the extractive industry the very best for 2017.

Progress on the **Minerals Development Bill** continued in 2016. It is currently expected that the Bill will be enacted by the end of 2017. This legislation will replace the current Acts, which date from the 1940s, with modern, fit-for-purpose legislation. The Bill provides for greater transparency and predetermination of terms, including rents and royalties, which will streamline the permitting process. It will also bring other aspects of the regulation of the minerals sector by the Exploration and Mining Division (EMD) in line with current best practice.

Message from the IMQS President 2017

by Brendan Morris, Managing Director LTMS Limited – Lisheen Technical & Mining Services

The mining industry is looking more positive in 2017! Metal prices are up, there is movement around development of new global projects and there is an air of optimism. Ireland is rebounding from the closures of Galmoy and Lisheen, with the progress of Galantas and Dalradian mines near Omagh in County Tyrone and the expansion of the Tara Mines operation. We are still in the top ten worldwide jurisdictions for mining attractiveness. All good news for Ireland!

Metal prices have seen positive movement in the 12 months from March 2016 to March 2017. Zinc is leading the way and has seen a rise in price of over 40% from $1,800/tonne to $2,600/tonne (April 2017). Lead, copper, silver, nickel and aluminium have all risen at rates of between 11% and 21%. Gold has been reasonably stable for the past five years at approximately $1,200/ounce and gold mining has been in a relatively steady state.

Boliden - Tara Mines has recently announced a major expansion to the Tara Deep ore zone, which will result in an investment of €44 million, €33 million for expansion of the tailings management system and €11 million for the mining project. In March, Galantas started a new decline from their existing quarry for access to their new underground mine and despite some challenges, expect to reach the orebody by the end of the year. Dalradian Resources have plans for future expansion of their operations. Gypsum Industries in Kingscourt and Kilroot Salt in Carrickfergus continues with production after more than 50 years in operation.

There is a large amount of exploration activity around the country in a variety of areas, with zinc, gold and lithium, high on the list of targets.

The Fraser Institute has ranked Ireland in 1st place once again for Policy Perception and 9th for Mining Investment Attractiveness. The survey is based on information from 104 jurisdictions across the globe. Ireland's high ranking is the result of the continued work by the government, its agencies, mining/exploration companies and the array of technical and mining service companies that are available to assist interested investors.

The construction industry continues to grow with both volume and value up significantly on an annual basis. The volume of output in the building and construction sectors increased by 16.8% in the fourth quarter of 2016, compared with the fourth quarter of 2015.

In July 2017, Tony Killian passed away at the age of 91. Tony was a longstanding member and leading force of the IMQS, having held the position of Honorary Secretary for 33 years. During that time he was very influential in all matters relating to the society and Tony was still writing articles for the Annual Review up to his final days. We are forever grateful to the immense contribution that Tony provided to the IMQS. Our deepest sympathy goes to Tony's wife Bridie and their family. May he rest in peace.

Planning permissions for dwellings showed an increase of 7.8% from 2015 to 2016, while non-dwelling units also saw a good increase. However, much of the growth remains in Dublin and some of the other cities.

The **quarry industry** is still struggling to make a full recovery from years of recession and this is particularly evident in rural areas, where the year started reasonably well but then slowed again. The main issues are a shortage of major projects, pricing of products against UK competition and there are still issues with delays in planning permissions, but this is slowly improving. If the industry rebounds, there is the potential for a shortage of an experienced workforce and this is evident in areas such as truck driving. The introduction of a government scheme for training of young school leavers in professional driving may be of benefit, and this could be based on a programme which currently exists in the UK.

Brexit is affecting the Irish quarrying and construction industry and there is a long way to go before we will know the full impact. However, Irish companies are already reacting and making adjustments to their businesses. The key areas of concern for Ireland are the stability of Northern Ireland, trade disruption, exchange rate, UK inflation and short/long term relationships in Europe. The withdrawal and new trade agreements between the UK and Europe will ultimately determine the effect on Ireland and it appears that we will be in a transitional period for a number of years. The Irish government has set up many groups and has made many consultations in order to address the Brexit effect, but the business sector must show the leadership and act faster than political process to ensure a smooth transition.

The **Irish government** has a history of supporting mining and exploration in Ireland and there are a number of sponsored programmes which are doing well. One of these is the Exploration and Mining Division (EMD) of the Department of Communications, Climate Control and Environment which is directed by Dr. Eibhlin Doyle. The EMD function is to apply the Minerals Development Act, to ensure that Ireland's mineral deposits are identified and developed responsibly and to actively promote the attractiveness of Ireland's deposits for private investment.

The **Geological Survey of Ireland (GSI),** under the directorship of Koen Verbruggen, collects geological data in order to provide maps, databases, resources, advice and information concerning Irish geology.

There are a number of projects being run from the GSI:

- The **Tellus** project, at the Geological Survey of Ireland, is a ground and airborne geoscience mapping programme, collecting chemical and geophysical data and will have 50% of the country covered by the end of 2017. The data collected is available free of charge to the public and is being used by exploration companies.
- The **Irish Centre for Research in Applied Geosciences (iCRAG) is** managed by Professor John Walsh. iCRAG brings together Ireland's leading geoscience experts on issues underpinning economic development, from safe and secure groundwater supplies to the discovery of mineral/aggregate deposits, and from de-risking oil and gas exploration to educating and informing the public on geoscience-related issues. iCRAG currently employs 150 researchers in a variety of areas spanning a broad spectrum of application areas linked to applied geosciences, including raw materials, marine, groundwater and hydrocarbons.
- The **Geoscience Ireland (GI)** project which is headed up by Sean Finlay (past President of IMQS), continues to grow and is now a network of 33 companies, delivering integrated expertise in water, minerals, mining, environmental and infrastructure development to clients in over 50 countries. The GI network which is supported by the Geological Survey of Ireland and Enterprise Ireland provides a range of expertise in design, consultancy and contracting services to multilateral agencies, governments and the private sector. There is a significant degree of collaboration between the

member companies on national and international projects, resulting in a greater ability to tackle complex projects.

All of these projects add significantly to the ability of investors to engage in exploration and mining in Ireland and we must continue to make Ireland a very inviting location for investment in our natural resources.

The **Prospectors and Developers Conference (PDAC),** which was held in Toronto in March of this year, was a great success for the Irish, with the 'Ireland – Open for Business' day very well attended. The event was opened by the Ireland Ambassador to Canada, HE Jim Kelly and included talks from government agencies and private companies. Of note from the presentations is the amount of activity currently taking place in the exploration and mining fields in Ireland.

The IMQS Council continue to carry out good work representing the natural resources industry and council members are active on various committees. IMQS is represented by Ciaran Greenan and Les Sanderson on the **Quarry Safety Partnership (QSP)** committee which is managed by the Health and Safety Authority and is a collaboration of industry, trade union, government agencies and related groups. The QSP targets safety improvements and provides information to the quarry industry and is a good conduit between industry and the HSA. The **Irish Mines Rescue Committee** is headed up by Mike Lowther and in 2016 Tara mines successfully represented Ireland at the World Mines Rescue competition in Canada, where they gave a very strong performance. Alan Dolan represents the IMQS at the **European Federation of Explosives Engineers (EFEE),** which promotes the standardisation of explosives training in Europe and also promotes explosives technology. We are represented on the **Quarry Skills Safety Scheme** by Les Sanderson, Keith McGrath and Ciaran Greenan and at the **Irish Geoscience Network** by Siobhan Tinnelly, Sean Finlay and Brendan Morris. Siobhan Tinnelly is the Chairperson of the Annual Review Editorial Committee and is assisted by Keith McGrath, Ronan Griffin, Sean Finlay (and by Tony Killian R.I.P. who provided excellent articles for this review.) The Dinner Dance committee of Carol Sanderson, Ciaran Greenan and John Francis (Vice-President in 2016) are responsible for a great event every year. I would like to take this opportunity to thank all of the Council members for their hard work and also Carol Sanderson, who does tremendous work as the IMQS Secretary. Mick Flynn has resigned from the council after giving many years of service and I would like to thank Mick for his efforts over the years. I am happy to welcome Sarah O'Connell and Nicola Molloy to the council. Sarah specialises in safety and environmental management at O'Connell Quarries in Limerick, while Nicola is a planning engineer with Boliden Tara Mines.

Safety is a focus area for us at the IMQS and in our industry in general. It is an issue that must be maintained at the forefront of all decision making processes. Training of all personnel, appropriate standards/procedures and continued safety engagement at all levels will all assist in the journey to zero harm.

The IMQS are currently working with other groups to develop a new course for drillers involved in mining/quarrying, geotechnical, water and exploration.

I am delighted to note that the **2017 Dinner Dance** will be held at the K-Club in Straffan. This year's function will include a golf tournament and the leisurely benefits of the spa centre. The Vegas Nights will provide the music as they did in 2016 and we will have a guest speaker.

I would like to congratulate the **Irish Association for Economic Geology** and the **Mining and Heritage Trust of Ireland** and the **Institute of Geologists of Ireland** and the many other geoscience groups in Ireland who all work hard in their respective areas to bring knowledge to our industry, our country and to make improvements to our environment.

In summary, the IMQS is in place to support the extractive industries in the responsible development and exploitation of our natural resources and as such we welcome your input through the members of the council, email and other means. We believe that Ireland's resources should be managed and extracted for the benefit of Ireland and in a manner that is environmentally friendly, socially acceptable and financially beneficial for the local community and country in general.

Activities of the Society

May 2016 to May 2017

Current Membership:

243	Ordinary
2	Fellows
13	Honorary Fellows
7	Honorary Members
14	Corporate

by Alan Dolan, IMQS Honorary Secretary

Dates of Council Meetings

2016: 13th September, 11th October, 8th November.

2017: 10th January, 21st February (AGM), 14th March, 11th April, 9th May.

Council Members:

In 2017, Keith O'Shaughnessy, Mick Flynn & P.J. O'Donnell stepped down as Council Members. Their input into the society was greatly valued, as is the continued support of many ex-council members who, although not directly involved, continue to actively support the society.

2017 is Brendan Morris', second year as President of the IMQS. Brendan is Managing Director at LTMS Limited (Lisheen Technical & Mining Services). The Council welcomed two new Members in 2017. ***Sarah O'Connell*** (Environmental, Health & Safety Officer at O'Connell Quarries) and ***Nicola Molloy*** (Planning Engineer, Boliden Tara Mines).

John Francis, (Customer Account Manager at Finning Ireland Ltd.) is Vice President for 2017. ***Leslie Sanderson***, (Director of Services at ECS Turbowash Ltd.) is Honorary Treasurer and ***Alan Dolan***, (Ground Control Engineer at Boliden Tara Mines), is Honorary Secretary.

Other council members are: ***Sean Finlay*** (Director of Business Development at Geoscience Ireland), ***Ciaran Greenan*** (Location Manager at Roadstone Ltd.), ***Ronan Griffin*** (Property Manager at CRH Estates), ***Mike Lowther*** (Manager of Mining at Boliden Tara Mines), ***Keith McGrath***, (Director at McGrath's Limestone Works Ltd.), and ***Siobhán Tinnelly***, (Associate Director at TOBIN Consulting Engineers).

Carol Sanderson, Executive Secretary, manages membership and communications. Carol is a member of our website committee and co-ordinates numerous other tasks for the society. Thank you all for your dedication and commitment.

IMQS Website, Communications & Social Media

For the year ending May 31st 2017, a total of 2278 hits were recorded on the website. As in 2015 – 2016, the Jobs section was our most visited page.

Posting job vacancies is free of charge.

Your advertisement will be viewed by members and followers who have a specific interest in the extractive industries. Please forward any jobs you may consider relevant to the industry to info@imqs.ie.

The IMQS has 407 followers on the LinkedIn, Group: Irish Mining & Quarrying Society. If you are not already a group member, why not join and catch up with some colleagues or maybe connect with somebody in your area of business. All members of the Irish Mining & Quarrying Society are encouraged to contribute to this active group and join in the discussions.

Our website committee are working on a complete rebuilding project for the IMQS website. The new site will be launched in Q4 2017. Our address will stay the same, www.imqs.ie.

The Extractive Industry Review 2016

The 2016 Annual Review is available to download from the IMQS website and was published by 4 Square Media.

The editorial team for 2016 was, Siobhán Tinnelly (Chairperson), Sean Finlay, Keith McGrath and Ronan Griffin R.I.P.

The theme for last year was SOCIETY, to demonstrate the variety of individuals, companies and activities that combine to make our industry one of the most influential in Ireland (and overseas). The review also contained other diverse articles which will be of interest to any reader.

Conferences / Seminars / Industry Events

(More details at www.imqs.ie)

- **Rescue Organisation Ireland Competition.**
  A competition for extraction techniques was held at Tayto Park on 22nd May 2016. A team from Tara took part. Mike Lowther represented the IMQS.
- **Annual Field Trip & Golf Competition - Irish Cement Limited, Platin Works, Drogheda.**
  The annual field trip took place on Friday, 26th August 2016. Many thanks to the management and staff of Platin for hosting the trip and their hospitality. Following the visit, the Annual IMQS Golf Competition took place at Laytown & Bettystown Golf Club. Winner - Sean Finlay.
- **IoQ-NI Stone Crushers Ball**
  The annual Institute of Quarrying (Northern Ireland) Stone Crushers Ball took place in the Europa Hotel, Belfast on 23rd October 2016. The event was attended by Alan Dolan & Brendan Morris on behalf of the IMQS.
- **IMQS Annual General Meeting**
  Following the IMQS Annual General Meeting on 21st February 2017 at the Spa Hotel Lucan, a seminar and demonstration on Mine and Quarry Planning Software Solutions was given by Geovia – Dassault Systemes. This was followed by a presentation from Kilroot Salt Mine on their recent mine developments and details of the upcoming annual field trip to the mine.
- **Prospectors and Developers Association of Canada (PDAC)**
  The annual Prospectors and Developers Association of Canada (PDAC) Convention was held in Toronto on 5th - 8th March 2017. Over 24,000 people attended. The IMQS was represented by Brendan Morris and Sean Finlay.
- **IMQS Seminar at the National Sports Campus, Dublin**
  A seminar was held by the IMQS on Thursday 18th May 2017. Presentations were made by;
  Tobin Consulting Engineers - Overview of the National Sports Campus (NSC) and the National Indoor Arena - Paul Cullen and Brian Kennedy.
  Murphy Surveys Ltd. - Drone Surveying in Mining, Quarrying and Construction - Julian Deeks.
  Roadstone - Specifications and Standards in Quarrying - Dermot McCarthy.
  Geological Survey of Ireland – Update on TELLUS Programme - Ray Scanlon.
  Tara Mines - Technological advances in mining operations at Boliden Tara Mines - Paddy McConnell.
  For details of the presentations, please visit imqs.ie.

Submissions

- **Call for Evidence - Permitted Development Rights for Mineral Exploration**
  On behalf of IMQS members, Brendan Morris submitted a reply to the call for evidence pertaining to Part 16 of the Schedule to the Planning (General Permitted Development) Order (Northern Ireland) 2015. This schedule deals with exploration activities. See www.planningni.gov.uk for more details.

Representations

Council members represented the IMQS at the following events/committees during 2016;

- Quarry Safety Partnership and Quarry Skills Certification Scheme meetings
- Real time Mining forum (realtime-mining.eu)
- The European Economic and Social Committee
- Strategic Implementation Plan of the

European Innovation Partnership on Raw Materials
- Extractive Industries All-Island Seminar
- Irish GeoScience Network
- Council of the European Federation of Explosives Engineers
- Prospectors and Developers Conference in Toronto

In addition to the above, the IMQS continually make representations when requested by various mining and quarrying related bodies. More details at imqs.ie.

Annual Dinner Dance 2016

The IMQS Dinner Dance is always a great opportunity to re-connect with people from the industry and to make new acquaintances. The event was held in the Ballsbridge Hotel, Dublin 4 on 26th November, 2016. It was very enjoyable night with more than 240 people attending.

Our Guest Speaker was Mr Sean Kyne, TD, Minister of State for Gaeltacht Affairs and Natural Resources. Particular thanks to the companies and individuals who sponsored the impressive spot prizes, and, of course, to all the members of the IMQS Council who helped organise the event. Photos from the night can be viewed on the IMQS website.

Mine Rescue

IMQS council member Mike Lowther is Chairman of the Irish Mine Rescue Committee (IMRC). A full summary of the activities of Mine Rescue can be found later in the review.

Future Events

Annual Dinner Dance 2017

This year's annual dinner dance will be held in the K Club, Straffan, Co. Kildare on **Saturday 11th November 2017**. There will be a golf tournament on the day. See imqs.ie.

Annual Field Trip 2016

The annual field trip will take place on **21st September 2017**. It will be held at the Kilroot Salt Mine, Carrickfergus.

Driller's Education Course

Brendan Morris, Sean Finlay and others from the extractive industry, have been in discussions with academic bodies to set up a course specifically for drillers from all sectors of the extractive industry. The course content should be finalised in early 2018. For more information and if you are interested in achieving this drilling qualification, see www.imqs.ie.

Online Courses / Flexible Learning for the Extractive Industry

A number of online courses are being run by the University of Derby, UK. Courses can be part-time, full time and online and range from individual modules to degree level qualifications. Further information can be found at either of the following web addresses: www.quarrying.org/education or www.derby.ac.uk.

If you know of other courses you think may benefit our members, please let us know or share via social media.

Conclusion

I would like to express my sincere appreciation to our President Mr Brendan Morris and Vice-President Mr. John Francis for their leadership and dedication to the work of the Society. I also wish to thank our Treasurer Mr. Les Sanderson for maintaining the accounts and to the other current officers and members of the IMQS Council who often serve on several sub-committees to voice and protect the interests of our members. I would particularly like to acknowledge the essential work done by Carol Sanderson, our Executive Secretary.

Finally, I would like to thank you, our members, for your patronage. The Society cannot exist without your continued support.

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Tara Mines
40 Years A-Digging!

by Sean Finlay, Director Geoscience Ireland & Past President of the IMQS

HISTORICAL MINES IN IRELAND

Minerals and mines are critical to every society since the beginning of civilization. Since humans began using tools, minerals were needed for felling, hunting, defence (or attack!), decorating and for agriculture.

In Ireland, there was a copper mine from the Bronze Age near Lough Leane in County Kerry. Silver and lead mines were operating from the 12th century in Co. Tipperary and copper mines in Counties Wicklow and Waterford from the 17th Century. Some small metal mine were developed around the country in the middle of the 19th century and coal mines were found in Roscommon, Leitrim, Tipperary and Carlow. Extensive research was undertaken by the Royal Dublin Society and later by the Geological Survey of Ireland (GSI) since its foundation in 1845 to develop mining. Sir Richard Griffiths was the RDS expert in minerals with the wonderful title of "Itinerant Mineralogist"; he oversaw the first geological map of Ireland.

By the 1920s, coal mines were still in operation but little or no metal mining. There was a gold rush of sorts near Avoca in County Wicklow in 1934. There were allegations about links between the Government and the developers and Dail questions were answered by the Minister at the time, Sean Lemass. However, no gold was found. The former Director of GSI Dr. Peter Mc Ardle, has written a fascinating book on gold exploration in Wicklow which dates back to 1798.

Apart from coal, few new mines were developed in the two decades from the 1920s onwards. In 1947, Eleanor Butler wrote in geography textbooks "Ireland has no mineral resources". However, not everyone was in agreement with that view. In 1958, Murrough V O'Brien, then Director of GSI, had papers published by the Institution of Mining & Metallurgy, providing estimates of significant potential reserves of base metals in Ireland.

MODERN MINING IN IRELAND

Around the same time, a Canadian exploration company - Irish Base Metals (IBM) – began prospecting for minerals in Ireland using new geochemical technology. The company was established around 1947 by four men who emigrated from Ireland to Canada. They were Pat Hughes, Matt Gilroy, Mike McCarthy and Joe McPartland. In 1961 IBM discovered a significant deposit of copper ore, lead, silver and zinc in Tynagh in east Galway. A mine was established in 1965 and Tynagh was the beginning of a new era of mining in Ireland. Since then, seven lead and zinc mines have been developed and Ireland is now an important centre for lead and zinc production and was in a leading position in Europe until 2015.

Table 1 Some Companies Emerging from Tara Mines Staff, Consultants & Contractors since 1980

Company	Principal (s)	Activity	Locations	Comments
Burmin	Des Burke & John Teeling	Gold E&D	Ireland	Ormonde & Sipa spun out
Celtic Gold, Celtic Resources	Sean Finlay & Herb Stanley	Gold E&D	Ireland, Canada, FSU	Taken over in 1994 & 2002
Connemara	John Teeling	Base Metals E&D	Ireland	active
Glencar Mining	Hugh McCullough, Noel Kiernan, Sean Finlay	Gold E&D, Mining	Ghana, Mali	Taken over 2009
Kenmare	Charles Carvill, John Teeling, Mike Carvill	Mineral Sands Mining	Mozambique	In production
Minco	John Kearney, Peter McPartland	Base Metal E&D	Ireland, Canada, UK	Restructured 2017
Minquest	John Teeling	E&D Base Metals	Ireland	Invested in Conroy (Galmoy), Ovoca, Minco & Kenmare
Navan Resources	Colin Andrew	Base Metals & Gold E&D	Ireland, Bulgaria	inactive
Ormonde	Mike Donoghue, Kerr Anderson	Tungsten(W), base Metals, Gold	Ireland, Spain	W project in Spain
QME	Peter McPartland	Contract Mining	Ireland, UK	active
Sipa	Des Burke	Gold E&D	Canada, Australia	inactive

Companies founded / financed by John Teeling after his Tara involvement include Botswana Diamonds, Petrel and Clontarf Energy. E&D = Exploration and Development.

THE NAVAN DISCOVERY

In November 1970, an associate company of IBM- Tara Exploration and Development Ltd., discovered the Navan zinc lead orebody- by far the larhest located to date in Ireland. There were many difficulties associated with the development. Another company- Bula- succeeded in gaining ownership of some of the minerals. The Government wanted more taxes and royalties. Fortunately, the extent of the orebody was such that Tara had sufficient reserves to develop on its own and following an agreement with the Government, Tara commenced production 40 years ago in 1977. Bula was unable to develop its minerals and was put into liquidation in 1984. Legal disputes continued for 20 years afterwards, but Tara regained control of the Bula portion of the orebody in 2004.

In 1977, the Navan orebody Tara was estimated to contain 77 million tonnes of zinc and lead ore. By 2017, over 85 million tonnes have been extracted and 34 million tonnes remain. There is little doubt but that more minerals will be found at Navan . The works are all underground , 6 km from north to south and 1 km in depth. New mineral resources have been located deeper still at 2 km below ground. The Tara zinc mine is one of the largest of its type in the world.

Tara Mines supports 730 jobs and pays € 38 million in taxes every year. The operation is conducted in an environmentally safe manner and is located within 2 km of Navan town itself.

THE FUTURE

In the 40 years since the start of Tara Mines, significant advances have been made in the understanding of the local and regional geology and consequently in discovering and developing further substantial mineral resources near Navan. Many geologists and engineers who have worked in Tara have gone on to provide local and international expertise in companies established to provide services to the mining industry; see table 1. 40 years a- digging responsibly, locally and globally is a considerable legacy and one that is likely to continue for another 10 years or more.

Sean Finlay P Geo C Eng
Geoscience Ireland

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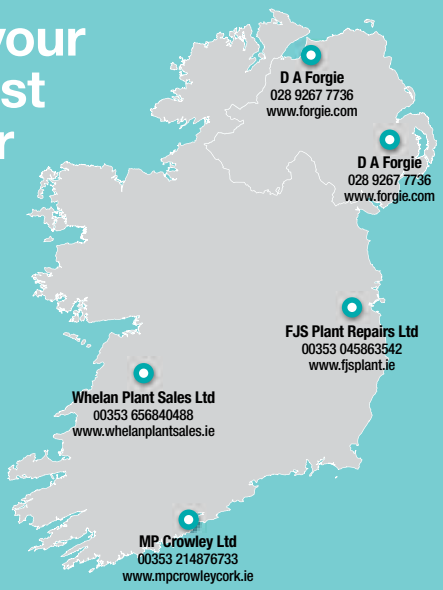

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Irish Mine Rescue Committee 2016 – 2017

by Mike Lowther Chairman IMRC, Richie Cahill Mine Rescue Officer Boliden Tara Mines, and Aoife Tallon Secretary IMRC

Outstanding Performance in Canada

As we went to press for last year's review, news had just come through from Sudbury, Ontario that the mine rescue team from Boliden Tara Mines had won second place overall in the International Mines Rescue Competition.

This was a phenomenal performance from our team, competing in a pool of 28 teams representing 13 nations. This prestigious event is held every two years by the International Mines Rescue Body (IMRB) in major mining regions around the world and is the equivalent of the mine rescue "Olympics".

The team was captained by Davy Harrington, and supported by Richie Cahill (Mine Rescue Officer at Boliden Tara Mines, and Briefing Officer during the competition), and Aoife Tallon (Mine Rescue Administrator at Boliden Tara Mines and Secretary of the Irish Mine Rescue Committee).

Boliden Tara Mines Rescue Team, Left to Right - Richie Cahill (Briefing officer), James Connolly, David Harrington (Captain), Gary McDonnell, Ruairi Russell, Paul Smith, Kieran Brassil, Aoife Tallon (IMRC Secretary), Ray Bowens (Benchman).

The competition involved a number of challenges including an underground search & rescue scenario, underground fire scenario, a first aid scenario, a technical rope rescue scenario, a classroom theory exam and a PSS BG4 breathing apparatus technician bench test.

Davy Harrington, the Boliden Tara Mines Captain, was honoured at the IMQS Dinner Dance in November 2016 with an award presented by President Brendan Morris.

Roy Tallon, Mine Rescue Manager at Boliden Tara Mines, also travelled to the event to judge at the bench test element and had the honour of being the only European judge at the 2016 IMRB competition, a recognition of his standing with his Canadian colleagues.

Mutual Training

Mutual training between the Irish mines serves to establish common mine rescue protocols and assists the participating mine rescue organisations to become familiar with the mining environments, facilities and equipment utilised at the mines participating in the mutual assistance programme.

The host mine set up realistic scenarios to gauge mine rescue response capabilities and identify areas for improvement while at the same time allowing mine rescue personnel to develop valuable skills and experience. Integrating mine rescue personnel from the different mines into one team during mutual training ensures the participating mines can be confident mine rescue personnel can co-operate effectively should mutual assistance be required during a real emergency.

20th April 2016:
Mutual training at Boliden Tara Mines

Mine rescue team members from Boliden Tara Mines, Dalradian Gold, Irish Salt Mining and Exploration and Gyproc completed fire behaviour training including instruction on the use of the PSS 7000 Compressed Air Breathing Apparatus and PPE thermal precautions.

Top row L-R: Orla McKenna, Craig Smylie, Trevor Smyth, Walter Brownlee, Ronan Tinnelly, Karl Martin, Sean Ledwith, Andrew Marshall, Anthony Moran. Bottom row L-R: Gerard O'Mahony, Jim Gallagher, Ger Cawley, Michael Donnelly, Kevin Proudfoot, Tony O'Reilly.

21st May 2016:
Mutual training at Dalradian Gold

Mine rescue personnel from Dalradian Gold, Irish Salt Mining and Exploration and Boliden Tara Mines completed an underground search and rescue exercise.

Anthony Moran briefs a combined mine rescue team.

10th August 2016:
Mutual training at Irish Salt Mining and Exploration

Mine rescue personnel from Irish Salt Mining and Exploration, Dalradian Gold and Boliden Tara Mines completed an underground search and rescue exercise.

Mine rescue team in action freeing a miner trapped under a machine.

Jeremy Hann acts as Briefing Officer at FAB.

11th May 2017:
Mutual training at Dalradian Gold

Mine rescue personnel from Dalradian Gold, Gyproc, Boliden Tara Mines and Irish Salt Mining and Exploration completed an underground search and rescue exercise.

Mine rescue team enter the mine portal. This team was comprised of two Irish Salt Mining and Exploration members wearing Scott twin air sets, one team member from Gyproc wearing a Biopak 240, one Boliden Tara Mines member wearing a BG4 and one Dalradian Gold member wearing a PSS BG4.

Mine rescue team members treating an injured miner who was located in an area contaminated with smoke from a fire.

14th June 2017:
Mutual training at Boliden Tara Mines

Mine rescue personnel received a presentation on the breathing apparatus utilised at Boliden Tara Mines after which mine rescue personnel from Dalradian Gold, Gyproc and Irish Salt Mining and Exploration successfully completed an underground search and rescue exercise utilising the equipment.

Gyproc Progress 2017

Gyproc have now developed a new mine rescue centre and completed an intensive mine rescue training programme.
The aim is to have 10 trained mine rescue personnel on call.

Interaction with other agencies

As we strive towards zero harm in our workplace we have thankfully experienced a reduction in mine emergencies requiring mine rescue response. Subsequently, in the absence of real time experience and to remain fully prepared to respond effectively should an emergency occur, mine rescue personnel more than ever rely on training and competition to maintain the required competencies.

Engaging with other rescue organisations and agencies also helps to ensure mine rescue personnel remain fully prepared and up to date with emergency protocols and equipment.

8th April 2017: Boliden Tara Mines - Meath Civil Defence

Boliden Tara Mines facilitated a Meath Civil Defence provincial competition on site.

The competition included challenges in trauma response, an emergency communications challenge, and surface search and rescue. Boliden Tara Mines rescue personnel assisted with the competition organisation and delivered a presentation on mine rescue to all in attendance.

L-R: Eoghan O'Neill – HR Manager Boliden Tara Mines, Jackie Maguire, Chief Executive Meath CC, Jason Morin – GM Boliden Tara Mines, Michael Fitzsimons – Meath Civil Defence Officer, Cllr. Francis Deane – Mayor of Navan, Cllr. Maria Murphy – Cathaoirleach Meath CC, Paul Kehoe TD – Minister of State at the Departments of An Taoiseach and Defence, Robert Mooney - National Director Civil Defence, Stephen Hall – Meath Civil Defence, Paschal Walsh – EHS Manager Boliden Tara Mines.

20th May 2017:
Boliden Tara Mines - Mine Rescue Organisation of Ireland

Boliden Tara Mines mine rescue recently participated in the Rescue Organisation of Ireland (ROI) trauma and RTA competition held at Navan Fire Station. The challenges involved giving first aid assistance and using equipment to extricate people trapped as a result of road traffic accidents.

(Photos: Boliden Tara Mines mine rescue personnel completing extrication of trapped casualties).

IMRC summary

The details above show that the last year has been extremely busy in Mine Rescue in Ireland.

The highlight was Tara's magnificent performance in Canada, but great work is being done in many quarters. Although we did not run an All Ireland and UK Competition in 2016, we continued to co-ordinate mine rescue activities in Ireland, and to liaise closely with emergency services north and south.

We must conclude this year on an extremely sad note – the loss of Irish Coast Guard Helicopter Rescue 116, during a rescue mission off the County Mayo coast on 14th March.

This helicopter was involved in the first mine rescue mutual training session held at Dalradian Gold in September 2015. The helicopter flew from its base in Dublin to Irish Salt Mining and Exploration's mine in Kilroot, County Antrim, picked up the ISME mine rescue team and brought them to Gortin for the mutual training. Afterwards the ISME team were flown back home, and Rescue 116 returned to base.

We send our deepest condolences to the families of Captain Dara Fitzpatrick, Captain Mark Duffy, Winchman Ciarán Smith and Winchman Paul Ormsby, and all of their colleagues and friends in the Irish Coast Guard.

Geoscience Ireland: Winning Business Overseas

by Sean Finlay - Director, Geoscience Ireland

Geoscience Ireland (GI) is the collaborative network connecting Irish technical experts to projects and project partners in over 50 countries. The network comprises over 30 companies which deliver the science and engineering needed for water, minerals, environmental and infrastructure development.

Ambition

Its ambition is to establish the Irish geoscience sector as a centre of excellence, or one-stop-shop, for highly-skilled, mobile expertise and innovation.

GI is supported in its ambition by the Geological Survey of Ireland – the National Earth Science Organisation within the Department of Communications, Climate Action and Environment (DCCAE) - and Enterprise Ireland. The GI initiative is led by Sean Finlay, Director, and business development activity is supported by Andrew Gaynor, Business Development Manager. In January, 2017, GI appointed two further Market Advisors – Elizabeth Murphy and Stephen Walsh - who together provide a platform for its Member Companies to win business in overseas markets. Sean Finlay, Director of Business Development in Geoscience Ireland, states that "the Member Companies have capabilities spanning a range of often intersecting specialisms from civil engineering, geotechnical and environmental consultancy and geophysical/geological services to drilling, mining and surveying."

Background

In 2009, Ireland witnessed its economic crash and a subsequent sharp fall in infrastructure spending which left many companies facing cutbacks and revenue losses. In 2010-2011, the Geological Survey of Ireland and Enterprise Ireland plus five reference companies in the geoscience sector identified opportunities for Irish companies in international markets and established Geoscience Ireland to target these opportunities thus protecting and creating jobs in the face of a beleaguered domestic sector. Since its inception in 2012, the Member Companies comprising the network have created more than 470 net new jobs in this highly technical area which incorporates a number of Science, Technology, Engineering and Mathematics (STEM) disciplines. Member's turnover now exceeds €310m with more than two-thirds generated from overseas activity.

In order for Irish companies to compete internationally in winning business, the GI network acknowledges that collaborating with one-another in a cluster dynamic, whereby trust and coopetition develops, enhances their ability to win business overseas.

Projects are sourced across the realm of public authorities, the private sector and international financial institutions and development agencies such as the World Bank, the Asian Development Bank, European and United Nations development programmes and banks.

Export Markets

Export markets are crucial for Irish companies. Ireland is a text-book example of a small, open economy and must have the capacity and support to export it skills and knowledge as well as securing inward investment. Irish companies, and Geoscience Ireland companies, have a strong track history in the UK and other mature markets such as North America and parts of Europe. As the implications associated with the looming Brexit scenario, GI agrees with the Irish public policy - as driven by the Dept. of the Taoiseach, the Dept. Jobs, Enterprise and Innovation and Enterprise Ireland - that Ireland's response must be two-fold in terms of supporting Irish companies who are already embedded in the UK but also supporting diversification in to new and emerging markets. GI Members have a strong record in emerging markets such as the Balkans and sub-Saharan Africa, and high-growth markets such as the Gulf region.

The UK

The geographical spread of projects and works completed stretches from the Orkney Island to Mozambique. GI Member Companies have a strong track record and diverse project experiences in the UK while half of its Members have offices or depots situated across the region, a number of which are supported by full time UK managing directors and staff. In a recent survey, 86% of GI Member Companies expressed concern regarding the possible effects of 'Brexit' however the Members remain resilient and pragmatic with regard to identifying and bidding for opportunities in the civil engineering and construction industry. Nonetheless, Irish companies supplying in to the UK must contend with uncertainty in investment decisions and fluctuations in the exchange rate - a 20% weakening since summer 2015 thus putting pressure on Irish companies when pricing their services for the UK market.

The Gulf and Africa

The Gulf region (or the Gulf Cooperation Council – GCC) can be difficult to gain traction in given the level of competition to capitalise on the regions ambitious investment strategy. However in the context of low oil prices, a number of GCC countries are investing in infrastructure development, renewable energy and water works.

Sub-Saharan Africa (SSA), in a broad context, is identified as an emerging market. Its cities are developing at a rapid pace thus requiring high quality planning and infrastructure support, and its minerals sector is continuously attracting inward investment – most evident at the annual Mining Indaba showcase in Cape Town which Sean Finlay attends with colleagues from the GI network and Enterprise Ireland. A lot of strategic infrastructure is supported through International Financial Institutions (IFIs) whereby an agency such

Sean Finlay - Director, Geoscience Ireland

Minister of State, Sean Kyne, T.D., with members of Geoscience Ireland, the Geological Survey and the French geoscience cluster - Pole AVENIA

as the World Bank will provide loans to low-income and developing countries to invest in their respective economic and social development programmes - such financing mechanisms lessens the risk exposure to Irish companies operating in these regions.

Ireland Today

Ireland is witnessing a growth in demand for housing, commercial and office space and industrial facilities; transport infrastructure and public utilities are being developed at a growing pace. This is a marked change in fortune since the onset of the economic crisis in 2009 – on the back of which GI was establish to assist Irish companies enter and sustain themselves in overseas markets. The technical expertise of GI Members is in considerable demand across such domestic developments.

Nonetheless, GI Members are remaining pragmatic and continue to develop their presence in overseas markets. Geoscience Ireland, by design, will maintain an international focus and, along with Enterprise Ireland and DFAT, will continue to support Irish companies in this aspect.

Experience shows that it would be remiss of Irish companies to slip back in to the comfort zone of a growing domestic market and forego traction and wins made overseas.

Team Ireland and Collaboration

The in-market support provided by Enterprise Ireland (EI) is fantastic across all regions, EI's Development Advisors and Market Advisors advise on market access matters and arranging strategic events which communicate and embeds the Irish skill-set as consistent, mobile and innovative. Our colleagues in the Dept. of Foreign Affairs & Trade's (DFAT) embassy and consular network provide great support in terms of facilitating receptions and networking events as well as visa and related advice.

Such agencies and departments are critical in providing access to networks when companies plan to enter new markets or scale its current existence; business networks – such as the Irish Business Network Scotland (IBNS), the British Irish Chamber of Commerce (BICC), the Ireland Canada Business Association (ICBA), the Arab Irish Chamber of Commerce (AICC) and Business Ireland Africa (BIA) are well-received by Irish agencies and the private sector as they continuously connect the right people together.

Having this consistent presence enhances the ability for Irish companies to export in to new markets. Key events such as ministerial-led Trade Missions and Enterprise Ireland supported Market Study Visits (MSVs) provide privileged access for Irish companies taking the step in to new markets.

In July 2017, Sean Kyne TD, Minister for Natural Resources, opened the "Industry & Innovation Conference" hosted by GI. The conference welcomed an inward visit of the French geoscience cluster – Pole AVENIA - and both clusters signed a Memorandum of Understanding directed at closer collaboration in the geoscience-sphere.

Future Ambitions

Geoscience Ireland is supported by its Department and Enterprise Ireland in its ambitions to:

- Support the creation of jobs in the geoscience sector – GI has set a target for its member companies to cumulatively create a further 200 net new jobs in 2017
- To attract larger Irish companies to the GI network to access greater opportunities. In 2017: Arup (Ireland), Lagan Asphalt, Roadstone and Mincon Group have become members.
- Establish Ireland as a leader in geoscience expertise and innovation.
- Access export markets in a collaborative manner through a cluster dynamic.
- Deliver balanced regional growth in Ireland - more than 50% of the new jobs created by GI companies in 2016 were outside Dublin.
- Gain greater traction with International Financial Institutions (IFIs)

For further information on Geoscience Ireland, please contact:

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The realisation of the economic and social consequences of a hard Brexit

by Gordon Best, Regional Director QPANI

I began last year's message by commenting on 2016 being a year of change! Well the trend has certainly continued through 2017. We are all beginning to realise the potential impacts of the UK's decision to leave the EU. Although negotiations on the UKs Brexit have not yet begun the realisation of the economic and social consequences of a hard Brexit deal is starting to hit home on all parts of the island.

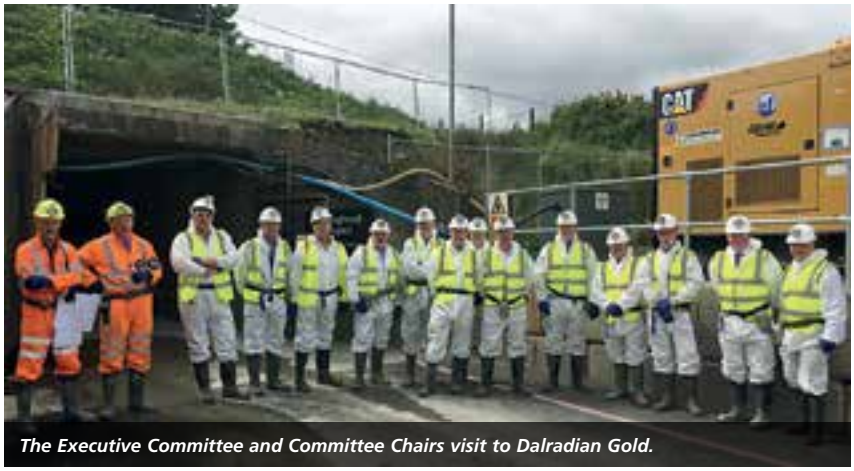
Recently I travelled to Brussels as part of an NI Business delegation recently to speak with both EU and UK officials who will be directly involved in the Brexit discussions. The intensive round of 12 meetings over the two days enabled the business organisations present to highlight the micro impacts of a hard border and potential introduction of trade tariffs and customs duties on the island of Ireland and between Ireland and Britain. It was good to learn that the Northern Ireland border issue is a top priority in the forthcoming discussions and that no one from the EU or UK delegations we talked to wants a return to the hard borders of the past.

It was also reassuring to hear that the chief negotiators on both the UK and EU side were no strangers to Northern Ireland. Michel Barnier and Guy Verhofstadt were key players in developing and delivering the EU Peace Funds for Northern Ireland. Also one of the leading UK negotiating team is Simon Case who previously worked in the Northern Ireland office.

We did learn, and were impressed by the fact, that the EU are at one when it came to agreeing the negotiating guidelines with all 27 Countries passing them in a matter of minutes. It is worth noting the clear statement within the guidelines recognising the "unique" trading position that Northern Ireland. It states "The Union has consistently supported the goal of peace and reconciliation enshrined in the Good Friday Agreement in all its parts, and continuing to support and protect the achievements, benefits and commitments of the Peace Process will remain of paramount importance. In view of the unique circumstances on the island of Ireland, flexible and imaginative solutions will be required, including with the aim of avoiding a hard border, while respecting the integrity of the Union legal order. In this context, the Union should also recognise existing bilateral agreements and arrangements between the United Kingdom and Ireland which are compatible with EU law".

As a business group we now intend to have further discussions with key players at home and in London over the coming weeks and months to press for solutions that ensure Brexit works for NI Business and our people.

At the time of writing the growing political vacuum in the North is creating a lot of uncertainty particularly around infrastructure investment. I was recently part of a business delegation that met with both Sinn Fein and the DUP to express on them the widely held wish that we need to have a working Executive and Assembly up and running again at Stormont. Local Ministers delivering a locally agreed Programme for Government and Industrial Strategy is what most people want. While funding and start dates have been agreed for a number of flagship projects including the A6, A5 the Belfast Transport Hub there is real concern that the absence of Ministers making decisions to progress much need projects in the education, health and social housing sectors will slow down and possibly reverse the growing momentum within the local construction sector. In my opinion we urgently need to have a process whereby relevant Permanent Secretaries can bring forward, through the head of the Civil Service, construction ready projects to the local political parties to get support and sign off so that projects can go ahead while political agreement is being sought. By doing this we will ensure jobs are protected, momentum is maintained in the construction sector recovery and economic growth is sustained.



The Executive Committee and Committee Chairs visit to Dalradian Gold.

It's that time of year again when our focus turns to **safety around operating and disused quarries and the risk of trespass by young people** who find playing or swimming in and around quarries an attractive pastime. Unfortunately on many occasions with tragic consequences. The Association and HSENI have sent a joint letter to all School Principals in Northern Ireland asking them to make all their pupils aware of our Cold Water Safety Strategy and the "Stay Safe Stay Out" message. There has been significant coverage on social media also. QPANI will again be joining up with NI Water to communicate the Cold Water Safety and Trespass message. The Association and HSENI have sent a joint letter to

all School Principals in Northern Ireland asking them to make all their pupils aware of our Cold Water Safety Strategy and the "Stay Safe Stay Out" message.

To date QPANI have submitted four responses to **Local Council Preferred Options Papers for their Local Development Plans**. We expect a number of the local Councils to go to consultation over the next few months. QPANI have written to all Councils highlighting our concern that the Councils have not as yet undertaken the appropriate economic assessment, consultations and background work on current Aggregate and Mineral resources within their Council area. QPANI contend that the POP process of Mineral Land Use Zoning has to be based on sound economic and geological data before any statement of intent is made in relation to declaring areas of mineral constraint or areas of mineral safeguarding. To do anything otherwise would render the Preferred Option Process flawed and in danger of being legally challenged. Furthermore we have re-stated our opposition to the designation of areas of minerals constraint as we believe it goes against more recent EU Guidance which can be accessed using the following link: http://ec.europa.eu/environment/nature/natura2000/management/docs/neei_n2000_guidance. Basically its sets out the reasons why Extraction in Natura 2000 sites or national, regional or local protected areas should not be banned but subject to case-by-case verification both in land use planning and during the actual permitting procedure.

QPANI has had a number of meetings with senior officials in the Department of Infrastructure and the Department of the Economy about the need for a **Northern Ireland Minerals Forum**. This forum would be similar to the Minerals Forum set up in GB under the banner of the CBI Minerals Group and led by MPA. We believe there is a real need for a structured and sensible debate to take place in Northern Ireland about the current and potential economic and social benefits a developing and successful Minerals Industry means for the NI economy. We would see the make-up of the group being from Department of Infrastructure, Department of the Economy, Minerals Industry, Politicians, Strategic Planners, Local Authority Planners and Environmental NGOs. This is very much in its infancy but there is definitely a commitment to take this forward.

The Association has also been **partnering the HSENI on delivering vehicle safety workshops**. To date there have been 9 workshops in total, 4 of which were held at the request of individual member companies for their own workforce. In total 156 employees have attended from 26 companies. Feedback from the workshops has been very positive.

Ken Logan informed our Safety Committee that HSENI intend to begin another round of workshops in the autumn focusing on health covering RCS, Noise and Manual Handing

We have also had a very successful round of Pollution Prevention Workshops in partnership with the NI Environment Agency. A total of 32 employees from 16 companies attended.

In May, **Dalradian Gold** kindly hosted a visit by our Executive Committee and Committee Chairs to their Curraghinalt Project near Omagh in Co Tyrone. The visit was extremely informative and enjoyable taking in a 2 hour tunnel tour and explanation of above ground operations.

We wish DALRADIAN every success in the forthcoming planning application. If granted this operation will bring significant employment and economic and social benefit to communities in the Sperrins and wider area.

As always, I am honoured to be asked to pen this short article for the IMQS Journal and may I wish IMQS and all your members every success in 2017 and the coming years ahead.

Guidance on Specification, Procurement, and Use of Hardcore under Concrete Slabs and Footpaths

by Liam Smyth FIEI, Sustainability Manager, Irish Concrete Federation Ltd.

Following the recommendations of the Report of the Pyrite Panel 2012, the National Standards Authority of Ireland (NSAI) Aggregates Panel began work reviewing the existing national product guidance and the development of a Code of Practice with regards to the procurement, and traceability of those products.

With regard to product standards, this resulted in the detailed Standard Recommendation 21:2014 + A1:2016 (**S.R. 21**), the Irish national guidance on harmonised standard I.S. EN 13242:2002+A1:2007, which is the standard that defines the characteristics and properties required of aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction. S.R. 21 contains six annexes, of which Annex E provides guidance for the specification and production of aggregates used as hardcore under concrete slabs and footpaths.

The Code of Practice resulted in **I.S. 888:2016** - Code of Practice for the Procurement and Use of Unbound Granular Fill Hardcore Material for use under Concrete Floors which outlines the requirements for the ordering, traceability and placing of hardcore for use under concrete floors and footpaths. This an important document which should be read in conjunction with the new national product guidance, and is aimed at ensuring cradle to placement accountability for the S.R.21 Annex E materials. The key aspects of these two documents are reviewed below.

Under the National Building Regulations Technical Guidance Document (TGD) C – Site Preparation and Resistance to Moisture, hardcore for use under concrete floors and footpaths must comply with S.R. 21 Annex E. An upcoming review of TGD C is expected to reference the most recent version of S.R. 21 and the placing details specified in this new standard I.S. 888:2016.

CE Marking to AVCP System 2+

As I.S. EN 13242:2002 is a harmonised standard, material produced and marketed in accordance with this standard must be CE marked and the manufacturer must prepare and provide a Declaration of Performance (DoP). Within I.S. EN 13242, only S.R. 21 Annex E material requires Assessment and Verification of Constancy of Performance (AVCP) system 2+ under the Construction Products Regulation 2011 (CPR), as a public confidence measure on foot of legacy pyrite issues. This requires an annual independent audit and certification of compliance by an independent (notified) certified body of the manufacturer's Factory Production Controls (FPC) as outlined in I.S. EN 13242:2002. Thus, any manufacturer being audited because of Annex E material production will actually gain AVCP 2+ for all 6 annexes, as it is the Irish adopted European standard that is audited, not an individual annex of the national guidance, and the notified body's certificate reflects this.

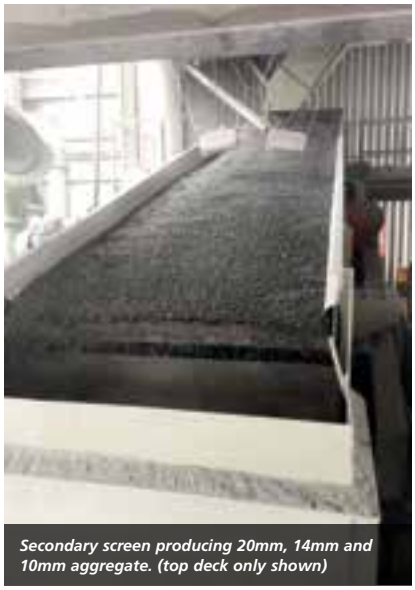
The DoP will most likely be available on the supplier's website or otherwise be sent out with each load despatched. Where Annex E material is supplied, it should include a statement of the intended use: "Unbound Granular Fill (Hardcore) for Use under Concrete Floors and Footpaths".

Geological Assessment of the Quarry

The quarry deposit and S.R. 21 Annex E finished product stockpiles must be subject to initial and ongoing assessment,

Blasted material being tipped into primary crusher.

Blasted material feeding into primary crusher.



Secondary screen producing 20mm, 14mm and 10mm aggregate. (top deck only shown)

Lanway secondary crusher reducing stone from 100mm into aggregate sizes.

including geological, chemical and petrographic assessment as required by a competent professional geologist. Following the initial assessment, an additional geological assessment must be carried out at least every 3 years, or when there is a major change in the lithology in the quarry, or as recommended by the professional geologist, who must be a professional member of the Institute of Geologists of Ireland, or an equivalent professional body, with a minimum of 5 years of experience of geological assessments of quarries and aggregates.

The professional geologist must provide the quarry operator with a report with particular reference to potential limitations on the end use of the aggregates. This report may cover many different uses of the material as long as each intended use is addressed clearly.

Amongst the key issues for review by the professional geologist are characteristics relating to material's durability and sulfur content. While the guidance requires that Annex E materials have maximum Total Sulfur (TS) content of 1%, petrographic analysis is required where TS is greater than 0.1%, with materials having TS less than or equal to 0.1% deemed acceptable immediately on that characteristic. All materials must comply with an Acid Soluble Sulfate maximum of $AS_{0.2}$ thereby limiting the reactive potential of the material.

Annex E material must have a maximum of 10% mudstone (argillaceous material) based on visual inspection by the professional geologist. Other key parameters tightened or with newly specified limits to ensure greater durability, and therefore less susceptibility to development of pyritic heave, include LA Value, Magnesium Sulfate, and Water Absorption, though T3 Blind is exempt from these requirements.

Gradings and Use of S.R.21 Annex E Hardcore

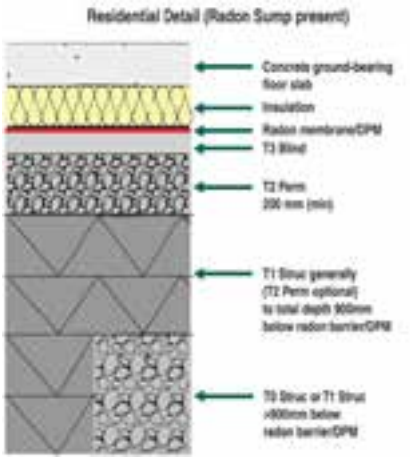
The current document provides for four different materials gradings, at least two of which are needed under every concrete slab or footpath (and within 500mm of each side of such concrete). They range in size to allow for deep fill to normal fill, for gas permeable fill and for blinding of whatever of the other fills have bene used under the pad. All structural fills are crushed material (fully crushed rock or 50% crushed faces with gravel).

T0 Struc is a 0/125mm for use at depths at least 900m below Damp Proof Membrane (DPM) and is not permissible less than 900mm below DPM. T1 Struc is a 0/32mm crushed rock or 0/40mm crushed gravel which is available to be used at any depth below the pad. T2 Perm is a gas permeable material which can be used as a replacement for T1 Struc or in conjunction with that material where a radon sump is being used, as long as a minimum depth layer of T2 Perm is used to ensure radon gas transfer to the sump. T3 Blind is a 0/4mm used to blind off the hardcore used immediately beneath the DPM/radon barrier.

I.S.888 sets out the placement of these materials in diagrams within the standard, which have been adapted and integrated into the diagram below:

Testing of S.R.21 Material

Initial type testing is carried out on the aggregate before it is placed on the market and thereafter in line with the Factory Production Controls set out in the standard and national guidance. The professional



geologist may recommend a change in the frequency of any or all testing, from the more frequent testing regime set out in S.R. 21 Annex E to a lesser frequency, based on experience and knowledge of the material as long as the FPC requirements of the I.S. EN 13242 standard are complied with for product conformity with the standard, and also in order to maintain certification to the AVCP system 2+. The frequencies set out for testing refer to production periods which may be continuous or cumulative days where production of the product is sporadic, as it will be in most quarries.

Delivery of S.R.21 Annex E Hardcore

Both documents set out various responsibilities with regard to the correct ordering and despatch of the material. I.S.888 requires that the builder communicate to the supplier in writing that the intended end use of the hardcore is for use under concrete floors and footpaths in accordance with S.R. 21 Annex E, and must further ensure that all hardcore for use under concrete floors and footpaths is ordered in accordance with the project specification, I.S. EN 13242 S.R. 21 Annex E. In the event of a dispute, compliance or not with these requirements may turn out to be key issues with regard to who knew the intended use and whether the appropriate material was ordered at the time of supply.

Material from plant being conveyed to stockpile after secondary screen.

The delivery docket must include information on designation, source and manufacturer, type of aggregate, aggregate size, date of dispatch, serial number of the ticket, reference to I.S. EN 13242 and a statement of compliance as appropriate stating "SR21 Annex E – T0 STRUC", "SR21 Annex E – T1 STRUC", "SR21 Annex E – T2 PERM", or "SR21 Annex E – T3 BLIND".

The builder's procurement arrangements for hardcore must ensure traceability from the point of collection or delivery, the handover point from supplier to the builder, to the location within the works where the material is incorporated.

Hardcore Inspection and Traceability on Site

The hardcore should be visually inspected by the builder before and/or during placing and compaction. Where required by the project specification, samples for testing should be taken on site. If as a result of visual or sample testing the product is not deemed to be compliant with S.R. 21 Annex E, agreed appropriate action should be taken including alerting the manufacturer and placing the material in quarantine and marking the material as non-conforming on site.

The builder should have a Method Statement for the project works detailing the sources and manufacturers of all S.R. 21 Annex E hardcore to be incorporated into the works, the arrangement for

managing and documenting individual stockpiles to ensure that only material from a single source is stored in any one stockpile, the arrangements for recording the precise location on site where the material from each source is incorporated, and the appointment of a designated person for ensuring that the builder's method statement is implemented on site. This Method Statement and compliance with same is the requirement of the main builder, irrespective of whether the placing of the hardcore is sub-contracted or not.

Prior to the placing of the S.R. 21 Annex E hardcore, the builder must also make available, where requested, documentation in respect of each proposed source of hardcore which identifies the manufacturer, and provides full details of testing and certification of the hardcore for compliance with S.R. 21 Annex E, including a statement of compliance from a professional geologist that the material is suitable for use as hardcore under concrete floors and footpaths.

Summary of Supply Chain Responsibilities

I.S.888 contains detailed responsibilities for both builders and manufacturers with regard to traceability and certification, including retention of documentation in case of issues arising at a future date. It acknowledges the potential for different forms of supply agreements by setting out two different scenarios, namely where the builder orders directly from the manufacturer and the manufacturer supplies the builder directly, and the alternative scenario where the builder orders directly from an intermediary and the manufacturer supplies the Intermediary who supplies the builder.

There are obvious consequences with regard to the creation of legal relationships under contract and tort law. The I.S.888 requirements are too many to go into here but are based on clear accountability from cradle to placement and clear points of handover between parties in each scenario. It is clearly of immense importance that all potential parties to such procurement and use arrangements are fully aware of their own responsibilities.

Additional Remarks

It is clearly imperative for all parties that material is pre-approved regardless of the supply chain chosen, and that evidence of traceability is sought by the builder where an intermediary is used.

In the case where there is an intermediary involved who is disclosing (and relying on) the original manufacturer for product certification and CE marking, the intermediary takes on the role of distributor, notwithstanding contractual responsibilities formed.

It should be noted that where an intermediary does not disclose the name of the original manufacturer, then the intermediary becomes the 'de facto' supplier and is wholly responsible for product compliance and for CE marking of the products supplied. It is not clear how such a scenario complies with I.S 888:2016 with regard to identification to the manufacturer.

Closing Remarks

Together these two documents, when properly specified and followed, can do much to ensure that quality is assured within this vital aspect of construction. It is vital that the construction industry is educated on these issues if this objective is to be attained. While much of the industry appears to have knowledge of S.R.21 Annex E, the requirements of I.S.888 are relatively unknown which disadvantages the party in ignorance. The review of TGD C is now urgent to adopt these documents formally. More detailed guidance is available from the ICF website at http://www.irishconcrete.ie/library/publications/

Photos courtesy of Bennettsbridge Limestone Ltd

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Industry Review

by Gerry Farrell, Chief Executive of the Irish Concrete Federation

It gives me great pleasure to contribute to the annual review of the Irish Mining and Quarrying Society for 2017. At the outset I would like to thank the Society's President, Brendan Morris for the invitation to contribute to this highly recognised publication and I would like to wish the Society's members ongoing success for the coming year.

My usual opening to this article is a commentary on the **current state of the national economy and the construction sector**. There is little doubt that our economy continues to perform strongly, the most 'concrete' evidence of this illustrated in the continued drop in unemployment and corresponding growth in job creation. While it may seem rather simplistic, I think it is reasonable to say, that if we didn't have **the spectre of Brexit in** the background, we could be very confident about the economic outlook for our country for the coming five years. However, that is clearly not the case and while much remains to be decided upon in the 'divorce' negotiations, it is clear that Ireland will have to readjust to develop a new relationship with our largest and most important trading partner. While the majority of ICF members, with the notable exception of the highly successful Irish precast concrete sector, may not be directly impacted, the indirect effects of Brexit on our own sector will be deeply felt. With a population of only 4.8 million people, it is inevitable that many businesses focussed on growth look to the UK as a valuable outlet for products and services. Anything which damages access to this market will directly impinge on these businesses, many of whom are either direct customers or the employees of direct customers of our industry. No part of this economy will be immune from the impact of the UK decision to exit the EU and it is incumbent on the Government, the state's development agencies and businesses themselves to plan for the new reality of our largest customer existing outside of the EU.

Brexit aside, the construction industry in Ireland continues to experience continued growth at the current time. In my contributions to this publication in recent years, I have always tended to err on the cautious side when giving a future perspective on the industry's fortunes. Unfortunately this year will be no different. To put facts in context, construction activity in Ireland this year, will still be less than 40% of the levels of a decade ago, notwithstanding the recent improvements in activity levels. Furthermore, growth in activity continues to be concentrated in urban centres, in particular Dublin, with much of this underpinned by investment by the multinational sector. It is clear that activity levels in rural Ireland will continue to be mixed, with limited investment in housebuilding, farm buildings and public infrastructure. It is inevitable that house construction levels will increase in the future to meet the demands of our growing population. However, it is also clear that the price of housing has the potential to become a major impediment to home formation, particularly for our young people and families. It is also clear that the cost of house construction needs to be tackled by Government and ICF welcomes the current ongoing studies on house construction costs currently underway by the Department of Housing, Planning and Local Government and the Housing Agency. In this context, ICF produced research in 2016 to show that **the cost of quarry-based products such as aggregates**, ready-mix concrete and concrete blocks **accounted for less than 5% of the overall cost of building a three bed, semi-detached house in Dublin**, a fact that will surprise many. It is a source of constant frustration to our members when public commentary on such a topical issue is often so uninformed that blame for the high cost of building in Ireland is attributed to the cost of the basic construction materials such as concrete. We await the findings of the ongoing studies into house-building costs with great interest and we hope that these studies will give clear guidance to Government on the options available to it to reduce these costs.

ICF remains hopeful, rather than confident, that Government will invest in the **public infrastructure** necessary to enable Ireland to meet the needs of its growing population and to attract investment to this country in the future, particularly in the aftermath of the decision by the UK to leave the EU. All of the key industry and economic advisory bodies in the country are unified in their calls for investment in the country's education, transport, energy and communications infrastructure and while there have been some recent welcome increases in spending, per capita investment levels in infrastructure remain the second-lowest in the EU. While we all appreciate that resources are scarce, Ireland needs to invest in our people and our public infrastructure in a sustainable manner to meet our future needs.

In March of this year ICF made a submission on the draft **National Planning Framework – 'Ireland 2040'**. The draft strategy outlines that there will be an additional one million people living in this country by 2040. While the document was undoubtedly comprehensive, a perspective of interest to those reading this publication is that while much attention is rightly given to highlighting our future infrastructural needs, there is rarely recognition that the sustainable supply of aggregates underpins this development. In our submission on the draft National Planning Framework, ICF has called for a national policy which recognises the strategic imperative of future access to our natural aggregate reserves. ICF looks forward to engaging with Government on this issue as the strategy develops. As part of ICF's submission on 'Ireland 2040', we focussed on the planning framework for quarries with a view to promoting a more complimentary and co-ordinated regulatory framework. The enforcement of planning and environmental legislation on a consistent manner throughout the country is essential to achieve this objective.

Indeed, it can be said that the lack of consistency in enforcement of planning and environment requirements in the extractive sector has been one of the causes of damage to Ireland's environment in recent years. Too often, advantage in the market place is bestowed upon the operator of least cost thereby conferring commercial advantage to those who avoid compliance costs, particularly in the area of planning and the environment. It is essential that the National Planning Framework clearly highlights compliance with planning and environmental requirements as a primary objective for the sector in the future.

I have mentioned the undeniable fact that Ireland's future development will require access to our aggregate resources in a sustainable manner to provide the materials necessary for the construction of our built environment. As the past year has shown, Ireland continues to suffer from some of the more negative quality legacies the of the construction boom of the past decade. It is regrettable that, despite the many examples of fantastic buildings and infrastructural projects in this country, much of the commentary understandably continues to focus on examples of poor construction with end customers often left severely impacted by the mistakes of others. As a key part of the construction supply chain, our industry has an important role in ensuring that the materials used in the construction of Ireland's social infrastructure are of the highest quality. Locally produced aggregates and concrete are indeed the backbone of sustainable construction and ICF continues to work with other stakeholder organisations to continuously improve standards and education in our industry. Many of the **standards applicable to products emanating from our industry have been updated in recent times and one of ICF's key priorities is to ensure that all of the necessary stakeholders are fully informed on the updated standards**. As is the case with planning and environmental compliance, it is imperative the commercial advantage in the market place is conferred to those suppliers that manufacture products in compliance with the relevant standards.

As activity increases in our urban centres, there will have to be a renewed effort to manage safety across the construction chain. As ever, ICF continues to work with industry and the Health & Safety Authority to promote a culture of continuous improvement in relation to safety in all of our members' locations. ICF was happy to work with the Society and our partners in Northern Ireland on the holding of the **All-Island Quarry Safety Seminar** in late 2016 in Armagh and we are progressing many progressive safety initiatives through the Quarry Safety Partnership on which IMQS also participates. The greatest risks of accidents often occur following a protracted period of low activity levels, low profitability and low level of investment in plant, equipment and personnel. Therefore, I would appeal to all involved in our sector to immediately put safety to the forefront of their list of priorities so that the industry will prosper in both a vibrant and safe operating environment.

As ever, the future outlook for our industry is difficult to gauge. It is a fact that our sector is made up of a large number of small businesses located throughout the country. These businesses have always played a key role in the local life and economy of their surrounding area and will continue to do so in the future. Increasingly, we also have companies in our sector who are developing valuable markets abroad, particularly in the UK. The operating environment and regulatory requirements are ever changing and the industry will have to continuously evolve to meet these new requirements and challenges. I am sure that the Irish Mining and Quarrying Society, like the Irish Concrete Federation will continue to devote all of its resources to assist the industry play its role in Ireland's future development while maximising its own potential. I wish the Society continued success in their important work on behalf of its membership for the coming year.

Galantas Gold
From Open pit to Underground and Exploration Developments

by Dr Sarah Coulter, Senior Geologist, Galantas Gold Corporation

Galantas Gold Corporation operated an open pit gold mine near Omagh, Northern Ireland, between 2007 and 2012. In 2015 the company was granted planning permission for an underground operation, development of which began in March 2017.

Quartz vein-hosted gold mineralisation was discovered on the Cavanacaw property by Riofinex in the mid-1980s. Intensive exploration across the eastern half of the Lack Inlier identified several key targets. Five veins are known within the Galantas 220 acre freehold, the most recent identified through drilling in late 2015. A further twelve veins lie within 1 km of the mine site. Kearney vein has been the focus since it was uncovered in 1987, ultimately forming the site of the open pit. The vein system, traced through drilling > 850 m along strike, will be the starting point for underground mining activities (Fig. 1). Since mid-2011, 18,980 m of diamond drilling has taken place, directed primarily at the Kearney and nearby Joshua veins. In fact, 71% of all holes drilled since the first discovery have targeted these two veins, therefore, there remains great potential for increasing the resource within the immediate vicinity of the mine. A NI 43-101 compliant resource estimate, preliminary economic assessment and detailed feasibility study was filed in September 2014. Plans for the initial six years of underground mining have been based on this resource.

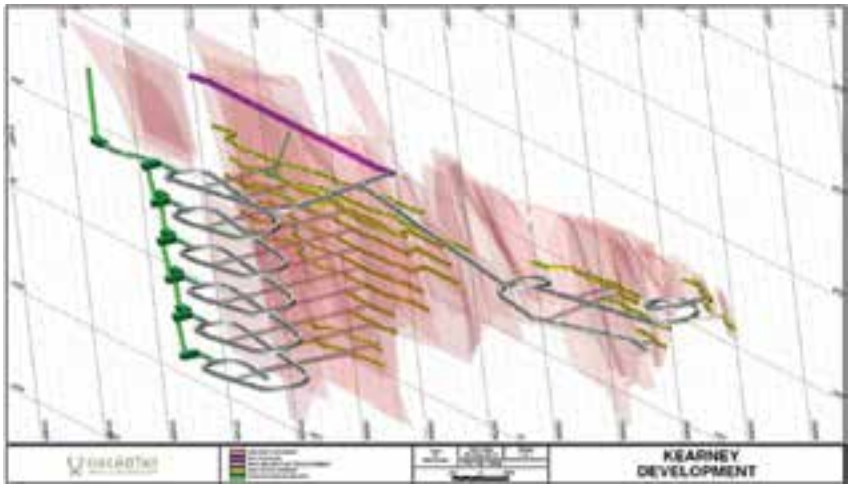

Fig. 1: Kearney underground mine plan.

Longhole stoping methods are expected to support production of 30,000-40,000 Oz of gold a year at a head grade >5 g/t. The mine site has a fully operational processing plant and tailings facility (Fig. 2). Regular shipments of flotation concentrate, rich in gold, silver and lead, were sent to a Canadian smelter during open pit workings. The same successful strategy will be employed during the underground phase. A judgement in respect of a judicial review of the planning permission is still awaited. The Board of Directors, having considered the legal advisors report and the planning consent, decided to proceed with underground mine development. Significant funds were raised through a placing at the beginning of the year and this will finance the early stages of development. The portal was recently constructed at the base of the open pit, however, development of the tunnel has been hampered by restrictions requiring police cover for blasting. Increased availability of cover in June allowed Galantas to get back on track and advance the tunnel (Fig. 3). The company is currently

Fig. 2: On site processing facility.

Fig. 3: Early stage of underground development

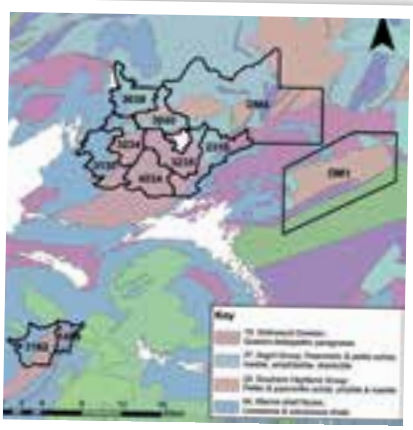

Fig. 4: Galantas held exploration licence areas. Geology base map (1:500,000) copyright DCCAE and the Government of Ireland.

operating 24 hours 5.5 days a week and the workforce has increased to 16 personnel. Once fully established, the underground mine is expected to create >100 jobs.

Galantas Gold currently hold 11 licences for exploration over 766 km2 (Fig. 4), two within Northern Ireland (NI) and nine in the Republic of Ireland (ROI). The licence block covers a diverse geology; prospective Dalradian lithologies are dominant, cut by major regional north-east trending faults. Lower Carboniferous limestones fringe the west of the block, associated with historic occurrences of lead, zinc and copper. An area of pre-Dalradian basement occurs to the south. The Tellus and Tellus Border datasets were crucial for effectively delineating initial exploration targets. Isolated magnetic and conductivity anomalies within the pre-Dalradian basement were investigated by Galantas geologists in 2015/16. Clusters of anomalies for chromium (1660 - 7290 g/t) and nickel (2040 - 3060 g/t) were found in outcrop considered to be derived from ultramafic intrusions. Gold in streams sediments (2.5 g/t highest), and outcrop containing copper (3430 g/t) and silver (3 g/t), are present within 3 km of the largest geophysical anomaly. Furthermore, minor vein hosted mineralisation has recently been discovered in a different ROI licence, bearing a similar trend to major regional faulting. Notable gold (1.82 and 2.15 g/t) and silver (18.7 and 32.7 g/t) values were recorded within a 5 m cutting. This licence runs adjacent to the largest NI Galantas licence, in which a trend of gold pathfinders has been identified. Whilst the main focus for Galantas is firmly on developing the underground mine, the company continues to explore potential within its prospective regional licences.

Implementation of next generation mine planning systems at Boliden Tara Mines

by Borjan Arias, Planning & Project Engineer at Boliden Tara Mines

BOLIDEN TARA MINES, WHO WE ARE

Boliden Tara Mines is Europe's largest zinc mine and is situated in Navan, County Meath, 50 Km North of Dublin. Production began in 1977 and over 90 million tonnes have been produced to date. New Boliden acquired the mine in 2004. Around 2.6 million tonnes of ore are mined annually for the production of zinc and lead concentrates.

HISTORY OF MINING SOFTWARE

The mining industry has always required a certain degree of customisation when it comes to software CAD applications and computing technologies. In other sectors such as construction, civil engineering, heavy industry, etc., when the final stage of a project, e.g. such as a building, bridge, or power plant is approved and designed, unless a critical unexpected event happens such as an engineering failure or a natural disaster, the final design will be subject only to minor changes. The reason for this high degree of compliance to plan in all of these sectors, is due to the fact that there are very few uncertainties on all the stages of the project. Mining however has to deal with the forces of nature and has learned to live with a large number of unknown variables and a degree of confidence based always on the best-known information at a particular point in time but which in some cases might not be enough to produce a final layout of infrastructure. The implications of this variability are precisely what make the mining industry one that has always been extremely demanding in terms of what software capability requirements. Usually the design of the mine incurs constant variations especially in those areas planned years ahead; therefore, any software capable of fulfilling the needs of the mining industry needs to be powerful, quick and versatile.

MINE PLANNING SOFTWARE AT TARA

Back in the early 1980´s when Tara had to choose what software program to use to assist the mine planning and mine design process, none of the emerging and most popular CAD packages that the computing industry was developing seemed to have enough flexibility to address all of the requirements that an underground mining operation required. Probably the most important limitation CAD programs suffered during their earlier stages of development was the inability to work with volumes and perform Boolean operations with solids. This is a critical need for the mining industry and probably one of the first that was addressed by the few early mine-specific software packages appearing in the market. Most of the physicals that are required to plan a mine are rather volume or mass related and because both the development infrastructure and the mining units (stopes) are quite commonly irregular shapes, obtaining valid closed triangulations usually requires powerful Boolean engines.

After having analysed the whole available range of products in the market, Tara Mines decided to implement Eagle from Macrovision in 1984. Eagle was not really a fully commercial CAD package but instead a Graphics Development Tool heavily used in the architecture sector and designed to empower users with proficient IT skills so that they could build their own libraries and applications. After 30 years of use and self-development at Tara, the site had made a remarkable tool by providing the technical team with a collection of customised, tailor-made solutions for geology, mine planning and surveying. Eagle also became quickly the core platform to control the data-management process onsite, being connected at its final stage to multiple databases and keeping a record for all the historical data of the mine.

WHY CHANGE?

Times change and the highly competitive environment that software developers are living in has boosted the amount of mining specific applications that are available for the industry. This situation, combined with an imminent shortage of Eagle skills at the mine-site due to the retirement of key senior people, has encouraged Tara Management to make a move from Eagle to one of the prominent world-wide accepted mining software packages.

CHALLENGES AHEAD

The situation was challenging even though software technology has experienced great progress during the last decade with quite a few visually impressive mining packages on the market. The fact that the Eagle system was self-developed for so many years meant that the new chosen one did not only have to match the current state-of-the-art industry standards around the globe but also needed to be customizable so it could continue to address the existing Tara-specific processes with the same efficiency Eagle proved to have, while at the same time overcome the existing limitations. These limitations are mostly related to data exchange and auditability, graphics engine rendering lack of power and a Boolean algorithm that was behind the capabilities of other competitors when having to deal with complex triangulations such as scans and other irregular shapes.

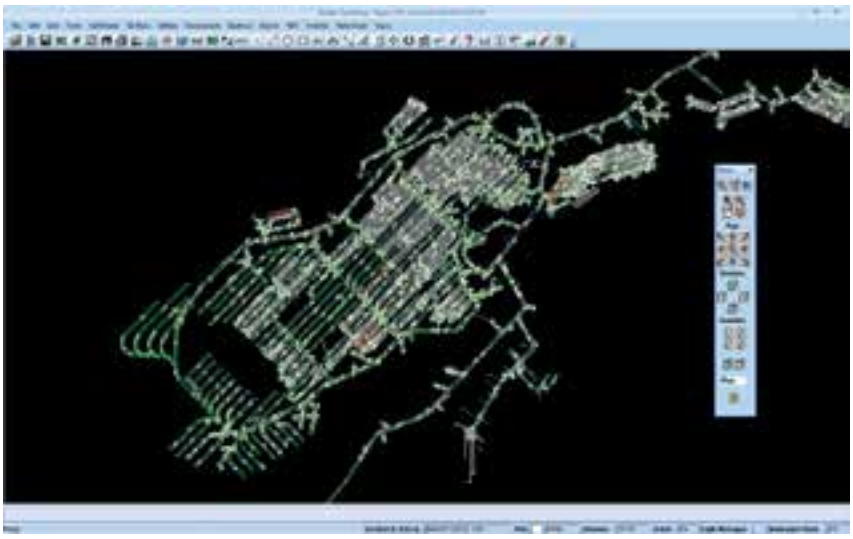

Figure 1: Eagle display window. One of the active levels of the mine.

Figure 2: Deswik.MDM Visualizer. As-Built 3D surveyed development.

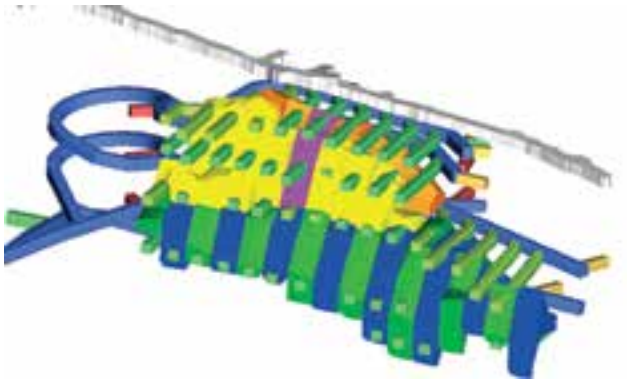

Figure 3: Long Term designs for stopes and development. One of the current active blocks.

The second problem the site was experiencing was related to how the schedules were built to coordinate all the activities happening underground. Microsoft Excel was the chosen scheduling tool and because it is not a Gantt Project application it involved having a separate spread-sheet for every individual set of activities: one for development, one for backfill, one for blasting and mucking, etc. Having these independent plans generated by different people implied that any uncommunicated lag in the sequence of activities meant necessarily having a certain conflict in the entire downstream sequence from the first delayed task until the last one in that particular critical path. Because of the tight nature of the confined spaces in an underground operation almost all the activities are interrelated with each other, so by keeping independent spread-sheet schedules, any change in the plan would cause cumbersome updating work involving rescheduling of activities in all these spread-sheets. The risk of overlap between activities with such a decentralised system is almost guaranteed, generating conflicts, congestion and unlevelled resources.

TECHNICAL DETAILS OF THE IMPLEMENTATION

After reviewing all available software products in the market, Boliden Tara Mines decided to implement Deswik Suite to replace Eagle. The software was benchmarked against the previous system and proved to be capable not only of addressing all the previously mentioned requirements but also enhancing quite significantly many processes that had constituted a bottleneck for years. The different key challenges faced during this implementation are explained in detail below.

1 – Data Management:

Deswik.MDM is a data management application that stores both graphic and scheduling data in SQL databases. This tool allowed the creation of a modern and more integrated replica of the Eagle system from the data management perspective. All the historical data was transferred with no major complications from Eagle to Deswik Graphics despite a few difficulties with the older datasets. Moving forward, this tool will be the only one holding both the historic, the live and the latest version of all graphic and scheduling data for the site: surveying, mine design, mine services, end mine infrastructure, constituting a unique central set of databases for most of the relevant mining data.

2 – Mine Design:

As explained above, it is important for mine specific CAD software to have the flexibility to quickly create new designs. Eagle was extremely efficient in short-term adjustments but not dynamic enough to layout long-term block designs. This circumstance affected the way longer-term areas were being scheduled. The tonnage within the reserves of any of these mining blocks was calculated based on what it was believed to be mineable applying very conservative recovery and dilution factors. The amount of development required to access these areas was estimated using empirical formulas developed from actual data recorded in similar or adjacent zones and the physical dimensions of the block. There were quite a few of these long-term reserves with an equivalent number of calculated development meters but with no physical 3D layout for the infrastructure required to mine them.

Deswik proved to be much better in doing long-term designs because Deswik.CAD has easier workflows assisted with some specific tools such as the Auto-Development Designer and the Stope Optimizer.

In the short-term environment, Eagle still was more efficient doing new in-fill designs or adjustments to existing ones. For Deswik to succeed as a design package at Tara, it needed to match Eagle simplicity when addressing this type of work. These tasks represent the largest bulk of design workload for the engineering team in their day-to-day work.

Deswik.CAD has the capability to implement user-developed macros. A small project was needed to build a customised tool for Tara that would enhance the in-fill development design process in Deswik for the engineers while maintaining a user-friendly interface that would still be accessible to all members of the team regardless of their computing background. The project combined knowhow and feedback coming both from Deswik consultants and from members from the Tara team until the final product was delivered. The tool allowed creating a few design template standards that could be easily adjusted for every specific case. The best example is the combination of a Truck Loading Bay and a Remuck. The time to complete this design task in Eagle would be around a minute, the equivalent task using Deswik standard CAD tools would take around 2 minutes to complete and the time using this newly developed Deswik-Tara tool was around 20 seconds. The new process was 66% more efficient than Eagle and 83% quicker than using the standard Deswik tools.

At the moment, Boliden Tara Mines are implementing the Lean philosophy in a complex production environment so every little improvement that helps to apply standards repeatedly and reduces wasted time throughout the whole planning process is embraced. The ability of Deswik to adapt to all kind of environments and to build client-customised macros and process maps was a key deciding factor for purchasing Deswik at Boliden Tara Mines, especially coming from the un-restricted and creative environment that Eagle provided for years.

3 – Boolean engine (3D operations with solids):

New surveying techniques and instruments allow the performance of such detailed reconciliation analysis that they even provide a constantly updated learning library to base future planning assumptions and estimations. The power of these survey enhancements can only be used when there is an equally powerful Boolean Engine able to perform complex solid volumetric calculations. Deswik has a reputation in the market for being one of the best mining software packages for dealing with solids. The survey development pickups which historically consisted of 4 lines (Back, Floor and Sidewalls) were complimented with 2 additional lines (Lower shoulder and Upper shoulder) and the data has been fed into the automatic tool within the Deswik Suite to create more detailed as-built volumes. These enhanced solids will be used in the development reconciliation ore and waste reconciliation procedure, replacing the

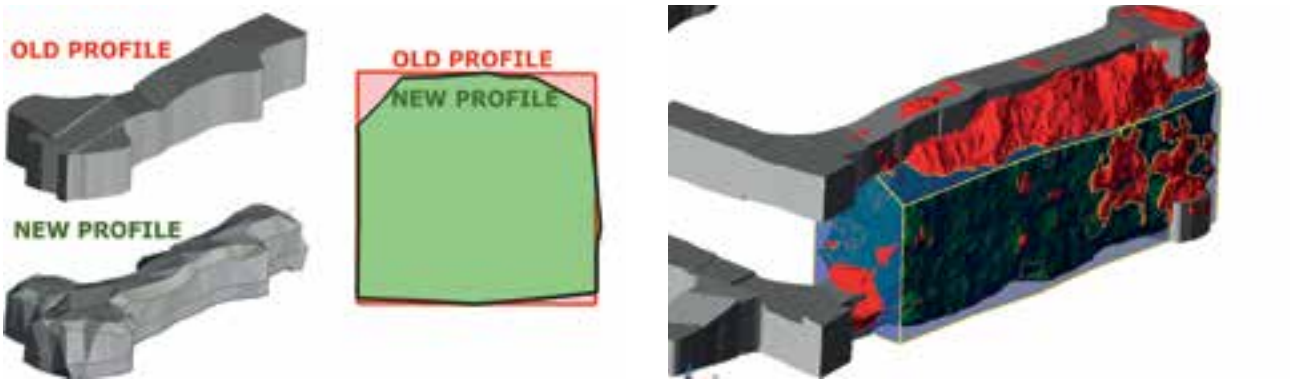

Figure 4: Comparison between Eagle and Deswik 3D As-Built solids for the same heading.

current existing method which is based on a more generic and less detailed approach.

Scans had been used in Eagle for a long time for multiple applications such as analysing the result of a blast, and understanding the shape of an old drift. But these scans, due to their complex triangulations were never used to generate closed volumes. Deswik provides the necessary tools to use these scans for volumetric calculations.

4 – Scheduling Integration:

One of the key functionalities where Deswik is felt to be ahead of its competitors is the real-time integration between Deswik. CAD and the Deswik.Sched, which are interactively connected. Any updates in the geology or the designs are automatically converted into variations of the schedule timing and physicals. This integration solved the first bottleneck that had to be dealt with, which was the amount of time required to transfer all the data from Eagle queries to the different spread-sheets.

The second bottleneck was the existence of parallel plans for different activities of the mining sequence in multiple independent spread-sheets that might easily experience overlaps and conflicts hard to flag. Because Deswik.Sched is a Gantt-based scheduling application, it was used to build a "Master Schedule" containing all the critical activities of the mining cycle, making redundant the rest of the sub-plans. This unified schedule increased the workload of the scheduling engineer so instead of assuming a more conventional structure where engineers can work in designs and schedules simultaneously, the team was divided and specialised for each of these tasks. This strategy proved to be a success getting engineers more specialised in their daily duties. It also allowed the scheduling engineers not only to increase their work output by adding a whole new set of activities to the "Master Schedule" that previously were planned independently, but also to be able to maintain an extended rolling plan (3 months ahead updated monthly and 1 year ahead updated quarterly).

Another task that used to take weeks using Excel was running different "What if…?" scenarios for LOM plans, Budgets, etc. Every iteration was practically resetting almost all the assumptions and rerunning the whole scenario with very little time saved. Because Deswik has automatic scheduling tools based on constrains, targets, priorities and resources, any of them can be changed and in just a few hours iterations can be re-run that used to take weeks.

CONCLUSIONS

New mining software has such a wide range of possibilities and offers so much empowerment for the end users. Implementing these new solutions represents a key milestone in the strategy of many mining companies who are striving to achieve increasingly demanding targets on efficiency, utilisation of resources, cost optimisation and safety.

Tara has overcome many challenges during the first phase of replacing a 30 year old system with a state-of-the-art one. Mine planning and scheduling at Tara have improve exponentially allowing the site to do higher resolution designs for long-term areas, have new tools to do short term designs that boosted the productivity of the team, construct a better understanding of what has been mined through detailed volumetric analysis and perform not only one but multiple scheduling scenarios. All of this provides management with better knowledge to optimize the Life of Mine Plan.

Nowadays we tend to put too much importance on technology but the real key to the success of these new systems is the people and Tara has been operating successfully for so long thanks to our people. Software is not meant to replace engineers but to empower them. There are still big challenges ahead of us and the complete replacement of the Eagle system is not finished yet but the foundations are built and with our remarkable group of professionals, success is guaranteed.

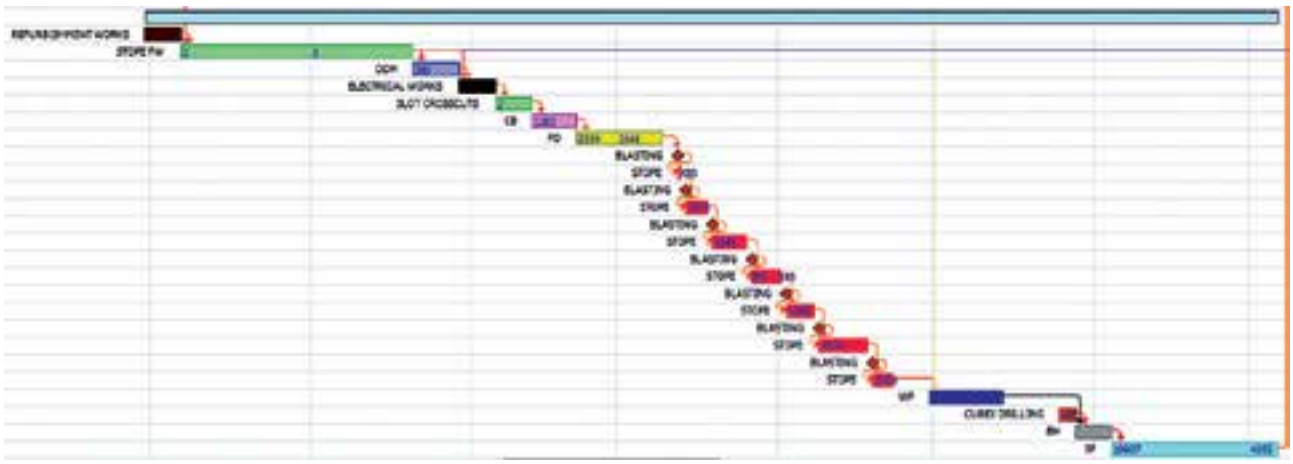

Figure 5: Detail of one of the basic mining cycles illustrating the amount of detail of our master schedule.

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EIT Raw Materials

by Tony Hand, Thematic officer - Mining at EIT Raw Materials

Two years ago, in this publication, I wrote about the setting up by the European Institute of Innovation and Technology (EIT) of an organization to address the challenges facing the secure supply of raw materials for Europe now and in the future, this organization being EIT RawMaterials. In 2015, I stated that EIT RawMaterials was in its embryonic stage, not quite sure of how it was going to fulfill the role placed on it by the EIT. Rising to the task, EIT RawMaterials is today the largest and strongest consortium in the raw materials sector worldwide, an impressive achievement in a few short years.

EIT RawMaterials comprises of a strong European-based community with more than 120 partners from more that 20 EU countries. The community consists of leading businesses, universities and research institutions across Europe as well as numerous cooperating task partners and support partners and is known as the Knowledge and Innovative Community, or KIC. Partners of the EIT RawMaterials are active within the entire raw material value chain; from exploration, mining, mineral processing, substitution, recycling and circular economy. The complementarities and diversity in EIT RawMaterials communities combined with a strong focus on innovation, business and entrepreneurship provide a novel collaborative community that is now a fertile ground for breakthrough innovative developments and radically new ways to address raw materials challenges.

Throughout its existence, the human race has depended on the earth for its survival. The surface provides water, crops, fruits, grazing for livestock etc., but below the surface there is a diverse quantity of raw materials that are vital for today's society to function without jeopardising supplies for future generations. However, Europe faces great challenges in securing raw materials in a sustainable way due to high reliance on imports, increasing consumption and decreasing quality and availability of resources.

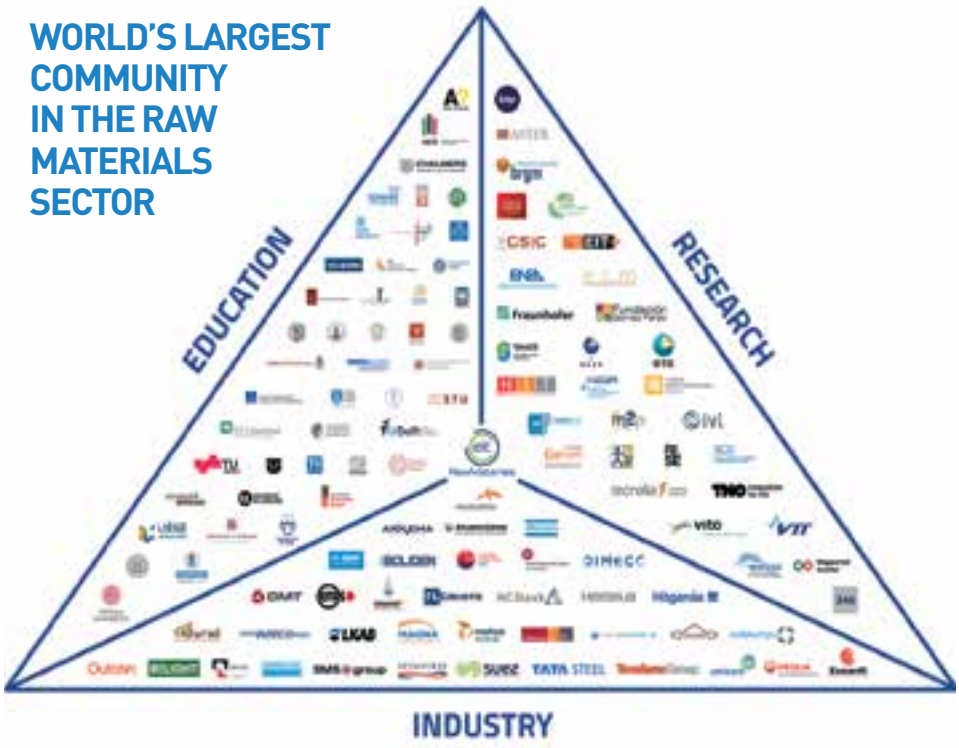
Exploration and mining activities forms the initial part of the raw material value-chain. However, mining in Europe needs greater support in order to secure and sustain this vital part of the value chain. The industry is facing surmounting challenges today, such as, deeper mining, social licence to operate, access to land, higher production rates, but at a lower cost and more challenging environments, both underground and on surface. At the same time, the industry need access to a new highly skilled generation of entrepreneurial mining professionals and a better wider-society understanding of the whole industry.

To meet these challenges, new innovative mining technologies, research and education are required through a coming together of business, research and education, to enable a sustainable, efficient and successful mining industry now and in the future.

Europe is the birthplace of modern exploration technologies and mining. EIT RawMaterials intend, through its vision to "**Make Raw Materials into a Major Strength for Europe,**" to build up Europe's mineral extraction and provide opportunities through the development of innovative smart and efficient technologies, new entrepreneurial-focused higher education and systemically linking with downstream parts of the entire raw material value chain.

Where does Ireland fit into scenario? Once again, the Fraser Institute places Ireland in the premier league as a perfect location on a global scale for exploration and mining companies to operate in. Earlier this year, Boliden the Swedish owners of Tara Mines, invested 44m Euro to expand the tailings facility and develop towards a new area that has the potential to be another world class ore deposit. Exploration drill rigs have returned to the Pallas Green area and gold mining is underway in the northern region of the country. Mining in Ireland is returning to a much heathier position and with the formation of the Lisheen Mining & Technical Services, LTMS, Irish knowledge and expertise in mining is now an exportable commodity.

EIT RawMaterials has core partners present in Ireland. Trinity College Dublin, the University of Limerick and Rusal Aughinish make up this partnership along with Boliden Tara Mines. Each of these partners are involved in a variety of projects funded by EIT RawMaterials to improve processes and knowledge for the industry and for wider society. In realising EIT RawMaterials vision of making raw materials a major strength for Europe, Ireland can contribute to every side of the 'Knowledge Triangle' and really show how mining, carried out in a responsible way, can benefit all stakeholders now and in the future.



EIT RawMaterials Knowledge and Innovative Community (KIC). The Knowledge Triangle.

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Transport Infrastructure Ireland (TII) update

This short overview is based on an excellent presentation by Geraldine Fitzpatrick of Transport Infrastructure Ireland (TII) to the Infrastructure Summit in May 2017.

Roads Programme

Funding is expected to increase over the next 3 years from c.€350M to over €600M pa.

Category	Projects (Completion Date) [Start Date]
Under Construction	M17 Gort to Tuam (2017): M11 Gorey-Enniscorthy (2019): N25 New Ross Bypass (2019)
"Shovel Ready" (Planning & Land Acquired)	M7 Upgrades [2017]: N4 Cooloney [2019]: N5 Westport [2021]: N8 Dunkettle I'Change [2019]: N22 Macroom [2020]: N56 Glenties & Inver: N59 Moycullen Bypass [2021]
Subject to Planning Approval	N6 Galway Bypass: N2 Slane Bypass: N28 Ringaskiddy: N21-N69 Adare to Foynes: N20 Mallow Relief Rd

Rail

The Luas Cross City project connecting the Red & Green lines is nearing completion. An extension to Cabra is planned as are upgrades to the Green Line. Long term plans (to 2035) for Luas envisage extensions to Finglas, Lucan and Poolbeg. Planning is underway on a new Metro North to connect the city to Dublin Airport and northward to Swords with a projected start date of 2021 and completion in 2027.

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Roadstone Limited: Energy Management

by Kevin Donovan, Roadstone Limited, Environment and Energy Management.

Presently, Roadstone has 46 active locations in Ireland and employs over five hundred people. The largest site which they operate is in Belgard, Dublin. Each location produces aggregates and a combination of blacktop, concrete, blocks, agricultural lime and architectural products.

As the company is involved in such an energy-intensive activity, strict measures are in force to ensure that Roadstone adheres to its environmental policies.

On a practical level, there are a number of dedicated performance managers who have been appointed with the responsibility for reviewing and managing each location's energy data against set key performance indicators (KPIs). This process includes regular liaisons with the energy manager and on a monthly basis a KPI report is issued for each product. It also details the energy requirement during non-operational hours.

'Meetings are also held on a quarterly basis with the locations split into two groups - north and south. These meetings include a presentation on energy management and each location manager has an opportunity to discuss their own site-specific projects and liaise with each of the other location managers. Energy Management Awareness Campaigns are also held monthly,' explains Kevin Donovan, Roadstone, Environment and Energy Management.

Furthermore, group workshops are held to facilitate further dissemination of information within the company. Also, every case study, including any information that may be required for replication, is accessible on the company's internal network. According to Donovan, this has resulted in the replication of projects throughout the country.

Roadstone Block Lorry.

Each location has an energy representative and the energy manager has responsibility for assisting all location energy teams to maintain and sustain energy improvements and management, including carrying out regular internal audits, awareness campaigns and sessions.

On a higher level, there is an annual Energy Management Review meeting which is held centrally and attended by each location manager and the top management. This meeting highlights the positive outcome of the previous year and also lessons learned. It gives each attendee an opportunity to make suggestions for improvements that could be made for the coming year. The meeting is also used to set out a program for the coming year.

On an energy and environment level, Roadstone became a member of the Sustainable Energy Authority of Ireland (SEAI) in 2007. On a pilot location in Slane, Co. Meath IS 393 was implemented.

Following the successful certification of this pilot location and the energy savings achieved, IS 393 was rolled out to a further eight locations in 2008 and eight more the following year and the Transport Department successfully achieved certification to IS 393.

By June 2010, all sites had successfully transitioned from IS 393 to EN 16001. By the end of 2012, nearly all locations had subsequently transitioned **to ISO 50001**. In the near future Roadstone aim to achieve company-wide ISO 50001 accreditation.

The successful certification of the 22 locations and the Transport Division was achieved by the development and implementation of an extensive collaborative programme that provided comprehensive training and mentoring to all location management teams. This included regular workshops, meetings and site visits that were coordinated and facilitated by the

Roadstone Minerals.

Roadstone Location.

Roadstone Concrete Pour.

SEAI Energy Agreements Support Manager.

The benefits and savings that have been achieved by the energy management strategy between 2008 and 2017 are many. The highlights include: 22 locations and the National Transport Department certified to ISO 50001; an average of three to four energy improvement projects per location per year; verifiable energy savings in excess of 24.6 million kWh and C02 reductions of approximately 21,500 tonnes.

As a result of their ambitious and collaborative programme, energy management has become embedded into site practices and procedures. In developing the programme, the focus has been to integrate where possible energy management into existing company systems.

There are many benefits to adopting ISO 50001. It provides a framework of requirements for organizations to develop policies for a more efficient use of energy, fix targets and objectives, the better use of data, measure results, review polices and continually improve energy management.

From Roadstone's perspective, ISO 50001 offered a systematic approach for the development and implementation of energy management. In developing the programme, their focus has been to evolve the energy management system so that continuous improvement is at the core of the system, and furthermore, it can be demonstrated.

This has recently been the case when the EU Energy Directive was the backdrop to evolving the system form location based to activity based, which also facilitated integration into existing company systems e.g., ISO14001 and ISO9001.

Also, the **Energy Efficiency Obligation Scheme (EEOS)** was used as a means to demonstrate that if multi-locations implemented projects by activity, there would be a larger group application for a rebate allowing each to collaborate and learn from each other.

The EEOS imposes a legal obligation on EU member states to achieve new savings each year from 1st January 2014 to 31 December 2020.

Being a member of the SEAI Large Industry Network (LIEN) was also critical in the implementation and roll-out strategy. The program offered them an Agreement Support Manager that guided them through the process and offered support.

Also the working groups offered by the SEAI has helped Roadstone enormously throughout the years.

From a technological perspective, Roadstone continues to enhance the energy monitoring system at each location nationally. Investments are also being made in areas such as water pumping, reduction of non-operational hour requirement and the implementation of measures to reduce the energy requirements of a number of their processes.

Roadstone has invested resources in implementing energy monitoring systems nationwide to establish where energy is used, set baselines, evaluate and implement savings measures and demonstrate savings.

In 2014 Energy Management Certification covered over 80% of Roadstone's energy profile. However, the management team still took the opportunity of the impending EU Energy Directive to reflect on how energy management is implemented to see if this be improved upon.

Roadstone endeavours to continuously improve its management system. The Energy Management Team has begun to redesign the system so that it will become activity / process based and within weeks the system began to become re-invigorated. Projects were established and ensure that by a collaborative approach a more substantial EEOS application could be made. EEOS rebates for over 2.7Gwh were received to date with further EEOS applications currently being assessed.

Other energy efficiency programs that Roadstone are involved in include the SEAI **Excellence in Energy Efficient Design (EXEED)** Program. EXEED provides a new framework for energy efficient design management for both new investments and upgrading of existing assets. EXEED will independently certify assets using this framework that optimises energy performance and energy management capability.

Roadstone have completed Stage 1 of the program and are now within Stage 2. This includes a number of projects across their Blacktop Manufacturing Process which involves taking a more holistic approach that includes mineral extraction, processing and the final element of laying the material.

In past preparation for the energy Directive, Roadstone's energy team began to consider energy management from a new perspective. They figured that transport would be integral to compliance with the Directive and they began to implement energy management into the National Transport Division.

It was during this phase that Roadstone began to establish a number of energy management projects which included changes in work practises, not only in the Transport Division, but at locations throughout the country.

Also, during the implementation of ISO 50001 for the Transport Department, it became clear of the value in certifying an activity as opposed to the previous practise of certifying the location. By certifying the activity, it simplifies implementation and facilitates integration of standards.

Through the influence of the Energy Management Team, the Transport Department have progressed from behind the scenes to being an integral part of energy management and positively influences best practice throughout our locations in Ireland. The team has now developed an enhanced training model for the implementation of ISO 50001 that will be developed further through the EXEED Program.

Roadstone's targets for the future are to ensure that the EEOS rebates achieved represent 80% of the savings associated with energy management projects established throughout their locations.

This will establish that all associated energy management savings have been validated to International Performance Measurement and Verification Protocol.

BACKGROUND

Roadstone is one of Ireland's great corporate success stories. It was founded in the 1930s by two brothers, Tom and Donal Roche, who started the company selling sand and gravel from a small yard in West Dublin. Over the next couple of decades they managed to grow their company during some of the worst periods of Irish economic life, the 1940s and the 1950s. By the 1960s, it was a well-established and hugely successful company. In 1970 it merged with Irish Cement to become CRH.

European Federation of Explosives Engineers

by Alan Dolan, Boliden Tara Mines

EFEE was founded in 1988 and has 25 National Associations representing 25 countries. Its purpose is to provide a European forum for professionals working in the field of commercial explosives.

The IMQS represents Ireland as a National Association at EFEE council meetings. The EFEE have many committees representing the interests of explosives users and manufacturers in Europe (see www.efee.eu). One of its primary on-going projects is PECCS (Pan-European Competency Certificate for Shot Firers/Blast Designers).

Currently in Europe there is no minimum training standard to become a shotfirer/blast designer. Each country has its own training requirement and standards which makes working in more than one European country difficult and quite often

prohibitive. To help alleviate this issue, EFEE has created PECCS, the Pan-European Competency Certificate for Shot Firers/Blast Designers, which aims to aid the transfer of shotfiring and Blast design skills within European member states. This accreditation will signify the achievement of a minimum standard of competency and allow a shotfirer/blast designer to work in any European country. It will be supplementary to the training already existing in respective European countries.

The PECCS project was granted funding by the Swedish Erasmus Programme in August 2016. A collaboration of eight countries are compiling educational material which will be available to prospective learners in early December 2017. For more about the project's progress and learning material used, visit the official web site; www.shotfirer.eu.

The 9th EFEE World Conference will take place from Sunday 10th September to Tuesday 12th September 2017 in Stockholm Sweden. More details at www.efee2017.com.

Specialised Mine Training in Russia

Kevin Lonergan, LTMS Director and Project Manager, at the entrance to a mine in Siberia.

by Brendan Morris – Managing Director, LTMS Limited, Kevin Lonergan – Operations Director, LTMS Limited and Padraig Barrett – Technical Director, LTMS Limited

Every mine needs to have a well-trained, motivated and experienced workforce in order to ensure that safety, production and cost targets are met during the operational phase of the mine.

Nordgold is a fast growing international gold mining company with operations in Russia, Kazakhstan and Africa. Two Nordgold mines are in a transition phase, from hand-held mining methods to mechanised mining techniques and for this transition Nordgold sought specialised training to ensure that a smooth transition was effected.

Following the closure of the Lisheen Mine in 2015, LTMS Limited (Lisheen Technical and Mining Services) was established in order to maintain the high level of mining and technical knowledge which was built up over the 15 year life of mine. Lisheen was considered to be a 'world class' mine by its owners, Vedanta Resources, previous owners Anglo American and by the industry in general.

The highly trained and skilled Lisheen mining team was well placed to provide the service that was required by Nordgold. Initially, LTMS was requested to perform an audit on two Nordgold mines in Siberia, at the Zun Holba and Irokinda gold mines. LTMS Director Kevin Lonergan carried out the audit at both mines and a plan was then devised for the training programme. The first part of the training programme required that a total of four trainers spend 45 days at the mines.

The Objective

The objective of the programme was to train a group of local mining personnel on safe operating systems, high speed development (tunnelling), operation of specialised mining equipment and the safe use of explosives. The project was carried out over a period of 45 days on site by four trainers, resulting in 180 man days of training. The contract period of 45 days was based on 12 hours per day, 6 days per week. In practice, there were also a number of Sundays worked during the programme as the trainers wished to make best use of the time on site and the system allowed this flexibility.

The Team

The team selected for the project in Siberia were experienced mining people including two who were qualified Supervisors and two who were employed as Trainers at the Lisheen mine and other operations. All had prior mining experience in a number of mining disciplines and each had more than 15 years of mining experience. The programme was managed by Kevin Lonergan, a Chartered Mining Engineer, a former Production Manager at Lisheen mine and currently Operations Director at LTMS.

Training

The scope included for the training of 20 people at each mine. The programme included the creation of Standard Operating Procedures (SOP), Planned Task Observation (PTO), Personal Assessment (PA) and Pre-Start Equipment Check (SEC) sheets, which were developed for a variety of unique mining tasks at both mines and for each individual unit of equipment.

The training programme included:

- Classroom training
- At the 'mining face' training for specific procedures
- Hazard Identification and Risk Mitigation
- 'On the machine' training
- Machine servicing and settings
- Assessment following each module
- Authorisation subject to successful assessment

Driving mining drifts (tunnels) to mass mining areas is an expensive and time consuming process. Tunnels advance in a series of steps, with a 'round' being one full cycle of advance, usually in lengths of 2m to 4m, depending on the equipment used, ground conditions and skill level of the miner.

The training process had a number of key elements involved in this 'round' cycle, as follows:

1. Drilling of the tunnel face with an electric hydraulic drill machine. Drilling accuracy, efficiency, hole location and proper use of machinery were all components of this element of training.
2. On completion of drilling, the holes are loaded with explosives. Key elements are the technique of loading holes, location of detonators and the firing sequence.
3. Following the blasting process, the broken muck is loaded and trucked away from the face. Loading techniques and

One of the mining camps in Siberia.

Face being drilled with the paint lines as a guide.

Face after drilling, being charged with explosives.

the management of loaders and trucks in very tight spaces is critical to the efficiency of the process and the management of the equipment.

4. Once mucked out, the area needs to be scaled, which is the removal of loose rock from the roof and sidewalls by mechanical and hand methods. Good drilling and blasting practices reduce the need for scaling and good scaling techniques are critical for safety and efficiency.
5. Installation of ground support such as 1.8m roof bolts and mesh is required to ensure the roof and sidewalls remain stable. Poorly installed ground support can significantly compromise safety, if the support mechanisms are not properly understood
6. Mining services such as air, electrical and water lines must be installed following a number of rounds and good practices improve overall efficiency
7. The new face is then prepared for drilling by re-scaling, identifying any unfired explosives and then marking the face with paint lines for the guidance of the drillers.

Additional elements of training which were included were equipment servicing (limited to what the miner is trained to do), equipment settings and equipment consumables management, all of which can be under the control of the miner.

There were many differences between training of locals in a western country and the two mines in Siberia and the trainers were required to maintain a high degree of flexibility, understand the cultural differences and communicate through an interpreter.

Results

The benefits of high quality training for company employees in any industry are well understood. In mining, which is a very high cost industry, well trained operators can contribute significantly to the bottom line. The benefits of the high quality training in this project included:

- Number of holes drilled per round (one drill and blast cycle) reduced from 72 holes to 54 holes, resulting in a 33% improvement
- Advance per round due to more efficient drilling and blasting , increased from 3.4m to 3.7m, a 9% improvement
- Ground support requirement reduced due to improved roof and sidewall profiling as a result of improved drilling and blasting. It was not possible to quantify the percentage improvement over a short period of time.
- Significantly improved safety practices as all tasks were proceduralised and all operators trained and authorised for each procedure.
- Lower overbreak and therefore less haulage of waste material. Overbreak is the breakage of rock outside of the mining profile (E.g. If the profile is designed at 5.0m x 5.0m and the actual size is 5.5m x 5.5m, then overbreak can be calculated at 21%).

New standard tunnel with a clean, even floor, services in place and the drill machine at the face.

Mining crew trainees with Trainers TJ Doyle and Steve Hayes (5th and 6th from Left).

Improved safety awareness results in a lower number of accidents, improved operational efficiencies and improved well-being of the workforce. The key areas where safety improvements were made in this programme are:

- Equipment training – Improved competency in areas of inspection and fault detection
- System training – Improved utilisation due to strategic planning of resources
- Introduction of appropriate procedures for all tasks – Standardization of best practice techniques
- Pre-start checks for equipment in work areas
- Implementation and monitoring of the safety standards – Establishment of safety checks – Vision Felt Leadership (VFL), Risk Assessment and Mitigation.

Overall, there are many benefits to the mine and to the local community, including improved security of employment as a result of cost savings and improved advance rates. A major benefit of a programme such as this is improved wellbeing for employees and their families as a result of an improvement in the overall safety of the mining process.

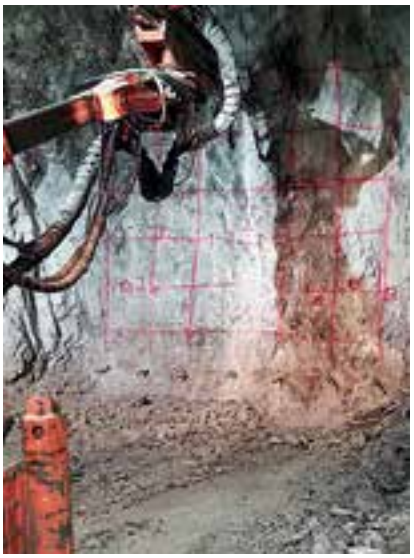
This endeavour was helped greatly by the 'buy in' from local Nordgold management, supervision and miners, all of whom seemed to appreciate the benefits of their new skills. The support from Nordgold senior management ensured that all parties understood the programme and were aligned to ensure maximum benefit.

One of the main challenges that the trainers had at the start of the project was to establish credibility and respect and to show respect for the local employees and community. This required an understanding of the local culture and customs and a high level of engagement at the start of the project.

Following on from this programme, a second phase of training was arranged for early 2017 at both mines and an additional two mines, one in Russia and one in Kazakhstan. This was indicative of the success of the programme and the benefits to each mine.

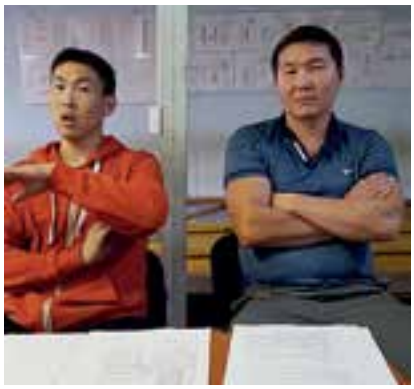
Summary

This training programme of Russian miners by Irish trainers is unique in that it takes a skill set from a 'world class' mine and utilises the benefits that were built up over a 15 year period and then transfers them in a systematic and functional way for the benefit of a new operation. Nordgold understood the necessity for a training programme to ensure that the safety, productivity and viability of their operations was secured and as such the project was and continues to be a success.



A face which has been prepared and marked to the new standard, with the lower holes drilled first and plastic pipes inserted to ensure they stay 'open'.

Trainers TJ Doyle (Left) and Steve Hayes (Second Left) at a weekly meeting with management.



Miners attending classroom training.

Miners completing the newly introduced Pre-Start Check Sheet.

The miners doing the training completion test.

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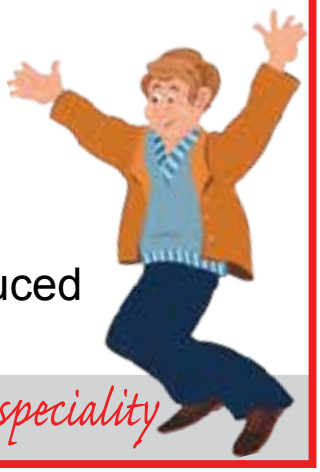


Late evening - Night orders, Early morning direct deliveries our speciality

How does the public perceive mining in Ireland?

by Dr Aoife Braiden, Research Manager, Geological Survey Ireland

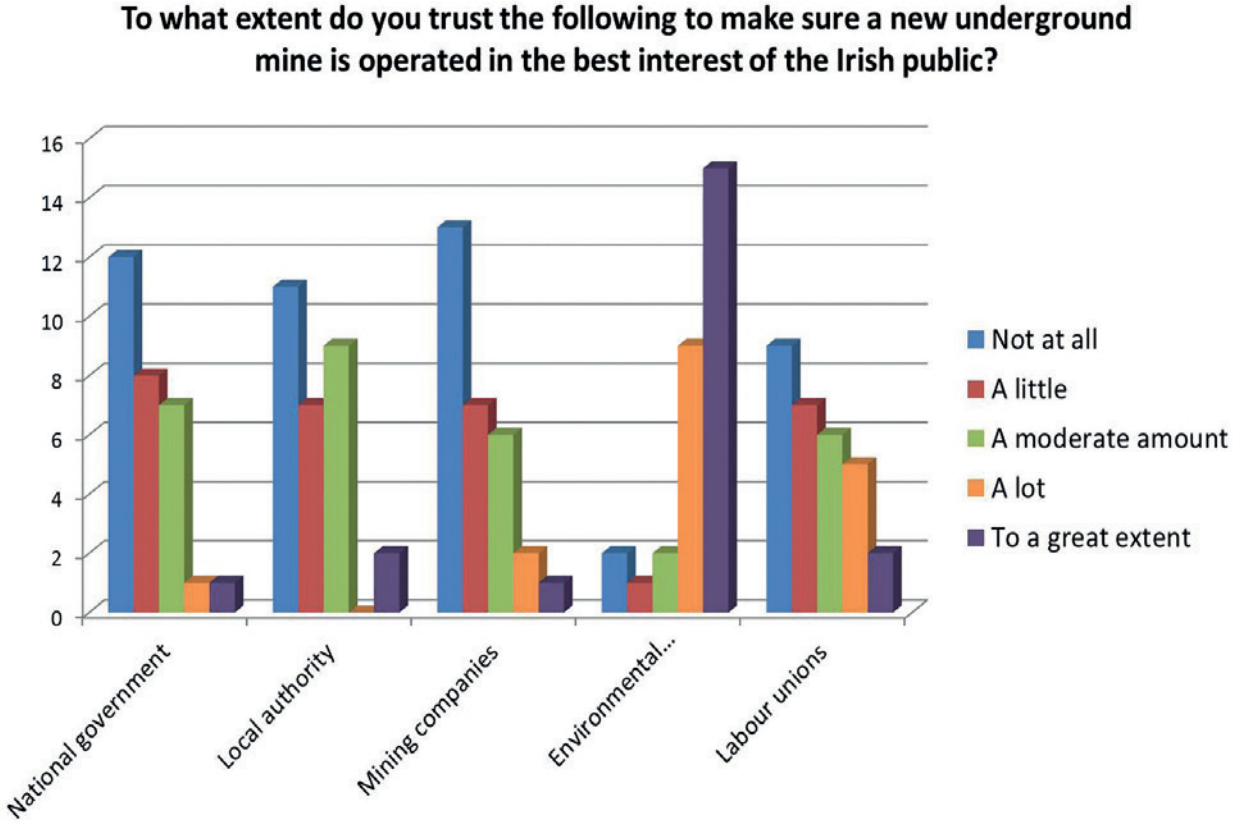
In the last two years, Geological Survey Ireland and the Irish Centre for Research in Applied Geosciences (iCRAG) have been developing a research programme specifically focussed on the perception of geoscience and how the public understand geoscience activities such as mining and energy related projects. To do this, we have engaged with social scientists in the areas of psychology, behavioural economics, geography and sociology to better understand how individuals and communities perceive what we (as geoscientists) contribute to society, but also to understand how we can better communicate our activities to the public and to policy makers.

As part of this research programme, we recently co-sponsored the STEP 4 workshop in University College Dublin, organised by Dr Geertje Shuitema. This workshop was specifically aimed at early career researchers in the area of environmental psychology. Fifty international students participated in a full week of lectures and exercises across range of environmental and energy related themes. Along with topics such as energy efficiency and consumer behaviour, the group was presented with the following question: **What is the public perception of underground mining in Ireland?** To provide some background, they were given a whistle-stop tour of minerals and critical raw materials, where we find them, how we mine them and what they are used for in our daily lives. The students were then given 4 days to research their topic, carry out a pilot study to support their findings and then present the outcome to their colleagues and sponsors.

A sub-group of ten students were assigned the mining study and, as part of their work, designed a simple questionnaire; a subsample of the results is presented herein. Due to time constraints, the sample size was very limited (n=29) but represented residents in Dublin and the midlands. Over 78% of respondents were resident in their current home for more than 5 years (53% of the total sample had been resident at their current address for more than 10 years). It is therefore likely that the majority of respondents have a significant connection to their local area. The majority of respondents stated that there was no mining currently in Ireland, therefore the survey questions were posed as hypothetical scenarios.

When asked **how likely it was that they would benefit from mining in Ireland**, 62% of respondents said it was somewhat unlikely or extremely unlikely, with only 20% stating it was somewhat likely or extremely likely (the remainder believed it is neither likely nor unlikely to benefit them). The perceived benefits were primarily positive economic impact and jobs, however overall respondents offered very few positive remarks made about potential benefits. When asked if they believed if they would experience risks from underground mines in Ireland over 40% said it was somewhat likely or extremely likely, with only 30% believing it was somewhat unlikely or very unlikely. Perceived risks included environmental damage, pollution, 'fracking', safety issues, destruction of property, gas/fumes and/or damage to landscape and areas of natural beauty or historical significance.

When asked **who they trust to provide reliable and honest information**,



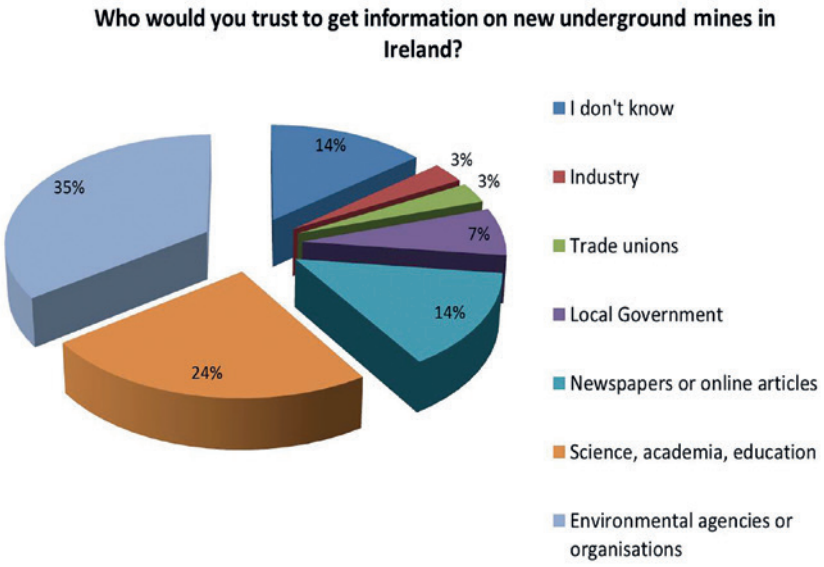
35% said environmental agencies or organisations, 24% said scientists or academic institutions and 14% said newspapers or online articles. Only 7% said local government, 3% trade unions and 3% industry. 14% did not know who to trust for information about underground mining in Ireland.

Finally, the respondents were asked to what extent they believed that the **local community would have a voice** in how a new underground mine is planned and regulated. Only 7% believe they would have a lot or a great deal of input. Over 82% believed that they would have little or no input at all.

The feedback from the students at the end of the week was, in itself, an interesting output from the study. As environmental psychologists, they were intrigued by the apparent contradiction of mining Earth's natural resources to service our 'green energy' sector, technological and medical industries. In particular, they felt uninformed (as were their respondents) about (i) where mineral resources come from, (ii) what they are used for and (iii) how they are managed. Many were simply not aware of minerals they use every day, others believed that most resources could be sourced from recycled materials and reused indefinitely.

Although this was a very small study and population sample, it is clear that all sectors have a role to play in providing clear, reliable, robust information about mining in Ireland – and mining in general. This must include all potential benefits and risks communicated in such a way as to allow individuals and communities to assess the information and make informed decisions. It is also essential that our education system and public information outlets highlight minerals, their uses and how we can responsibly manage our natural resources.

Geological Survey Ireland and iCRAG will continue to develop this area of research and will expand the pilot study to regional or national scale over the coming year. If you would like to be involved, or to suggest specific areas/topics, please contact aoife.braiden@gsi.ie



Thanks to the STEP 4 team: A. Gillis, D. Albuquerque, E. Gallagher, J. Liao, K. Hamann, K. Krause, M. Baldoino, S. Sanniti, S. Mac Donald, V. Frick, C. Boomsma, W. Poortinga, G. Schuitema.

One Hundred Years of IQ

by James Thorne, Chief Executive, Institute of Quarrying

The Institute of Quarrying (IQ) is celebrating its centenary in 2017, marking the occasion with a series of high profile member and public events designed to share the essential role the sector fulfils in our everyday lives.

One hundred years ago, four quarry workers laid the foundations for a professional body to represent and support individuals working in the mineral extractives sector. Now, IQ is a global network with over 5,000 members, including 13 UK branches and international offices in Australia, Malaysia, New Zealand, Hong Kong and South Africa.

Our headline celebration event is the 'IQ Quarry Garden', which will feature at the first ever RHS Chatsworth Flower Show this summer in the grounds of Chatsworth House in Derbyshire. The garden's design has been inspired by Horticulture students from Nottingham Trent University's Brackenhurst campus, who worked alongside RHS award winning designer Paul Hervey-Brookes.

The Quarry Garden project represents the successes we have achieved as an industry over the past hundred years, highlighting the importance of quarrying and the many ways it has a positive impact on our wider world - from biodiversity promotion to community engagement.

Centenary highlights also include a new book commemorating 100 years of IQ, plus a conference and industry dinner at the Belfry in October, with guest speaker and IQ patron the Duke of Devonshire. Other activities include the creation of a number of IQ cycle routes that encompass quarries along the journey.

As an Institute we are responsible for setting standards of professional development within our industry. We also lead the way in community, social and safety initiatives, as well as addressing environmental challenges and fulfilling our industry's role as good neighbours within the communities in which we operate.

We have come a very long way over the last 100 years. Looking ahead, we're casting our sights on the opportunities for the next century. That's about further enhancing the sector's reputation as a career that's open equally to women and men, encouraging greater diversity in the workplace, delivering on environmental and sustainability challenges, as well as creating a more joined up global approach to what we do and how we do it.

Find out more about our centenary events, membership and training opportunities that we offer by visiting www.quarrying.org.

Department for the Economy
www.economy-ni.gov.uk

GSNI Geological Survey of Northern Ireland
Celebrating 70 years: 1947–2017

Geological Survey of Northern Ireland supporting Mining and Quarrying

Geological Survey of Northern Ireland

Geosciences are essential for societal requirements such as the supply of natural resources to meet our energy needs, the supply of metals to meet our material demands in manufacturing and technology, and the supply of construction minerals to build the infrastructure vital to underpin our economy.

This year GSNI celebrates 70 years of public service providing;

1. Sources of geological expertise, information and data
2. Services and commissioned research
3. Sustainability and safeguarding advice

This work supports Northern Ireland's economy, protects its environment and creates jobs in the following sectoral areas;

- Aggregates e.g. crushed rock, sand and gravel
- Metallic minerals e.g. copper, lead, zinc, gold, silver, platinum
- Non-metals e.g. rock salt, potash, barite, brick clays
- Energy minerals e.g. coal, lignite, peat
- Oil and gas
- Underground energy storage e.g. gas and air in salt caverns

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Revisiting Historical Mines

by Mark Holdstock, Aurum Global Exploration

Aurum is a geological and exploration services company based in Kells, County Meath. Our work takes us to many parts of the world to assist with the exploration for new mineral resources. Limited funding for exploration over the past few years has meant that the exploration focus has been on historical mining districts or around older mines, where operators are searching for additional resources. This often brings the company's personnel into situations where they are entering abandoned workings or mines where the health and safety standards are somewhat different to the high standards we expect into today's modern mines.

Over the past four years, Aurum has been assisting FBC Mining and Arctic Resource Capital with exploration around the historic Black Angel Mine at Maarmorilik in western Greenland. The area was named after the original marble mine, which operated back in the early 1900s. From this same fjord, Alfred Wenger, the originator of the theory of continental drift, led a series of expeditions onto the Greenland ice cap, including his final, and fateful, last expedition in 1930.

The **Black Angel Mine** was discovered in a cliff face showing in the late 1960s and put into production in 1973 by Cominco, after underground exploration had outlined a resource of 4.1 Mt grading 15% Zn, 5.0% Pb and 28 g/t Ag. Subsequent exploration discovered further zones of mineralisation and the mine enjoyed a largely profitable life, spanning 17 years, until it's closure, by operators Boliden, in 1990, having milled a total of 11.3 Mt grading 12.4% Zn and 4.2% Pb.

Developing the original mine was a huge logistical challenge, not just due to the arctic climate, but particularly due to the ore occurring 600 m up a vertical cliff face and still 400 m below the surface of Black Angel mountain. The mines name was derived from the angel-like figure in the cliff face just below the discovery showing, which is caused by highly deformed pelitic sediments within a more massive sequence of marbles.

View of Black Angel mountain from the camp.

The processing plant was built 1 km west of the mine across the fjord on the site of the former marble quarry, the only reasonably level ground in the area. The mine entrance was reached by a cable car spanning the fjord, which transported all the necessary materials and personnel. Similarly, all the ore was removed from the mine after primary crushing, using a second cable car system, that transported it directly into the processing plant. Concentrate was shipped to smelters in Europe and North America between May/June and December each year, depending on ice conditions.

The mining method used at Black Angel was primarily room and pillar, with various modifications to allow the mining of the variable geometry of the orebody, which consisted of a number of folded lenses of massive sulphide, which could reach 20 m in thickness.

Following the closure of the mine in 1990 several groups relooked at the potential for extracting the remaining high grade pillars. During 2005-2010 Angus & Ross plc (latterly Angel Mining plc) operated the project and completed a feasibility study on the pillars extraction, identifying a resource of 1.3 Mt grading 7.5% Zn & 2.6% Pb. This also coincided with Aurum's first involvement with the project, taking part in the exploration of the Glacier zone and reviewing at the regional exploration potential. Glacier zone had been revealed by the retreat of the ice sheet in the period since the closure of the mine. Angus & Ross reinstalled the cable car system but it was never commissioned due to the falling zinc prices after 2008. This led to the abandonment of further development and exploration, after two seasons of exploration and the eventual mothballing of the project.

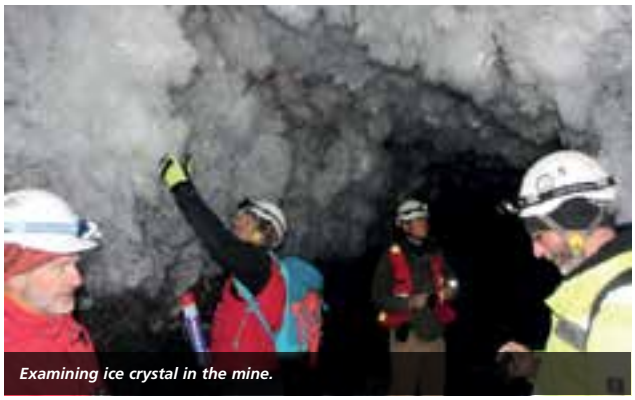
FBC Mining became owners and operators of the project in 2013, more recently managed by Arctic Resource Capital (ARC). Over the past three summers Aurum has undertaken further exploration drilling and geophysics aimed at discovering new resources that would allow mining to recommence in the area. Extraction of the pillars alone is uneconomic, but significant exploration potential remains to the east of the old mine, in the so called Deep Ice Zone, where surface drilling (through 500 m of ice and rock) intersected mineralisation including 6.9 m grading 19.5% Zn & 13.1% Pb.

To understand more about the geological setting and assess the current state of the

Camp and fjord from inside the upper cable car terminal.

The mine inspection team pose on the upper platform; Brendan and Jonathan from LTMS along with Mark, Graham and Eoin from Aurum.


Access stairs from the pad to the portal.


Examining ice crystal in the mine.

underground workings, a partial inspection of the underground development took place in 2016 with the assistance of LTMS Limited (**Lisheen Technical and Mining Services**). The main aims were to establish protocols for safely entering the old workings and to establish how they could be fully evaluated in the future.

Assessments were carried out in both the Nunngarut and Angel zones. The Nunngarut zone consists of two separate ore bodies to the west of the mine reached by a 6 km underground haulage from the plant site. Accurate surveying of the haulage was completed along with geotechnical and ventilation assessments. The portal was scaled and loose rock cleared. A 3D image of part of the working was completed, using a ZEB1 laser scanner, to examine it's suitability for completing a detailed assessment of the remaining pillars, should it be required in the future.

The Angel zone was the largest of eight separate lenses within the main mine, and can now only be accessed from a helicopter platform perched 600m metres up the vertical Black Angel cliff face, and a 400 step 'staircase' down the cliff face to the portal.

Considerable ice build-up occurs near the mine portal, with freeze-thaw action developing some loose ground but 20 metres inside the mine the ground conditions have remained remarkably stable during the 25+ years since mining operations ceased, with only minor falls of ground noted. Robbing of pillars in the latter stages of the mining operation have left some large unsupported spans but there is very little evidence of any pillars under stress. Only rarely is there any ground support in place.

The ventilation, where there is airflow, is good. Deeper into the mine, there is no airflow but the oxygen level remained normal and no gases were present. The western part of the mine lies within the permafrost zone. However, to the east the mining extended beneath the ice cap, which provides an insulating effect and the rock is no longer frozen. In areas where the slightly moist air comes into contact with the permafrost, spectacular ice crystals develop.

Beneath the ice cap ground water occurs within fractures, and these are fed by water


Helicopter landing pad on the Black Angel cliff face.

that develops beneath the ice. During the operation of the mine, ground water was piped out through fresh air vents in the side of the mountain. This system still appears to be working well, although efforts to make a better assessment of the ground water inflows within the mine were prevented by bulkheads that didn't appear on the available mine plans. Suitable mine plans are not always available for historical mines, which adds its own safety and logistical challenges when examining the workings. Entering historical mines requires extreme caution and an appropriate assessment of the ground and air conditions by qualified personnel, before work is undertaken.

Although good grade zinc resources remain at Black Angel, only with new exploration success is mining likely to recommence at this remote location. The typical exploration field season lasts roughly 3 months, from ice break up in early June to the potential return of winter conditions by late August. Maarmorilik benefits from an excellent camp which remains on site, with good satellite internet access, providing the ability to extend the field season. Work in 2014 continued to late September when increasingly poor weather conditions started to restrict the helicopter support required for exploration work.

The potential for further discoveries remains good in the area, such as along the 15+ km long structural corridor between Glacier zone and the Nunngarut mining area, where small resources have already been defined. Mineralisation has already been identified at a number of other locations but exploration requires persistence and patience in what is a very complex geological setting, with extensive thrusting and folding of the mineralisation. Western Greenland is a logistically challenging location, but opportunities remain for new discoveries in a mining area with a great history, as well as providing a spectacular place to work!

Mark Holdstock has been working in the zinc exploration and mining industry since 1980. He worked previously as Chief Exploration Geologist at Boliden Tara Mines, where he led the team that discovered the Southwest extension. He is currently Managing Director of Aurum Exploration Limited, where he works on a variety of exploration projects both in Ireland and overseas.


Survey and scaling work at the Nunngarut portal.


Within the mine, untouched in 26 years.


The team examining the main Angel zone underground workings

Striving for continuous improvement & a sustainable future

by Sarah O'Connell, EHS Manager, O'Connell Quarries

O'Connell Quarries is a family owned and operated quarry located in Ardnacrusha, Co. Clare just 3 miles from Limerick City.

The business was set up by Bobby O'Connell in 1978 when he started out on his own excavating from the 57 acre site. Since then the business has grown and expanded into supplying crushed stone, high PSV (polished stone value) chippings, ready mix concrete and sand to the commercial and domestic market. In more recent years the business has moved towards a more sustainable future, by branching into the Construction & Demolition (C&D) recycling industry.

Construction & Demolition Recycling:

By importing and processing C&D waste (building rubble, broken concrete, blocks etc.) it allows for the preservation of the natural and high PSV aggregates on site. The aim of the C&D recycling within the quarry is to reduce dependency on the natural aggregate and to promote a full circle economy where possible.

The C&D waste is segregated, then processed in the mobile Terex Jaw crusher, where it is then screened to produce good quality 6F2 material. Procedures and assessments are in place

and carried out throughout the recycling process to ensure no hazardous waste is imported and no cross contamination of the virgin aggregate occurs.

The benefits associated with Construction & Demolition Recycling:

- Improves environmental image and performance of a project.
- It can help eliminate illegal dumping and associated negative impacts on the landscape.
- Complies with legislation and waste management regulation.
- It's an economical alternative to land-fill based disposal.
- It conserves natural resources and reduces our dependency on natural aggregates.
- Less energy is required for mineral production.
- Commitment towards zero waste.

Infrastructure Developments within the Quarry:

Secondary Washing Plant: In order to comply with the extremely demanding requirements regarding cleanliness of chips for surface dressing, Cabragh Engineering from Co. Tyrone installed a supplementary washing plant in early 2017 in order to reprocess the 14 and 10 mm chips. This plant which is isolated from the main plant, is made up of a feed bin, feed conveyor, a Trio single shaft log washer, a washing screen and stockpiling conveyors.

The Trio Log Washers assists in breaking down the dust that may be present in the crushed chips. Scrubbing is accomplished by the severe abrading action of corrugated faced Ni-Hard shoes mounted on the spuds welded to the log shaft which is rotating. The feed material has been pre-screened and only the 14mm and 10mm chips are reprocessed. The washed products are screened again into 14mm and 10mm high PSV surface dressing chips. Dust content test results are coming back at 0.1% which makes the chips ideal for surface dressing.

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Ireland at PDAC 2017

by Andrew Gaynor, Geoscience Ireland

PDAC once again hosted a great event in Toronto from 5th – 8th March, 2017, with more than 24,000 attendees. There was a strong indication that confidence has returned to the mineral exploration and mining industry, particularly in the zinc sector, with gold showing well as usual.

The mineral exploration and mining industry is cyclical in nature and has faced a variety of economic challenges over the past several years. While a recovery is happening, it is great to see this being reflected at the PDAC Convention, where the exhibitor space was full and there was a general feeling of optimism about the future.

The **'Ireland – Open for Business'** day on 6th March, was very well attended and was chaired by Gerry Stanley, Head of Minerals Section at GSI.

The session was opened by Ireland's Ambassador to Canada; H.E. Jim Kelly. This was followed by presentations relating to government agencies and government supported programmes in ROI and NI;

"Ireland: A Prime Location for Mineral Exploration and Development"; **Dr Eibhlin Doyle** (Chief Geologist, EMD)

"Northern Ireland: Mining developments and exploration opportunities"; **Dr Mark Cooper** (Chief Geologist, GSNI)

"Ireland's Ranking in the Fraser Institute Survey"; **Kenneth P. Green** (Fraser Institute)

"GSI Initiatives; TELLUS, R&D, Geoscience Ireland"; **Koen Verbruggen** (Director, GSI)

TELLUS Geochemistry; **Dr Eric Grunsky** (Dept of Earth and Environmental Sciences, University of Waterloo)

"Research innovation at the Irish Centre Research for Applied Geoscience" **Prof John Walsh** (University College Dublin; Director, iCRAG)

This session was followed by a series of short presentations on recent developments and new entrants to the Irish scene, such as:

Gold; Dalradian, Galantas, Conroy, Bowpark

Base Metals; Boliden Tara Mines, Group 11, Unicorn, Adventus

Critical Metals; Blackstairs Lithium, MOAG

The final session included short presentations from

Invest Northern Ireland; **Aine Mallaghan** (VP Business Development (Chicago), INI)

Geoscience Export Services; **Dermot Reidy** (Senior Development Adviser, Enterprise Ireland)

A networking session completed a very successful event, where the IMQS Council was represented by its President, Brendan Morris and Sean Finlay, Director of Geoscience Ireland.

Brendan Morris, President IMQS stated:

"The 'Ireland – Open for Business' day reflected the wide array of government engagement in the minerals extractive industry and the extent of involvement of mining and exploration companies. This reflects our very high rankings as an attractive investment location and a country which has well developed policies in the extractive industry sector. In addition to this, Ireland has many established companies associated with exploration and mining, providing services in many forms and many of these companies are engaged under the Geoscience Ireland umbrella, which is a network of 30 companies, delivering integrated expertise in Ireland and overseas."

PostScript

A Trade Mission to Canada took place from 30 May to 2 June 2017. Led by then Minister of State Sean Canney TD, the Trade Mission involved 30 companies, supported by Enterprise Ireland, the Ireland Canada Business Association and Ireland Canada Chambers of Commerce in Toronto and Ottawa. Geoscience Ireland took part and had bilateral meetings with mining companies and with the Geological Survey of Canada.

PDAC PROSPECTORS & DEVELOPERS ASSOCIATION OF CANADA

Andrew Gaynor
Geoscience Ireland
March 2017

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Geoscience Ireland is supported by the **Geological Survey of Ireland** and **Enterprise Ireland**.

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Ecocem Set to Capitalise on London Market with Second Import Terminal Opening

by Micheál McKittrick, MD Ecocem Ireland Limited

Ecocem Ireland, Ireland's premier manufacturer of high performance low carbon cement, upped their export capacity earlier this year with the official opening of their second bulk Import terminal, capitalising on the potential to supply the London / south east construction market.

This is Ecocem Ireland's second Bulk Import facility in the UK and is located in Sheerness in the Port of Medway. Ecocem Ireland are a subsidiary of Irish company Ecocem Materials, Europe's largest independent manufacturer of high performance, low carbon cement. Ecocem Ireland opened its first bulk import facility in Runcorn in early 2016.

The import terminal required an investment of £2.5 Million (approximately €2.9 Million) which will see the firm being able to supply the market with 250,000 tonnes of the low carbon cement alternative per annum. This is part of the overall Ecocem Materials Strategy to develop export markets from its existing facilities in Ireland, Holland and France.

Ecocem's second investment into the UK in a state of the art import facility demonstrates to the market the need for the low carbon cement alternative and the growing demand from the UK construction industry. Ecocem has already engaged in long term agreements with major concrete manufacturers in the UK and will continue to build momentum in the coming months.

Ecocem's cement is the Best Available Technology for minimising the environmental impact of concrete, whilst maximising its technical performance. This technology is used widely in Ireland and the UK in projects such as the AVIVA Stadium in Dublin and the Shard in London.

As the UK seeks to reduce its carbon footprint, coal fired power stations are either being shut down or switching to biomass fuel. The challenges facing the UK steel Industry have been well publicised (strong sterling, cheap Chinese imports, etc.) and have resulted in the closing of some factories and a sharp reduction in output from others. These two factors have resulted in shortages in the supply of alternative binders to the concrete industry, increasing costs and lowering performance.

The UK concrete industry has long appreciated the technical superiority of using alternatives such as GGBS, and Ecocem is now in a very strong position to service this opportunity from the facilities in Runcorn and Sheerness.

The demand for low carbon materials in Europe has never been stronger, reinforced by the historic international agreements at the recent COP 21. Ecocem has the ability to deliver a reduction of over 70% in the carbon footprint of concrete, the world's most popular building material.

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Understanding Underground

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Geological Survey Ireland is a leader in open, accessible data supporting public safety, infrastructure, public health, and a variety of economic sectors including agriculture and ecotourism.

We provide accurate, impartial information about a variety of geoscience topics, from minerals to groundwater, to natural hazards - all free of charge.

GROUNDWATER

The Groundwater Programme collects data from landowners across the country to create many useful maps that describe how much water can be found underground and where, and how much natural protection it has. We can also advise homeowners and farmers on the best way to drill and site a well.

TELLUS

A national programme to gather geochemical and geophysical data across Ireland involving two types of surveying - airborne geophysical using a low-flying aircraft and ground-based geochemical sampling of soil, stream water and sediment. Activities up to autumn 2017 include airborne surveys in Mayo and Donegal, and a geochemical survey across the west central midlands.

Strategic and integrated dewatering systems within the underground mining industry

by Eoin Collins, Project Engineer, IMEC Consultants Limited

The necessity for strategic and integrated dewatering systems within the underground mining industry is gaining increasing focus of late, as miners strive to perform in an era heavily focused on cost effective and socially and environmentally responsible operations.

Considerations by operators for planning dewatering installations should not only include the system duty requirements, but also the corresponding operational and environmental impacts in the short and long term. This was certainly the sentiment of Management at a substantial block cave gold mine in New South Wales on Australia's south east coast.

Mining engineering consultancy IMEC who are a key player in the provision of engineering solutions for underground mine dewatering systems worldwide, were engaged by one of the world's largest gold producers to review their current and planned dewatering system strategy. Principally, the review was to investigate the sites current plan with respect to its efficiency (power and hydraulic performance), operating cost and develop options beyond the conventional methods that may present environmental, cost, sustainability or other benefits.

The clients plan was one developed at the mine feasibility stage and IMEC therefore set-out to verify the accuracy of the assumptions and design criteria used in generating the plan. This verification was done through utilization of outputs from the site SCADA and Data acquisition systems. The outputs included trended data for the operating system including actual performance. Upon completion of the review, specific areas in which to rationalise the existing dewatering plan were focused on.

IMEC identified some significant variances in the actual ground water inflow rates, compared with the original hydrogeological estimates which forms the basis of the site dewatering plan. The site initiated hydrogeological modelling (by others) and the results of these studies in conjunction with trended site data enabled IMEC to identify opportunity to reduce the system pumping capacity requirements.

Rather than installation of an additional UG to surface system, the site could use a 'chained' system to extend the current system further into the mine. This would present a significant capital and operating cost saving compared with the original strategy.

In addition to rationalizing the system capacity. IMEC presented an option to treat the UG dewatering feed in a bespoke plant and enable its re-use in the mining process as a new water supply.

The site had been discharging all of its underground dewatering feeds into a surface treatment facility which from deeper parts in the mine was a lift in excess of 1000m vertical. All raw water used within the mine was delivered from a surface holding tank and discharged down a primary feeder along the decline.

IMEC designed a treatment plant that would 'clean' the dewatering feed up to the same standard of that being delivered from surface. The treatment plant had a much lower power consumption compared with pumping dewatering feeds from the same horizon to surface, and so the system presented savings in both water discharge to surface and supply from surface.

The recycling system presented further operating cost savings compared with the original plan and also offered a significantly improved plan for water management.

The project remains at engineering phase and IMEC are excited and thankful to be part of such an interesting and challenging project and look forward to progressing from engineering through to construction and operational phases.

IMEC are a multidiscipline engineering consultancy specialising in providing EPCM support services to the mining industry. Positioned to support projects worldwide with offices in Dunshaughlin Co.Meath and Perth, Western Australia.

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Laser scan data and aerial imagery combining datasets in Northern Ireland

by Paul McCabe, Director, Six West. www.six-west.com

Thanks to recent technological developments within our industry, geospatial professionals can be more flexible in their approach to capturing, analysing and delivering survey data than ever before.

Whilst the idiosyncrasies of a particular job - geography of the site, accuracy requirements, time constraints etc - all contribute to the practicalities of how a survey is undertaken, we are now in a better position to offer clients a range of deliverables depending on how they intend to use the data. The choice of GNSS, laser scanners, UAS (drones), and total stations whether they be owned, hired or commissioned as a service, allow a more flexible approach, even to the extent that multiple sensors can be used to create a combined dataset. In particular, as more survey practices invest in laser scanners and UAS, we are seeing a growth in combined point cloud and aerial imagery data sets. Scan data and aerial imagery complement each other perfectly with laser scans providing high accuracy, detailed, 3D data sets whilst high resolution aerial imagery provides a wider context for this data and allows for the identification of meaningful contours and features that cannot be distinguished from laser scan data alone.

For this project, the combination of highly accurate scan data and high resolution UAS collected digital aerial imagery proved to be the answer for a challenging survey job at a former quarry site in Coleraine, Northern Ireland.

Trimble TX8 at the Coleraine site.

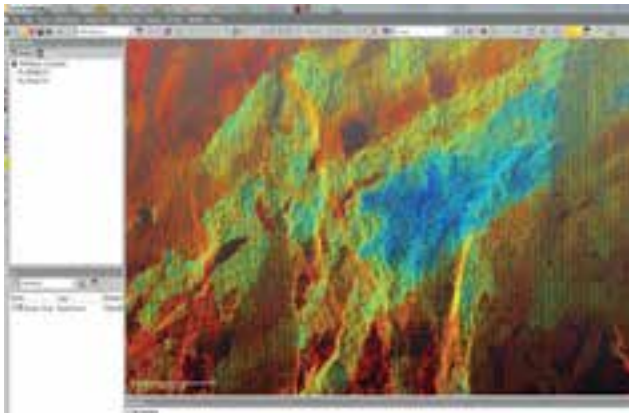
Site assessment

Coleraine is a large town in County Londonderry in Northern Ireland and home to a former quarry that up until the 1990's produced a range of crushed aggregate, concrete and asphalt for the local construction industry. The owners decided to redevelop the site for mixed commercial and residential use, a decision which saw the quarry excavation void turned into a feature lake and the establishment of a tiered and restored quarry floor, designed to provide a stable platform for the development.

However, as the site development progressed, two issues arose: firstly the site property boundary was poorly established and required comparison with Land Registry mapping to ensure that there had been no encroachment and secondly, the stability of the 25m high rock face along the northern boundary of the site needed to be assessed.

Following an inspection of the site it was apparent that a conventional topographic

RGB Point cloud from eBee and greyscale intensity from TX8 Scanner combined data set.



Close up of colour intensity from data scanned at approx 260m.

survey would be time consuming, costly due to the size of the site and dangerous to undertake, especially along the northern site boundary because of its proximity to the old 25m quarry face. Additionally, the confined nature of the adjacent commercial and residential property would further complicate an optical or GNSS survey. It was decided that a dual approach would work best. Firstly, the site would be flown with a senseFly eBee UAS to generate a high resolution orthomosaic of the area along with a full DTM, good to 50mm, which would allow a preliminary desktop inspection of the rock face in 3D.

Secondly, a 3D laser scan of the quarry face would be undertaken. This laser scan would deliver the accurate baseline model of the rock face required for detailed inspection and comparison with repeat surveys at agreed intervals in the future.

Flying the site

Six West regularly use its senseFly eBee for aerial imaging and the eBee was again selected for this job. The first task on site was to set up a GPS base station and establish its coordinates using a Trimble R8 GNSS and Trimble's VRS correction service. Using these base coordinates, a further Trimble R6 GNSS was used to survey a total of nine Ground Control Points (GCP's). For a GCP to be taken into account it needs to be visible in two images and to optimise results, at least five images are required. On this project, where the quarry face was of greatest interest, the more GCPs placed at the top and bottom of the face, the more accurate the reconstruction would be.

Point cloud information from the aerial imagery captured by the eBee.

Before the day of the aerial survey, a suitable take-off and landing spot was located to the south of the site and a flight plan was established taking into account the areas of interest. Once on site, the final parameters of the flight were decided including flying altitude (in this case 120m above take-off point), wind speed and lateral and

longitudinal overlap.

Three flights were completed with an overall flying time of 50 minutes. In total, 420 images were captured and processed back at the office to generate an orthomosaic and DSM. Using the nine GCP's the job was georeferenced to Irish grid coordinates resulting in a mean error of 0.007m. The result was a densified point cloud with a ground sampling distance of 3.66cm.

Scanning the quarry face

An accurate baseline model of the rock face was required for a comparison with repeat surveys in the future. However with a 100m wide lake at the foot of the face, many laser scanners would struggle to pick up the rock face's wet, black surface. KOREC Ireland recommended that the laser scan be undertaken with Trimble's TX8, a long range time-of-flight scanner, which would cope well with the extended range and poor surface conditions.

On the day of the scan work, a Trimble R8 GNSS with Trimble VRS Now was used to establish Irish Grid co-ordinates and level to OD Belfast for two newly established primary control stations. A Trimble R6 was then used to pick up the scan target locations and tie them in to the primary control. Eight scans were undertaken for the 700m long section of rock face with scans lasting three minutes for an 11mm x 11mm resolution capture at 30m range and 14 minutes for long range 340m scans.

The collected data was processed using Trimble RealWorks software and the LAS files were combined with the aerial data set.

Aerial imagery of the site captured by the eBee.

A combined data set

All post processing was carried out using senseFly's postflight Pix4D software and Trimble RealWorks processing software. The individual LAS files were easy to view and edit individually or as a complete model in RealWorks and additionally, a free Realworks viewer was supplied to the customer and their geotechnical consultants allowing them to view and interrogate the model.

In conclusion, an accurate detailed baseline survey was produced which can be compared with future surveys undertaken with any alternative equipment. The combination of aerial imagery and laser scan data generated an up to date orthophoto of the site with a DTM which can be used for modelling, earthworks design and any future development of the area.

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Accuracy of Drone Collected Survey Data

by Peter Kinghan, Chartered Mineral Surveyor & Chartered Geomatics Surveyor

Drones, UAVs, RPAS, SUAs or simply Unmanned Aircraft are one of the most exciting technologies to surface over the last few years. Slowly drones are starting to be used in a wide range of industries as the commercial world opens its eyes to the potential for their industry.

The drones are one thing but it's the sensors that can be mounted on them that provide the greater potential. For geomatics surveyors it's not the drones, or the sensors, but the structure from motion **photogrammetric software** (SfM) that has proven a game changer for the profession. This SfM software, largely automated, has made it significantly easier, and quicker, to produce high-quality digital surface models (DSMs) and orthoimage mosaics from imagery acquired with variable orientations and overlap, and from cameras that have not been rigorously calibrated. The visualisation of the final SfM product is impressive, really impressive, but is the inherent data quality as impressive. Just because the final product looks right, if not carried out properly it may not necessarily be right and if the 'old age' lessons of photogrammetry have not been practiced then the results definitely won't be right.

Surveyors talk and work in millimetres. One way to ensure silence in a room of geomatics surveyors is to mention that you had a 100 millimetre error in your traverse. This size of error raises eyebrows! So, considering this sensitivity what are the potential sources of error from drone surveys, how accurate is the survey information obtained, and what are the 'tricks of the trade' or the important things to take into consideration when producing survey data from drone collected imagery. The Society of Chartered Surveyors Ireland have funded this research to find the answers to these questions to ensure that their members are up to speed and fully in the picture on this relatively new technology and, more importantly, SfM software.

Some **potential sources of error** from RPAS and SfM produced products include Image Quality, Image Scale, Image Geometry, No. of Images, No. and Location of GCPs, GCP Configuration, GCP Ground Type e.g. soft / hard, GPS Accuracy, Human Error (as with all survey methods), Flight height / Pixel resolution, Light conditions, Availability of textures, Overlap, The Type of Terrain, Inaccurate GPS / IMU sensors, Shutter speed, Camera lens alignment, Accuracy of the RTK GPS used to survey the Ground Control Points, the real exposure end time of an image and the GPS timestamp tagged to it and Wind speed to name a few!

So, considering this non-exhaustive list of potential errors is millimetre accuracy survey data possible from photography collected by drones? In short, yes, but it's not simply a case of throwing the drone in the air, downloading and processing the data. The research, carried out on a quarry in Westmeath using a fixed wing survey grade drone, produced different data sets, with the same imagery, using a number of different ground control points and configurations. The results of the research indicate that accuracies of 1 - 2 meter RMSE are achievable when no ground control points are used. Accuracies of 0.08 m RMSE were achieved when 24 ground control points were used spread evenly across the area. All data was collected at 120 meters flight height with greater accuracy achievable from data flown at a lower flight height (although high spatial resolution does not necessarily imply correspondingly-high spatial accuracies).

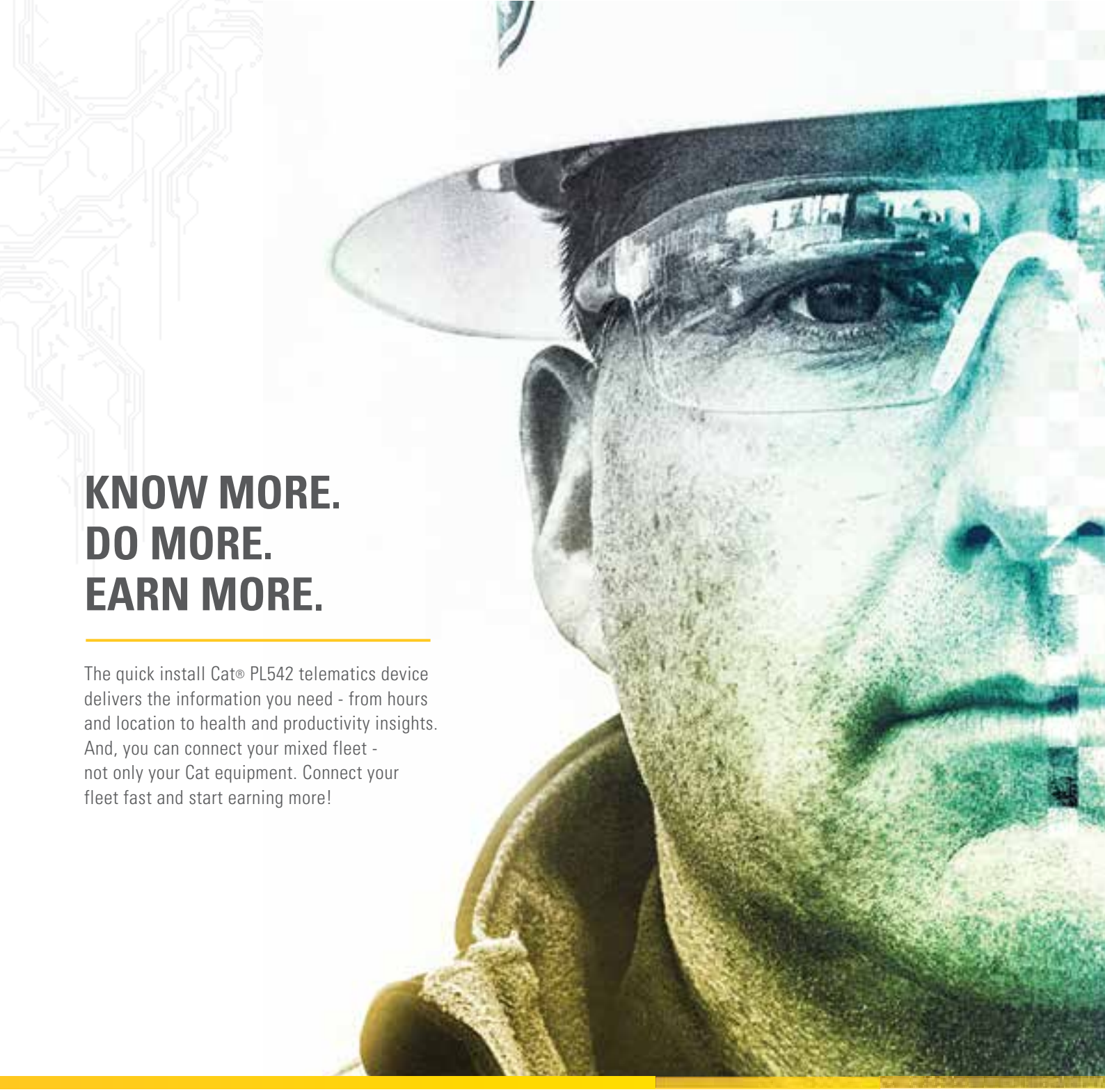
There are a number of **learning outcomes** from this research that will help improve the accuracy of drone collected survey data, including,: Flight height / Ground Sample Distance (GSD) affects accuracies (Lower flight height = higher pixel resolution = (potentially) more accurate results); Ground Control Point (GCP) Ground conditions (Preferably located on hard surfaces): Number of GCPs (The more the better for higher accuracy); Preferred GCP Configuration (One GCP every three baselines along the flight direction and every two baselines perpendicular to the flight direction); Human Error (Can be an issue…..as with all survey methods); Number of Images (Increasing the number of images produces denser meshes and improves model accuracy; Vertical imagery is geometrically weak (Strengthen image geometry by obtaining oblique imagery in addition to the vertical dataset acquired for object coverage).

The key for practitioners is to be open and clear when it comes to achievable accuracies and for users of drone collected survey data to be clear on what survey specifications they require as different workflows will dictate the accuracy achievable.

Safe flying!

email: pkinghan@slrconsulting.com

Surveying at The Burren, Co. Clare



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Ireland's ground and airborne geoscience data acquisition programme

by Dr. Aoife Brady, Tellus Project Manager, Geological Survey

The Tellus Programme is Ireland's ground and airborne geoscience data acquisition programme, collecting geochemical and geophysical data to inform the management of Ireland's natural resources and environment.

The programme, run by the Geological Survey, a Division of Department of Communications Climate Action and Environment (DCCAE), involves two types of surveying – airborne geophysical surveying using a low-flying aircraft, and ground-based geochemical surveying of soil, stream water and stream sediment. To date over 40% of the Republic of Ireland and all of Northern Ireland has been surveyed and plans are underway to survey the rest of the country. The data collected by Tellus is used by a wide range of stakeholder groups across Ireland, particularly mineral exploration, environmental management, agriculture, human health and third level researchers in these areas. For the minerals industry in particular, the availability and access to precompetitive geoscientific data is crucial to attracting investment in Irish mineral exploration.

Tellus' **airborne geophysical survey** comprises measurements of magnetic field, gamma-ray spectrometry and time-domain electromagnetic data. The high resolution data collected is an invaluable tool for effectively 'seeing through' Ireland's often deep glacial deposits and extensive peat cover and sensing geological features not apparent from conventional mapping techniques. The new data are being used to revise the Geological Survey's quaternary and surface bedrock geology maps, assist in mineral exploration, identify potential areas of contamination and map areas of radon risk. The Tellus **geochemical surveying** is characterizing the baseline chemistry of soils, stream water and stream sediments across Ireland, taking samples at a density of approximately one every 4km2. Multi-element laboratory analysis of these samples allows a suite of some 55 maps to be produced, which are important for both agricultural productivity and environmental management, particularly for improving our understanding of how trace elements, essential for animal and crop health, are distributed in the environment.

The latest findings from the **2016 airborne survey** over Galway and south Mayo, released earlier this year, are providing new insights into the complex geology of Connemara, including faults, folded rock formations and areas of previously undiscovered buried granite. The new data has also shed fresh light on the radon risk impacting on the West of Irelands revealing extensive areas of fractured limestone, which can be exploited by naturally occurring radon gas leading to large radon accumulations within the overlying soil, which can pose a threat to health. Using the data, the Tellus Programme is working alongside the Environmental Protection Agency (EPA) to further improve understanding of the distribution of radon gas to update maps and guidance for communities, planners/builders and house owners across the region and wider country.

Currently, the Tellus airborne survey is collecting data over northwest Mayo and west Donegal. By the end of 2017, approximately 50 % of the country will be completed, and airborne data acquisition will have been completed across the northern half of the country to a horizontal line just south of Galway and Dublin. The Tellus ground survey commenced this spring with peri-urban soil sampling in the urban areas of Greater Dublin and Galway. Regional soil and drainage sampling begun at the start of May across Co. Galway, and will progress, over the course of the summer, across counties Roscommon and neighbouring parts of Offaly, Westmeath and Longford until late autumn.

All data collected by the Tellus programme and maps produced are freely available from the project website, www.tellus.ie. The impacts from previous phases of the programme were recently published in the 2016 book publication by the Royal Irish Academy, 'Unearthed: Impacts of the Tellus surveys of the north of Ireland'. The book presents the outputs of the first two Tellus phases, Tellus Border and the Tellus survey of Northern Ireland, which to date represents the largest collaborative cross-border geoscience programme conducted across the island of Ireland.

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An Appreciation

Tony (Michael Anthony) Killian

by Leslie Sanderson

It is with great sadness that we report the passing of Tony Killian who was a long time member and former Secretary of the Irish Mining & Quarrying Society.

Tony, who was 91, was well known throughout the extractive industry as the foremost explosives expert of his time and was very well regarded within the mining and quarrying community; his unfailing contributions especially to the IMQS Annual Review of the Extractive Industry will be greatly missed.

Family members were joined at Requiem Mass, held at the Church of St. Vincent de Paul, Marino, Dublin, by his many friends and colleagues, including 11 Past Presidents of the IMQS, such was the esteem in which he was held, and although sadness was evident, and as stories unfolded there was many smiles and much laughter relating to his extraordinary life.

Commented colleague and IMQS Past President Les Sanderson: "Tony, beloved husband for 60 years of Bridie, loving father of 8 children and 14 grandchildren, was a farmer, technical explosives expert, society secretary, historian, researcher, editor, pilot, golfer, art enthusiast, antiques connoisseur, builder, traveller, and fun loving story teller with a passion for life. Where does one start to tell of such an extraordinary man's life?

"His early years were spent in Athlone, later in the greater Dublin area and in recent years residing in Drumcondra. I had the great privilege of visiting him while he lived in The Ward approaching harvest time where he took to showing me fields of golden wheat and spent some time describing this scene to me in a way that only an artist and writer could. His appetite and appreciation of art and its enhancement of life was evident in so many ways."

Added Les: "A technical engineer and leading expert with in the explosives supply industry since 1951 with ICI and IIE, Tony would often regale us with sometimes humorous stories of joining blast teams to demolish 22 story apartment blocks in Hackney, London or of assisting the Irish Army in blasting the remains of Nelsons Pillar and leaving it in neat piles down O'Connell St. Dublin, or the blowing up of Chimney stacks in other parts of Ireland. That is apart from the more serious work of demolishing quarry faces or creating tunnel profiles.

"As Council Member & Hon Secretary of the IMQS from 1979 - 2002, he saw it as his duty to guide, steer and cajole 18 IMQS Presidents, arranging field trips both at home and abroad, dinner dances, presidents receptions, guest lists, golf outings (and hounding and abusing fishermen) Hillhead exhibition trips and so much more!

The Killians in New York

"In his leisure time he was passionate about his golf. His ever enquiring mind led him to travel to places to research and write the most intriguing stories about the building of the Panama Canal or the origins and design of the Pyramids or the Fingal's caves expedition. In all he wrote 37 Papers for the IMQS Annual Review.

"In 1995 Tony persuaded me to publish the first Quarterly news letter which we called "The Extractive Times". We continued to jointly edit this for some years and it developed into the publication which we now know and respected as the 'Annual Review' with its own editorial team.

"I had the honour of sitting with Tony in hospital in May while he laid out for me the papers he wanted to have ready for the 2018 Annual review."

Concluded Les: "Tony loved life, stories and people. I would like to think of him as doing his most exciting research yet, exploring a place which none of us yet know too much about, and having to explain to St Peter some of his often scurrilous stories about the angels or the Pearly Gates. Tony, may you really enjoy your well deserved Rest in Peace."

Outgoing & Generous

Others paying tribute to Tony include his long time friend and colleague Darryl Magee who, along with IMQS's Don Litster, was also instrumental in bringing the Annual Review to the A4 glossy journal that it is today.

"The Annual Review was a big part of Tony's life, as it was mine and Don's. I think all three of us would have retired a long time ago had it not been for our love of working together on the publication, the success of which was in many ways down to Tony, a genuis researcher and gatherer of stories.

"Up until his death, we were already planning the 2018 edition and I will miss him a lot, working with him was something that I will always treasure."

And added 4SM (NI) Ltd's Helen Beggs: "As publishers, we worked very closely with Tony over the years. He was an absolute pleasure to deal with, a true gentleman in every way. His knowledge of the industry was inexhaustible. His sad passing is a big loss to the industry and we extend our sincere condolences to the family circle."

Tony is survived by his wife Bridie, sons Aidan, Michael, Brendan, David, Patsy and daughters Anne, Mary and Sandra.

Oscar Wilde Master of Words & Stones

by Tony Killian

Incorporating five beautifully colourful and exotic rock types from three different continents, the Memorial to Oscar Wilde in Dublin's Merrion Square is truly a geological wonder.

The work of art consists of three pieces, the stone sculpture of Oscar Wilde, a pillar with a bronze of his pregnant wife and a pillar with a bronze male torso.

In the sculpture Wilde is wearing a green smoking jacket with a pink collar, long trousers and shiny black shoes, with an unusual two-sided expression on his face, depicting both joy and sadness.

In an innovative way, Osbourne used stone to form Wilde's image.

- Wilde is depicted reclining on a 35 ton white quartz boulder from Co. Wicklow
- His head and hands are carved from Guatemalan jade;
- His jacket is made of green nephrite jade from Canada;
- His collar and cuffs of thulite from central Norway;
- His shoes and socks of black granite from India;
- His trousers of blue pearl granite from Norway; and
- His shoe laces and buttons are of bronze.

The Pillars

The pillars in the foreground of the memorial are covered in quotations from Wilde's writing, setting out his thoughts, opinions and witticisms on art and life.

Included are some of his famous one-liners such as:

Be moderate in all things, including moderation.

The play was a great success, but the audience was a disaster.

He would stab his best friend for the sake of writing an epigram on his tombstone.

Women's styles may change, but their designs remain the same.

I can resist everything except temptation.

Always forgive your enemies, nothing annoys them so much.

I am not young enough to know everything.

Many today know the controversial, flamboyant, and debonair Victorian dramatist, through his works the "The Picture of Dorian Gray" and "The Importance of Being Earnest." Larger than life, Oscar Wilde was a poet, dramatist, author, and celebrity.

His work and spirit are as relevant, witty, and alive as ever over 100 years after his death, great respect on November 30, 1900, in Paris.

His famous tomb, designed by Sir Jacob Epstein, is located in Père Lachaise Cemetery, Paris, France. It took nine to ten months to complete with an accompanying plinth by Charles Holden and an inscription carved by Joseph Cribb. Epstein's great respect for Wilde was emphasised when he requested that his ashes be placed alongside Wilde in the structure in 1950.

The sculptor depicted Wilde's love of beautiful objects, including stones, as well as his colourful personality. The memorial captures Oscar Wilde's flamboyant and colourful personality, depicted at age 40-a pivotal time in his professional and personal life.

Danny Osbourne, was the designer and sculptor of the Memorial, comissioned by the Guinness Ireland group, and erected in 1997.

Watching the Birth - and Death - of an Island

by Tony Killian

It was one of the rarest events imaginable. A 240-foot-tall volcanic island in the South Pacific was still venting sulfur gases in December 2006, four months after it emerged from the sea.

The first thing Swedish sailor Fredrik Fransson noticed as he set out in the yacht Maiken, from the Vava'u Islands in Tonga last August was that the water was the wrong colour. Instead of the familiar deep blue of the open ocean, the waters surrounding the Maiken were lagoon green. Then as the vessel continued westward, the surface of the ocean inexplicably turned to stone. in front of us it was as if there was no more sea," "It was like the Sahara, with rolling hills of sand as far as the eye could see." But the Maiken hadn't run aground. Instead, she had sailed into a massive raft of floating pumice stone. No one on Earth knew it yet, but just a few miles away, the ocean floor was violently thrusting up fresh new land.

"Often in the South Pacific you have clouds on the horizon, but this time there was one that stood out," Fransson says. "Then we saw a black pillar shooting up into the air, and we understood that it had to be a volcano." Fransson and his shipmate cautiously navigated toward the smoke. Where the chart said there should be an under-water seamount called Home Reef, they found an island, growing one explosion at a time. "It was kind of a smoldering, smoky stuff. It looked like coal, and when there was an eruption, we could see the new material piling up on it," says Fransson.

Barnacles and mollusks hitchhiked on erupted pumice, which drifted more than 2,000 miles from Tonga to Australia.

When the Maiken crew posted their observations online, scientists jumped at the news: Undersea eruptions probably occur dozens of times a year, but they are mostly in remote places or at extreme depths, so they are rarely witnessed by humans. Greg Vaughan, a geologist with NASA's Jet Propulsion Laboratory, says, "We decided right then that we needed to get in there and get some satellite data." NASA's ASTER and MODIS instruments captured bird's-eye views of the new island, allowing researchers to gauge the temperature of the heated waters surrounding it and track the giant pumice rafts that the volcano had spewed out. By Vaughan's estimation, it was the first time scientists had ever been able to study an island-forming eruption with images from space.

Meanwhile, volcanologist Scott Bryan of Kingston University in London was gunning for a research expedition to the island before it disappeared. Many new volcanic islands are ephemeral, lasting only months before disappearing again under the sea. "Ultimately, it's a battle between the frequency and volume of eruptions and the wave action taking it back down to sea level," says Bryan. The type of material that erupts also affects an island's life span. True lava forms more enduring structures—like Surtsey in Iceland, which broke through surface waters in 1963 and remains exposed today—while islands of mostly pumice and ash are quickly torn down by the waves.

That didn't bode well for Fransson's find. When Bryan finally reached the site this February, he found that the new island—originally over a tenth of a mile square—had already nearly washed away. The rotten-egg smell of sulphur dioxide gas hinted that magma was still cooling inside. Although sea conditions were too rough to make landfall, Bryan was able to collect water samples near the volcano for chemical analysis, which is currently under way. By now, he says, a shallow seamount is probably all that remains of the surprise island at Home Reef.

Though the exposed island existed for only a few months, the eruption may have a lasting biological impact. Pumice rafts remain afloat for months or even years, becoming home to barnacles, corals, algae, oysters, tube worms, and even the odd anemone. In April, eight months after the eruption, pumice from Home Reef that had been heavily colonized by such organisms washed up in Queensland, Australia, more than 2,000 miles away. The diversity of the famed Great Barrier Reef in Australia may be stocked in part by pumice stowaways from eruptions in distant waters, says Bryan, who is studying the rafts with his colleagues. "It's an amazing interaction of all these different aspects of Earth and surface processes, which are so dependent on one another," he says.

A 240-foot-tall volcanic island in the South Pacific was still venting sulfur gases in December 2006, four months after it emerged from the sea.

As the smoke cleared, they noticed something strange just at the water's surface.

The yacht Maiken cut through a giant pumice raft during the eruption.

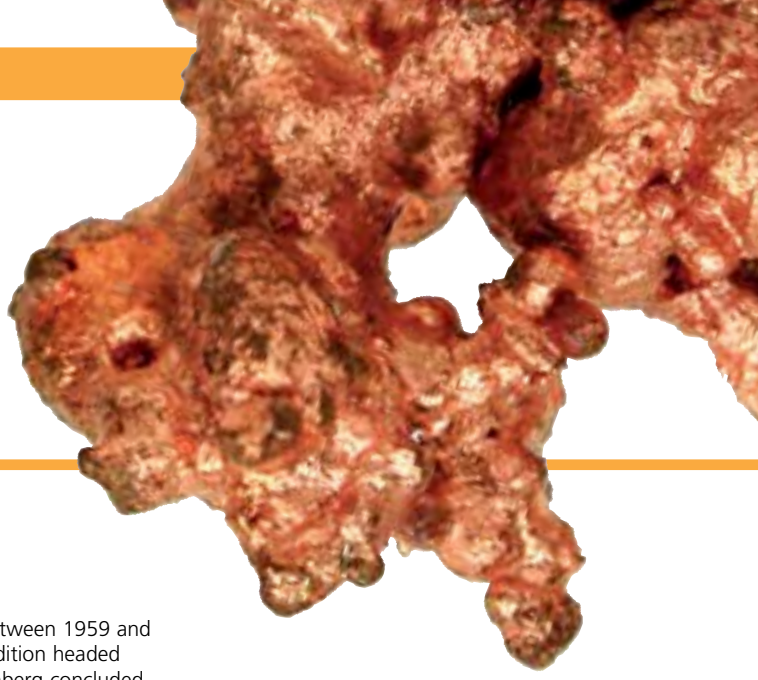
The crew decided to sail through it, leaving a break in the stone behind them as they went. They wondered what could have caused this expanse of stone to suddenly appear. Once they were a safe distance away, they heard a faint rumbling. Looking back they saw water bubbling from the surface.

They anchored to watch this tremendous event. Massive plumes of smoke filled the sky.

The stunned crew couldn't believe what they were seeing: It was the actual birth of a new island.

It was one of the rarest events imaginable.

Copper in the Bible



by Tony Killian

The copper (Heb. neḥoshet) referred to in the Bible is not pure copper but an alloy of copper and tin. This alloy – bronze – was the most useful and important metal from the beginning of the third millennium B.C.E. to the 13th century B.C.E. when it began to be replaced by iron. Copper mines in the ancient Near East were located in Cyprus (from which the name copper is apparently derived), Sinai, and Egypt. It was the main metal extracted in Erez Israel in antiquity and is the only one mined there today. Copper is usually extracted from sulphide minerals, and partly from silicates, and carbonates; very small amounts of native copper are also found.

The Arabah contains copper mines in three main centres: (1) Faynān (biblical Punon,) [1], around 40–50 km south of the Dead Sea in the eastern Arabah; (2) the area of Wadi Abu Khushayba, around 13 km. southwest of Petra; (3) and in the Timnah-Amram region which also extends southwest of Elath. The copper deposits appear in the form of concentrates in the white Nubian sandstone with a base of Evronah complex formation of the Lower Cretaceous period. The concentrates are connected with the layer of fossilized trees in the sandstone and are composed mainly of sulfides, carbonates, silicates, and copper oxides. They have a high copper content which reaches as much as 30–40%. Nelson Glueck, the first to describe these deposits in detail, attributes the beginning of copper mining and smelting activities to the Kenites, Kenizzites, and Kadmonites [2] who inhabited the area and were related to Tubal-Cain (i.e., the Kenite), the first metalsmith[3]. In Glueck's opinion they were nomadic tribes who wandered in the Arabah and were metallurgical specialists. He also associates the Edomites with the metal industry and its trade through the Arabah and the Red Sea. The area was conquered by David, and Solomon continued to work the mines and develop international trade, mainly by way of Ezion-Geber; his metallurgical industry was located in the plain of the Jordan "in the clay ground between Succoth and Zarethan" [4]. Glueck suggests that copper was even exported from the Arabah by Solomon, and also that the protracted wars between Judah and Edom during the period of the Kingdom of Judah, were over control of the copper mines in the Arabah.

Excavations

Excavations carried out between 1959 and 1969 by the Arabah Expedition headed by Professor Beno Rothenberg concluded that the copper mines in the Timnah area are not to be attributed to the time of Solomon. Rothenberg distinguished three periods at the site: the Chalcolithic period (fourth millennium B.C.E.), the Early Iron Age, and the Byzantine period (third–fourth centuries C.E.). Rothenberg suggests that Egyptian kings in the 14th–12th centuries B.C.E., and not the kings of Israel and Judah, sent mining expeditions to the Arabah, and that the copper mines and the smelting installations were operated by the Egyptians together with the Midianites, Kenites, and Amalekites. Among the finds in an Egyptian temple discovered in Timnah was a copper snake which dates it to the time of the Exodus. According to the excavator, the Kenites and the Midianites employed highly developed methods of copper production that ceased with the Israelite Conquest; only commercial activities, and not production, were undertaken in the period of the Monarchy by way of Ezion-Geber and the Red Sea to Ophir and Sheba. Rothenberg also emphasizes that a metallurgical centre was located in the Succoth-Zarethan area where imported raw copper was made into finished products [5].

Processing and Uses

The copper was extracted from its ore by smelting in an oven and then cast. Heat was produced by charcoal from acacia trees which grow in the Arabah. Much copper was used in manufacturing vessels for the Temple and especially for the Tabernacle: clasps, sockets, rings, posts of the enclosure, lavers, etc. The biblical description of copper weapons indicates a highly developed military culture, e.g., the description of Goliath: "He had a helmet of bronze on his head, and he was armed with a coat of mail, and the weight of the coat was 5,000 shekels of bronze" [7]. Copper was fashioned into a symbol for the Israelites in the desert in the form of a serpent of copper made by Moses [8] (see *Copper Serpent); it was preserved by the Israelites up to the time of Hezekiah who destroyed it, calling it *Nehushtan [9]. The destruction of the Temple is emphasized by the removal of the copper; after the Temple was burnt, the Babylonians destroyed all the objects in it and carried away a great many copper objects to Babylonia and "the bronze of all these vessels was beyond weight" [10]. In its use in vessels for the Tabernacle and Temple head shall be copper" [11]. It also denoted drought – "I will make your skies like iron and your earth like copper" [12]. The word for chains (neḥushtayim) is also derived from copper. Not only the heaven and earth but also the Israelites are compared with rigid copper: "your forehead copper" [13].

(Editor's Note)

Erez is named after the first nucleus that settled the kibbutz. They were members of the Noar Oved nucleus from Petah Tikva. They originally settled on ground in the area of Or HaNer in 1949. In 1950, they were resettled in its current location on land belonging to the depopulated Palestinian village of Dimra. Erez Israeli (born 1974) is an Israeli artist, specializing in Sculpture and Installation Art. (Israeli lives and works in Tel Aviv)

Nelson Glueck was an American rabbi, academic and archaeologist. He served as president of Hebrew Union College from 1947 until his death, and his pioneering work in biblical archaeology resulted in the discovery of 1,500 ancient sites.

Biblical References

(1) Num. 33:42
(2) Gen. 115:19
(3) ibid.4:22
(4) I Kings 7:46
(5) I Kings 7:46
(6) Ex. 26–36
(7) I Sam. 17:5–7
(8) Num. 21:9
(9) II Kings 18:4
(10) II Kings 25:13, 16
(11) Deut. 28:23
(12) Lev. 26:19
(13) Isa. 48:4

Darryl Calls Time on his Career in the Publishing World

by David Stokes

Former publisher of our sister magazine Export & Freight and more recently publishing consultant Darryl Magee has retired from the industry, which he has 'served' for over half a century.

At 78, Darryl says he wants to spend more time with his family and grandchildren, but equally he wants to pursue his passion for golf, painting and singing, and who could deny him that after such a successful career in the publishing world.

Having spent much of his life working alongside Darryl, Plant & Civil Engineer editor David Stokes recently met up with him to recall the good old days, and typical of his sense of humour, he cautioned: "I don't want this to sound like an obituary – there's a lot of life left in the old dog yet!"

He adds:"It's been a difficult decision to step down. I love the industry and the people in it and I will miss the buzz and excitement of getting out and about meeting clients, many of whom have become good friends over the years, and remain so."

A qualified HGV driver, Darryl spent many years 'test' driving trucks and vans for Export & Freight magazine, for which he reported from all over Europe and further afield. "I will definitely miss the travelling, although I haven't done so for a few years now. "

However, he'll certainly not be putting his feet up. As an active member of Portadown Male Voice choir he has a full schedule of engagements lined up. "Over the coming weeks we will be doing concerts all over the north and south of Ireland, and I also want to take up painting once again and, of course, there'll be the odd holiday abroad, so I don't anticipate being bored."

While Darryl may miss the association of his work colleagues, his work colleagues and business partners will most definitely miss him. Comments Plant & Civil Engineer publisher Garfield Harrison:"I am proud to say that Darryl has been my mentor for the last 20 years and I have learned so much from him. His energy, passion, desire and publishing skills have been so evident over the years and he will be sorely missed.

"His people skills, whether on the editorial, advertising or HR side, are amazing and the one thing he has always drummed into us that you should always 'treat people the way you would like to be treated yourself and you will never go far wrong'. This is what all of us at Plant & Civil Engineer have tried to adhere too.

"Everyone at Plant & Civil Engineer wish Darryl and his wife Olive a long, happy, healthy and well deserved retirement."

Those sentiments have been echoed by fellow Plant & Civil Engineer publisher and Editor-in-Chief Helen Beggs: "I have known Darryl for almost 30 years and he has always been an absolute gentleman, both in business and in his personal life.

"Our business wouldn't exist today if Darryl hadn't founded Export & Freight some 45 years ago and we owe him a great debt of gratitude for that. He taught Garfield and I all we know and the standing and respect in which the industry holds him is extensive. He will be sadly missed by all who know him in the industry and we wish him nothing but happiness on the golf course and with his wonderful family and grandchildren."

Another life-time friend is Billy Austin who grew up with Darryl in Portadown and who, in some ways, was a catalyst for Darryl's long and successful career in the publishing world. Their professional paths first crossed at the Portadown Times, a weekly newspaper that was then part of the Morton Group.

Recalls Billy, an accomplished artist who now runs his own print & design company, Austin Graphics: "As Advertising Manager at the Portadown Times there came a time I needed an assistant, and who better, I thought, than my old mate Darryl. A quick learner, he was soon promoted to Advertising Manager of a sister paper, the Lurgan Mail.

"Along with another advertising colleague, Ivor Smith, sadly now deceased, and a great editorial team behind us, we helped build the Morton Group into a highly respected and very profitable enterprise.

"Darryl and I became Directors in the Morton Group and as new challenges called we decided to set up our own operations. Darryl founded Export & Freight, along with the late Andrew Crozier, and I started my own company, and as they say, the rest is history."

Not quite! A lot happened along the way. Tales of Darryl's exploits are as boundless as they are endless.

As a salesman he just didn't take 'no' for an answer. Persistence was his middle name. Like the time we were working on the Lurgan Mail, me as Deputy Editor and Darryl as Advertising Manager. He had been striving for over a year to encourage a local fashion retailer to begin advertising in the newspaper again after a 22 year 'break' brought about by an earlier experience when the shop owner had taken out a full page advert, the headline of which should have read in very large and bold letters: 1,000 SHIRTS FOR SALE.

Alas, when the paper was published on that Thursday morning, to everyone's horror, someone had failed to spot that the letter 'R' was missing from the word 'SHIRTS.' The owner didn't quite see the funny side, even though all 1,000 shirts sold out very quickly!

It led to the retailer shunning the newspaper for over two decades before Darryl began appearing on the scene week after week after week. At first, the shopkeeper kept showing him the door, but he finally relented. Darryl got a 'yes' and the retailer was back on the advertising pages. Darryl's perseverance had paid off, a quality that has contributed to his outstanding and prolonged success in the publishing world.

Adds Billy: "There was always a serious side to business, but there's no doubt our early days were filled with fun and laughter. Great times, indeed. I wish Darryl a long and happy retirement."

As we all do here at Plant & Civil Engineer. Our office door will always be open to him.

Obituary: Vincent McCabe R.I.P.

(Past President of the IMQS 1988-1989)

Vincent McCabe Emeritus Professor of Engineering at UCD and Past President of the IMQS (1988-1989), passed away on 27th June 2017.

Vincent was a UCD lecturer in mechanical engineering from 1959, and dean of the faculty of engineering and architecture at UCD from 1986-1992. He was one of six brothers who all did degrees in mechanical and electrical engineering in UCD. He served as Treasurer for the IMQS for many years before serving as President.

We wish his wife Finola and family our condolences at this sad time.

Irish Mining & Quarrying Society
Annual Dinner Dance 2016

Chris & Shirley Stevenson, Ruth & Gary Megarrell, Liam Binions, Katie Doyle, David & Deirdre Egan, Padraig & Stephanie Flynn, John & Sinead Francis.

Brendan Kieran, Eileen Johnston, Siobhan Tinnelly & David Johnston.

Anne & Pat O Connor, Olive & Darryl Magee.

Stanley Bartlett, Padraig Barrett & Alan Buckley.

Pat Griffin, Mary Griffin, Eileen Johnston & David Johnston.

Ciaran & Marcella Greenan, Ronan & Elizabeth Griffin.

Avil Kyne & Minister Sean Kyne.

Heather Sanderson, Sean Finlay, Les Sanderson & Hilary Finlay.

Danielle Coombs & Trevor Wills.

Barbara & Keith McGrath.

Eibhlin Doyle, Gerry Stanley & Avil Kyne.

Brendan Morris - Presidents Address

Brendan Kieran & Siobhan Tinnelly.

Tony & Sandra Burke, Noelle & Kevin Donovan, Maureen & Denis O Callaghan, Sharon & Tim O Mahony, Breda & Alan Geraghty.

Barbara McGrath, Moira Lonergan, Julie Barrett & Olive Buckley.

Mike Lowther, Dave Harrington & Brendan Morris - IMQS Rescue Award.

Ciaran & Marcella Greenan, Cyril & Martina Maher, Ronan and Elizabeth Griffin, Patricia & Gary O Brien, Ciaran & Joanne Collier

Kytrina Mullan, John & Mary McEntagart, Pat & Anne O Connor, Dave Mullan, Ariane Gibson & Morgan Walker.

Jo Morris, Olive Magee, Katie Morris & Shauna Morris.

Carol Sanderson & Roy Sanderson.

Derek Maher, Ciaran Greenan, Marcella Greenan, Mr Sam Murphy,

David Burke, Mary Callan, Donal Brennan, Carmel & John Kelly, Lisa Neary, David Taylor, Monica & Liam O Shea.

Koen Verbruggen, Brendan Morris,(President IMQS) Sam Eccles (President of Institute of Quarrying NI), Minister Sean Kyne, Sean Finlay & Prof Dermot Duff.

IMQS Annual Dinner Dance 2017

Saturday 11th November, 2017

This year's IMQS Dinner Dance will take place in the Kildare Hotel Spa & Country Club, Straffan, Co. Kildare.

This is a 5-star resort on a former Georgian estate on 300 rural acres along the River Liffey in County Kildare 30 minutes from Dublin International Airport and Dublin City Centre.

The resort offers golf on two internationally recognised championship courses. Our Golf Tournament will take place on 11th November at 11.00am - Email info@imqs.ie for more details.

Music will be supplied by Vegas Nights who are a fantastic 6 piece band fronted by both a male and female singers with a sophisticated sound and look, the band perform a brilliant mix of music from Pop to Country and the Classics! Followed by a DJ that will keep you dancing to the early hours!

The event will be addressed by a Guest of Honour.

There is also ample free parking.

This is a social evening with good and outstanding entertainment, a brilliant chance to meet up with old friends and make new acquaintances in the industry. Individual or small groups will be accommodated on members tables, so don't be put off if you want to come by yourself or in a small group.

Tickets are now available on the IMQS web page
http://www.imqs.ie/DinnerDance.aspx

IRISH MINING & QUARRYING SOCIETY

Membership Application Form

IMQS, THE LUCAN CENTRE, PRIMROSE LANE, LUCAN, CO. DUBLIN
Web: **www.imqs.ie** Email: **info@imqs.ie** Tel: **08949 27942**

PERSONAL Details (PLEASE USE BLOCK CAPITALS THROUGHOUT)

Surname: ..... Forename(s): .....
Home Address: .....
.....
Telephone Number: .....
Mobile: .....
Home E-Mail Address: .....

EMPLOYER Details (PLEASE USE BLOCK CAPITALS THROUGHOUT)

Employer: .....
Address: .....
.....
Telephone Number: ..... Mobile: .....
Work E-Mail Address: .....

Correspondence Address (please tick both location to be sent to & by what means
Home ❑ Work ❑ E-Mail (preferred by IMQS) ❑ Post ❑

Please state association with the Mining or Quarrying Industry: .....
Proposed by: ..... (Existing IMQS Member)

Note: Should the candidate be unable to obtain a proposer who is a member of the IMQS, the application will be assessed by the Council of the IMQS and membership is subject to the approval of the Council. Please send to address above enclosing payment of €50 (ordinary membership). (Membership fees are payable in January each year and are valid for that calendar year).

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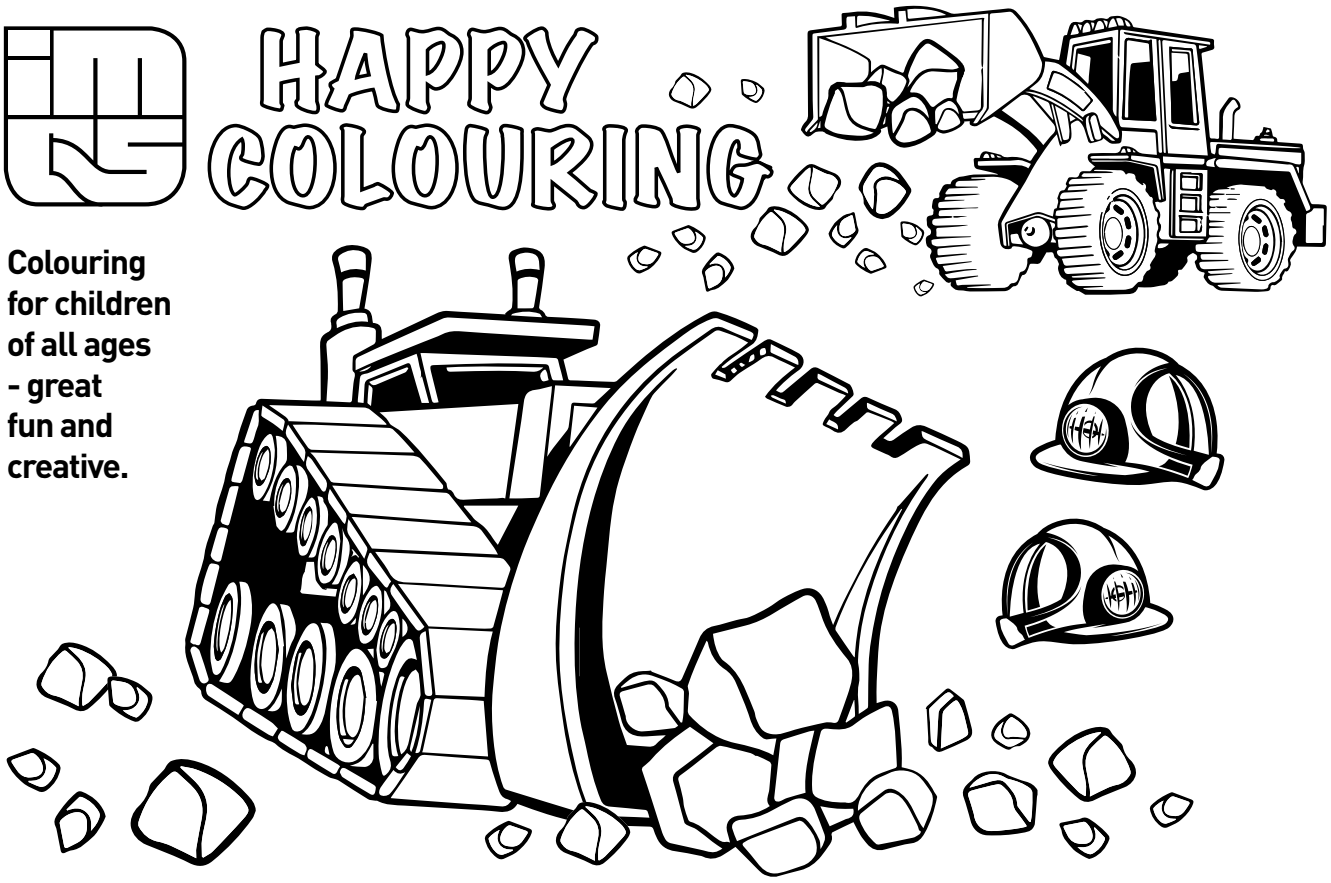

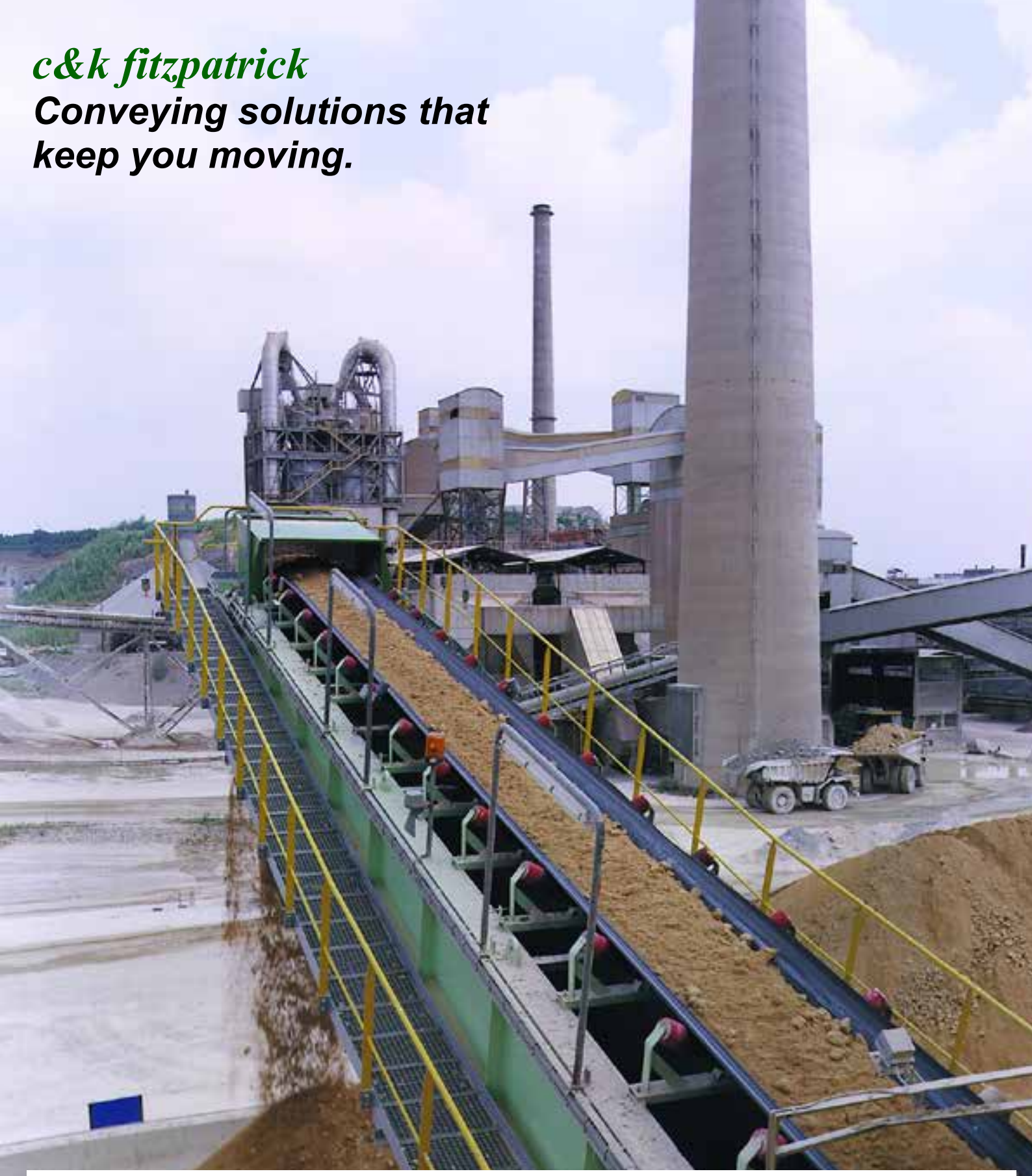

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