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Volume 36 • Number 4 • December 2018

GEOTECHNICAL news

Looking down the Mount Meager runout path

Wireless Data Collection | for Geotechnical Monitoring Instrumentation

2 Wireless Data Collection Systems to quickly get you connected to your data: **RSTAR** and **DT LINK**

+ MINIMUM PER CHANNEL COST + EXTRA LONG BATTERY LIFE + LONG DISTANCE TRANSMISSION

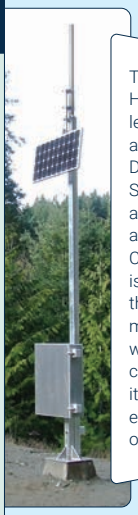
FULLY AUTOMATED COLLECTION (REMOTELY)

An RSTAR System uses data loggers (nodes) at the sensor level, deployed in a star topology from an active RSTAR Hub containing an RST flexDAQ Data Logger.

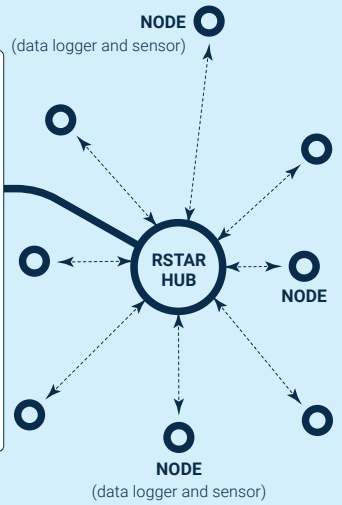
rstar ARRAY RADIO SERIES

FEATURES

- Up to 10 years of battery life from 1 lithium 'D' cell.
- Up to 14 km range from Hub to Node in open country. (depending on antenna type)
- Up to 255 nodes per RSTAR Hub.
- Based on 900 MHz , 868 MHz and 2.4 GHz spread spectrum band. (country dependent)



The RSTAR Hub shown left contains a flexDAQ Data Logger System with an antenna and battery. Collected data is saved to the flexDAQ memory where users can access it remotely, either on-site or off-site.



>>> Watch the video for both systems at: www.rstinstruments.com/Wireless-Data-Collection.html <<<

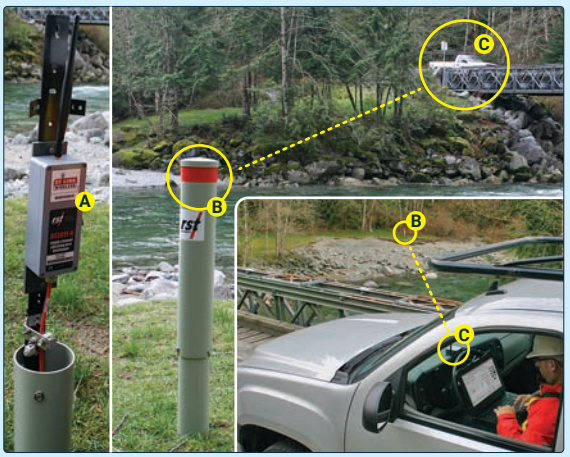
SEMI-AUTOMATED COLLECTION (ON-SITE)

DT LINK is an on-site wireless connection to RST data loggers for quick data collection. Ideal for hard to access areas where the data logger is within line of sight.

DT LINK WIRELESS

FEATURES

- Safely & easily collect data from data loggers that are in areas with poor access, trespass issues and hazardous obstacles.
- Years of battery life from 1 lithium 'D' cell.
- Range up to 800 m (900 MHz) and up to 500 m (2.4 GHz).
- Collect data in seconds with a laptop connected to DT LINK HUB.



Pictured: (A) DT LINK WIRELESS data logger, connected to a vibrating wire piezometer and housed in a (B) protective enclosure, has its data collected from a laptop connected to the (C) DT LINK HUB - all within seconds from the convenience of your vehicle.

DT SERIES DATA LOGGERS

RST's "DT Series" Data Loggers accommodate the RSTAR and DT LINK WIRELESS Systems. Compatible sensor types include: *Vibrating Wire, Potentiometers, MEMS Tilt Sensors, Strain Gauge (full bridge) Sensors, Digitally Bussed Sensors, 4-20 mA Sensors, and Thermistors.*

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Cover *Looking down the Mount Meager runout path at a devastated Capricorn Creek. The Mount Meager landslide, at ~50 Mm^3 was the largest in Canadian history, but pre-historic events associated with volcanism are known to be even larger. Recent research at SFU reveal active fumaroles on the volcanic massif. See article page 30.*

Photograph: Rick Guthrie, 2010.

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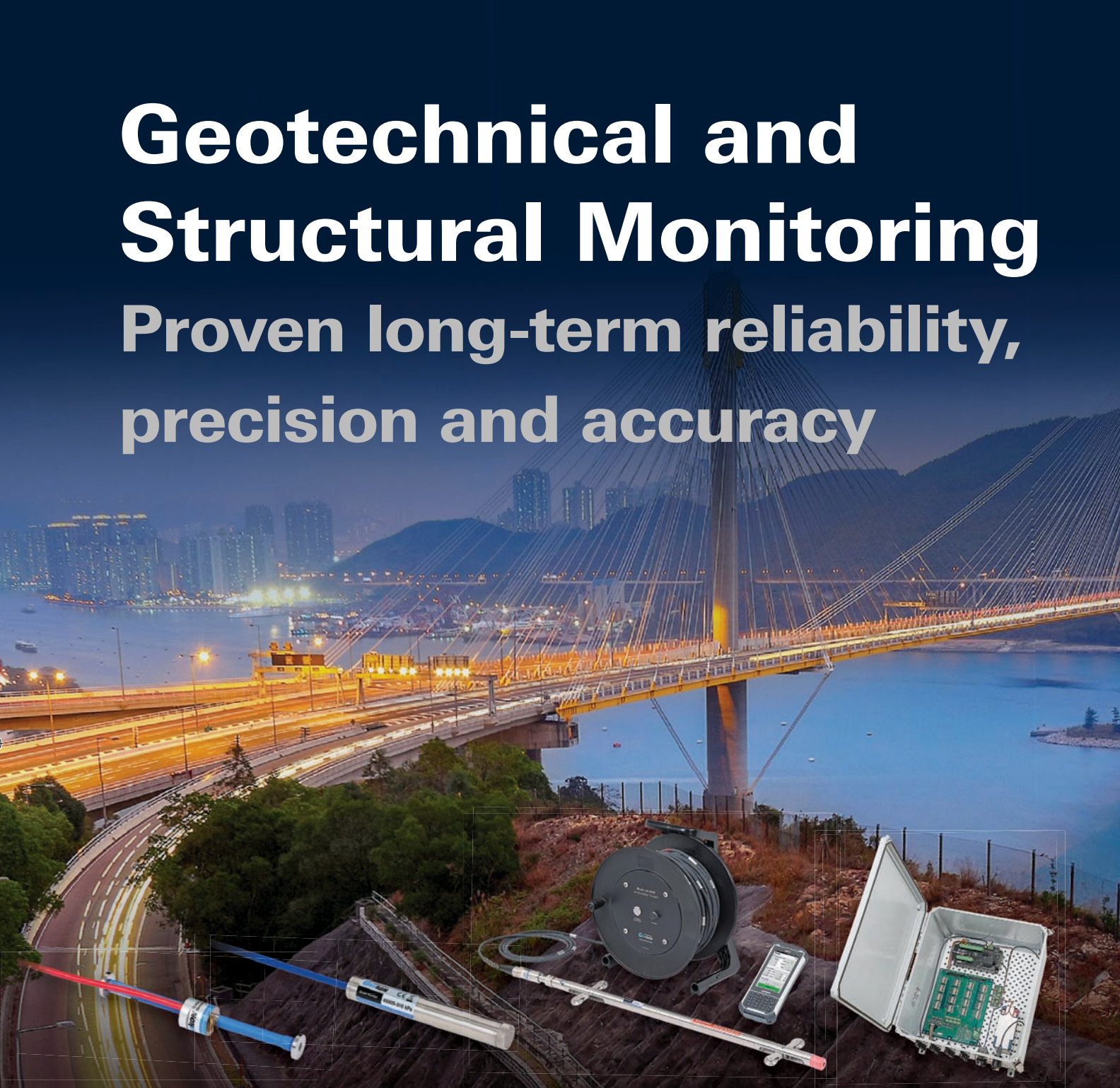

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Message from the President

Dharma Wijewickreme, President of Canadian Geotechnical Society

As we reach the month of December 2018, I will be completing my two-year term as the President of the Canadian Geotechnical Society (CGS), and this will be my last message to you through the Geotechnical News magazine. As traditionally done, I would like to take this opportunity to highlight some of the key accomplishments by our CGS team (the Executive Committee, Board of Directors, and National Office) over the past two years.

From a high-level viewpoint, much of our efforts over the past 2 years have been focused on: member engagement and involvement (including young professionals), new approaches for general communications, enhancement of member experience and services, and improved relationships with Local Sections.

Our flagship Cross Canada Lecture Tours (CCLTs) were very successful, with **Dr. Vaughan Griffiths** (Colorado School of Mines) delivering in Spring 2017, **Dr. Jean-Marie Konrad** (Université Laval) presenting the 100th CCLT in the Fall of 2017, followed by the Spring 2018 speaker **Dr. Tom O' Rourke** (Cornell University, Ithaca, NY) and **Dr. Alex Sy** (Klohn Crippen Berger) for the Fall 2018 tour.

The final Errata for the 4th Edition of the Canadian Foundation Engineering Manual (CFEM) has been published and is available on the CGS website. Printed copies will be included with all new purchases. Thanks are due to **Ken Skaftfeld** for editing and finalizing the Errata. Planning is underway for the new online CFEM with the main goal to address the technical content of the CFEM as we enter 2019 with the next Executive Committee.

The CGS continues to be in a healthy financial position despite the budgeted deficit that was approved last year. The CGS Board of Directors (BOD) and membership approved an increase of the registration fee for regular members effective 2019. It has been 8 years since the last fee increase, back in 2011. A Financial Advisory Task Force examined ways to best invest the CGS' funds, keeping in line with the government regulations, and the task force recommendations are in the process of being included in the Administration Manual.

In keeping with our vision, the communication task force was established to develop a solid Communication Strategy for the Society as we move forward with many action items. The communication topics addressed

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ranged from the content/format for the CGS electronic newsletter, the updated technical magazine to be produced beyond December 2019, the website, and social media portals. The first report from the task force on the planning and next steps towards a new printed/online magazine from CGS was presented to the Board in September 2018 with approvals obtained for a number of moving forward tasks. A personalized myCGS dashboard was introduced to the CGS website along with newly updated user-friendly navigation panes.

CGS Geotechnical Info Net (CGSGIN) is now renamed CGS E-news. **Nicholas Beier** will take over from **Don Lewycky** as the CGS News Editor, starting with the March 2019 issue. Special thanks are due to Don for his many years of extensive time and effort serving as the CGS News Editor. A renewed Membership Committee was formed to promote the value of being a CGS member, especially amongst young geo-professionals and students.

I am also pleased to note that a number of important strides have been made regarding CGS Sections, Committees, and Young Professionals. These include recognizing the Chairs of the Committees and Geotechnical Research Board as voting members of the BOD. The Heritage Committee has been very active, with their initiatives to recognize pioneers of geotechnique at the annual CGS Conferences – including presentations on major geotechnical projects in 2017, and leading women in 2018 (thanks are due to **Doug VanDine** and **Heinrich Heinz** with a team of volunteers). A new award was created to recognize the CGS Early Achievement Award for outstanding accomplishments provided by members in the early years of their career. **Greg Siemens** and **Jasmin Raymond** successfully completed their Colloquium Lecture Series. The 2018 Colloquium award winner selected by a committee led by the GRB Chair was **Matt Lato**, who made his presentation in Edmonton. The 2019 Colloquium was announced in Edmonton and **Kathy Kalenchuk** will present at the 2019 conference in St. John's, NL.

The annual CGS conferences, **GeoOttawa 2017** (led by **Mamadou Fall** and **Paul Simms**) and **GeoEdmonton 2018** (co-chaired by **Don Lewycky** and **Seán MacEoin)**, were highly successful, with amazing involvement and commitment by the respective local organizing committees and also excellent support provided by Gibson Group Management Inc. The prestigious opening keynote address at the CGS conference, the R.M. Hardy Address, for the years 2017 and 2018 were given by **Dr. Richard Bathurst** (Royal Military College of Canada) and **Dr. C. Derek Martin** (University of Alberta), respectively. The annual CGS conferences were also well complemented by the Geohazards 7 Conference held last June in Canmore, Alberta (Conference Co-Chairs: **Michael Porter** and **Valérie Fréchette**).

Some outstanding members received prestigious awards from the CGS as well as external organizations such as the Engineering Institute of Canada (EIC). The most prestigious award of the CGS, the Robert F. Legget Medal, was received by **Doug Stead** in 2017. The recipient of this award for 2018 was **Michel Aubertin**, who has served the CGS in many leading volunteering roles including the highest position as the President, and now contributing as the Executive Director with the Society's National Office. Another CGS Past President, **Kerry Rowe** was awarded with the Order of Canada, an honour of national significance. I would like to take the opportunity to encourage all CGS members to promote the CGS Awards and solicit nominations from colleagues! The details related to the award winners for this year are presented elsewhere in this magazine.

The CGS is maintaining very good relationships with affiliates, including the Engineering Institute of Canada, the Canadian Society for Civil Engineers and the Canadian Foundation for Geotechnique. It is a pleasure to note that we now have a fully signed Memorandum of Understanding (MOU) with ASCE Geo-Institute, which will allow us to collaborate more effectively with our important neighbouring learned Society.

As of January 01, 2019, **Mario Ruel** will become the President of the Society for the next two-year period. It is my pleasure to congratulate and welcome Mario and his team! I extend my fullest support to ensure a seamless transition from one administration to the other.

It is also important that I take the opportunity to extend my sincere thanks to all BOD members, and of course, for the tremendous contributions and commitments by the following individuals:

- The members of the Executive Committee: VP Technical - **Suzanne Powell**; VP Finance - **Kent Bannister**; VP Communications and Member Services - **Jean Côté**; Technical Division Representatives - **Richard Brachman** (2016-2017) and **Nicholas Vlachopoulos** (2018); Section Representatives - **Seán MacEoin** (2016-2017) and **Andrea Lougheed** (2018-2019); and Young Professional Representatives - **Ariane Locat** (2016-2017) and **Maraika DeGroot** (2018-2019).
- **Bruno Bussière** (Chair of the GRB); **Ian Moore**, **Craig Lake**, and **Daichao Sheng** (Editors of the Canadian Geotechnical Journal)
- The National Office Team: **Michel Aubertin** (Executive Director), **Wayne Gibson** (Director, Administration and Finance), **Lisa McJunkin** (Director, Communications and Member Services), and **Emily Fournier** (Communications

Coordinator) for their respective roles with the CGS National Office.

- All other CGS volunteers involved in the Board, Sections, Divisions, Committees, and external representations.
- CGS Corporate Sponsors

In the way of closing remarks, I would like to recall two questions that I raised in two of my previous messages:

- "Should we provide incentives and support to geo-professionals to deliver high quality products and services in geotechnique and justify fair and appropriate compensation in a highly competitive business environment?"
- "In addition to the current activities, should CGS consider connecting with and contributing to the society-at-large, complementing our traditional member-focused activities and approaches?"

I have elaborated with respect to these questions in my previous messages in the Geotechnical News (in March 2018 and September 2018, respectively), and I do not intend to repeat those for brevity. In an overall sense, although these are quite broad questions, it is my personal belief that our Society has a great opportunity to contribute to the geo-profession as well as society-at-large by carefully examining and attempting to address these questions.

It has been a great honour and privilege to serve the Canadian Geotechnical Society. The opportunity I had over the past two years to work with an amazing group of volunteers has been a busy, rewarding, exciting, and enjoyable experience. I invite all of you to volunteer and encourage the young geo-professionals and students to join and contribute to the CGS. The great thing about volunteering is that you need to get permission only from you and nobody else – just decide and do it!

Thanks very much. Season's Greetings and wish you a very happy New Year 2019!

Dharma Wijewickreme
President - 2017/2018

Message du président

Alors que nous arrivons au mois de décembre 2018, je terminerai mon mandat de deux ans à titre de président de la Société canadienne de géotechnique (SCG) et ce sera mon dernier message dans le magazine *Geotechnical News*. Comme le veut la tradition, j'aimerais profiter de l'occasion pour souligner certaines des principales réalisations de notre équipe de la SCG (le Comité exécutif, le Conseil d'administration et le Bureau national) au cours des deux dernières années.

D'un point de vue supérieur, une grande partie des efforts que nous avons faits au cours des deux dernières années ont été axés sur l'engagement et la participation des membres (y compris les jeunes professionnels), les nouvelles approches pour les communications générales, l'amélioration de l'expérience des membres et des services qui leur sont offerts, de même que la consolidation des relations avec les sections locales.

Nos Tournées de conférences transcanadiennes (TCT) emblématiques ont été très réussies, avec le **Dr Vaughan Griffiths** (Colorado School of Mines), qui a donné celle du printemps 2017, le **Dr Jean-Marie Konrad** (Université Laval), qui a présenté la 100e TCT à l'automne 2017, suivi par le conférencier du printemps 2018, le **Dr Tom O' Rourke** (Université Cornell, Ithaca, NY), et le **Dr Alex Sy** (Klohn Crippen Berger), pour la Tournée de l'automne 2018.

La version définitive de l'erratum de la 4e édition de la version anglaise du Manuel canadien d'ingénierie des fondations (MCIF) a été publiée et est maintenant affichée sur le site Web de la SCG. Un exemplaire imprimé sera inclus avec tous les nouveaux achats. Des remerciements à **Ken Skaftfeld** pour la mise en forme et la finalisation de l'erratum sont de mise. La planification est en cours pour le nouveau MCIF en ligne et l'objectif principal est de se pencher sur son contenu technique au début de 2019, avec le prochain Comité exécutif.

La SCG maintient une situation financière saine malgré le déficit prévu au budget qui a été approuvé l'année dernière. Le Conseil d'administration (CA) de la SCG et les membres ont approuvé une augmentation de la cotisation des membres ordinaires à compter de 2019. Cela fait huit ans que la dernière augmentation des cotisations a eu lieu, en 2011. Le Groupe de travail consultatif sur les finances a examiné des façons de mieux investir les fonds de la SCG, tout en respectant la réglementation gouvernementale, et ses recommandations sont en voie d'être incluses au Manuel administratif.

Conformément à notre vision, le Groupe de travail sur les communications a été établi pour élaborer une solide stratégie de communication pour la Société, alors que nous allons de l'avant avec de nombreuses mesures. Les sujets abordés relativement aux communications allaient du contenu/format du bulletin électronique de la SCG et du magazine technique actualisé à produire après décembre 2019 au site Web et aux portails de médias sociaux. Le premier rapport du Groupe de travail sur la planification et les prochaines étapes en vue de la création d'un nouveau magazine imprimé/en ligne par la SCG a été présenté au CA en septembre 2018, et des approbations pour un certain nombre de tâches futures ont été obtenues. Un tableau de bord personnalisé appelé maSCG a été intégré au site Web de la SCG, ainsi que des volets de navigation conviviaux actualisés.

Le Réseau d'information géotechnique de la SCG (RIG SCG) s'appelle maintenant l'E-info de la SCG. **Nicholas Beier** remplacera **Don Lewycky** à titre de rédacteur de **CGS News**, à compter du numéro de mars 2019. Je tiens à remercier tout particulièrement M. Lewycky pour le temps et les efforts considérables qu'il a consacrés pendant de nombreuses années comme rédacteur de CGS News. Un nouveau Comité des membres a été formé pour promouvoir la valeur de l'adhésion à la SCG, particulièrement auprès des jeunes géoprofessionnels et des étudiants.

Je suis également heureux de constater qu'un certain nombre de progrès importants ont été réalisés par rapport aux sections, comités et jeunes professionnels de la SCG. Cela comprend reconnaître les directeurs des comités et le président du Conseil de recherche en géotechnique (CRG) comme des membres votants du CA. Le Comité sur le patrimoine a été très actif, notamment en présentant des initiatives pour reconnaître des pionniers de la géotechnique lors des conférences annuelles de la SCG, y compris des présentations sur d'importants projets géotechniques en 2017 et des femmes chefs de fil en 2018 (je remercie **Doug VanDine** et **Heinrich Heinz**, ainsi que leur équipe de bénévoles). Un nouveau prix, le Prix d'excellence en début de carrière de la SCG, a été créé pour récompenser les réalisations exceptionnelles de membres en début de carrière. **Greg Siemens** et **Jasmin Raymond** ont terminé avec succès leur série de conférences du Colloquium. Le lauréat du Prix du Colloquium 2018, sélectionné par un comité dirigé par le président du Conseil de recherche en géotechnique (CRG), a

été **Matt Lato**, qui a fait sa présentation à Edmonton. Le Colloquium 2019 a été annoncé à Edmonton, et **Kathy Kalenchuk** le présentera lors de la conférence de 2019, à St. John's, à Terre-Neuve-et-Labrador.

Les conférences annuelles de la SCG, **GéoOttawa 2017** (organisée par **Mamadou Fall** et **Paul Simms**) et **GéoEdmonton 2018** (coprésidée par **Don Lewycky** et **Seán MacEoin**), ont été couronnées de succès, avec la participation et l'engagement remarquables des comités organisateurs locaux respectifs et aussi l'excellent soutien de Gibson Group Management Inc. La prestigieuse conférence d'ouverture de la conférence de la SCG, la conférence R.M. Hardy, a été donnée par le **Dr Richard Bathurst** (Collège militaire royal du Canada) en 2017 et par le **Dr C. Derek Martin** (University of Alberta) en 2018. Les conférences annuelles de la SCG ont également été complétées par la conférence Géorisques 7, qui s'est déroulée en juin dernier à Canmore, en Alberta (coprésidents de la conférence : **Michael Porter** et **Valérie Fréchette**).

Certains membres exceptionnels ont reçu des prix prestigieux de la SCG ainsi que d'organisations externes, comme l'Institut canadien des ingénieurs (ICI). **Doug Stead** a reçu le prix le plus prestigieux de la SCG, la Médaille Robert F. Legget, en 2017. Le lauréat de ce prix pour 2018 a été **Michel Aubertin**, qui a servi la SCG dans de nombreux rôles de bénévole de premier plan, y compris le poste le plus élevé de président, et qui contribue maintenant à titre de directeur général au Bureau national de la Société. Un autre ancien président de la SCG, **Kerry Rowe**, a obtenu l'Ordre du Canada, un honneur revêtant une importance nationale. J'aimerais profiter de l'occasion pour encourager tous les membres de la SCG à promouvoir les prix de la SCG et à solliciter des candidatures auprès de leurs collègues! Les renseignements concernant les lauréats de cette année sont présentés ailleurs dans ce magazine.

La SCG entretient de très bonnes relations avec des affiliés, y compris l'ICI, la Société canadienne de génie civil et la Fondation canadienne de géotechnique. C'est un plaisir de noter que nous avons maintenant conclu un protocole d'entente avec le Geo-Institute de l'ASCE, qui nous permettra de collaborer plus efficacement avec notre importante société savante voisine.

À compter du 1er janvier 2019, **Mario Ruel** deviendra président de la Société pour les deux prochaines années. J'ai le plaisir de féliciter M. Ruel et son équipe ainsi que de leur souhaiter la bienvenue! J'apporte tout mon soutien pour assurer une transition harmonieuse d'une administration à l'autre.

Il est également important que je profite de l'occasion pour remercier sincèrement tous les membres du CA, et bien entendu, en particulier les personnes suivantes pour leur contribution et leur engagement exceptionnels :

- Les membres du Comité exécutif : v.-p. technique – **Suzanne Powell**; v.-p. aux finances – **Kent Bannister**; v.-p. aux communications et services aux membres – **Jean Côté**; représentants des divisions – **Richard Brachman** (2016-2017) et **Nicholas Vlachopoulos** (2018); représentants des sections – **Seán MacEoin** (2016-2017) et **Andrea Lougheed** (2018-2019); et représentantes des jeunes professionnels – **Ariane Locat** (2016-2017) et **Maraika DeGroot** (2018-2019).
- **Bruno Bussière** (président du CRG); **Ian Moore**, **Craig Lake** et **Daichao Sheng** (rédacteurs de la Revue canadienne de géotechnique).
- L'équipe du Bureau national : **Michel Aubertin** (directeur général), **Wayne Gibson** (directeur, Administration et finances), **Lisa McJunkin** (directrice, Communications et services aux membres) et **Emily Fournier** (coordonnatrice des communications), pour leurs rôles respectifs auprès du Bureau national de la SCG.
- Tous les autres bénévoles de la SCG qui travaillent au sein du CA, des sections, des divisions ainsi que des comités et qui la représentent à l'externe.
- Les commanditaires de la SCG

En guise de conclusion, je voudrais rappeler deux questions que j'ai

Dharma Wijewickreme and the 2018 CGS Board.

soulevées dans deux de mes messages précédents :

- « Devrions-nous inciter et soutenir les géoprofessionnels pour qu'ils fournissent des produits et des services de haute qualité en géotechnique et justifier une rémunération juste et appropriée dans un environnement commercial hautement concurrentiel? »
- « En plus des activités actuelles, la SCG devrait-elle envisager d'établir des liens avec le grand public et de contribuer à l'ensemble de la société, en complément de nos activités et approches traditionnelles axées sur les membres? »

J'ai développé ces questions dans mes messages précédents dans *Geotechnical News* (en mars 2018 et en septembre 2018, respectivement), et je n'ai pas l'intention de le refaire par souci de concision. Dans l'ensemble, bien qu'il s'agisse de questions assez générales, je crois personnellement que notre Société a une excellente occasion de contribuer à la géoprofession ainsi qu'à la société en général en les examinant attentivement et en tentant d'y répondre.

Ce fut un grand honneur et un privilège de servir la Société canadienne de géotechnique. L'occasion que j'ai eue au cours des deux dernières années de travailler avec un groupe incroyable de bénévoles a été une expérience chargée, enrichissante, passionnante et agréable. Je vous invite tous à faire du bénévolat et à encourager de jeunes géoprofessionnels et des étudiants à se joindre et à contribuer à la SCG. Ce qu'il y a de bien avec le bénévolat, c'est que vous n'avez besoin d'obtenir la permission que de vous et de personne d'autre; il vous suffit de décider de le faire et de le faire!

Merci beaucoup. Joyeuses fêtes et bonne année 2019!

Dharma Wijewickreme
Président – 2017/2018

From the Society

Canadian Geotechnical Society Awards and Honours for 2018

R.F. Legget Award – Michel Aubertin, Professor Emeritus at École Polytechnique de Montréal and CGS Executive Director

R.M. Quigley Award Tied –

Lisa N. Wheeler, **W. Andy Take**, **Neil A. Hoult**, *"Performance Assessment of Peat Rail Subgrade Before and After Mass Sstabilization"* and **P.J. Pells**, **Z.T. Bieniawski**, **S.R. Hencher**, **S.E. Pells**, *"Rock Quality Designation (RQD):Time to Rest in Peace"*.

Honourable Mentions - R.K. Rowe, **R.W.I. Brachman**, **M.S. Hosney**, **W.A. Take**, **D.N. Arnepalli**, *"Insight Into Hydraulic Conductivity Testing of Geosynthetic Clay Liners (GCLs) Exhumed After 5 and 7 Years in a Cover"* and **Ariane Locat**, **Pascal Locat**, **Denis Demers**, **Serge Leroueil**, **Denis Robitaille**, **Guy Lefebvre**, *"The Saint-Jude Landslide of 10 May 2010, Quebec, Canada:Investigation and Characterization of the Landslide and its Failure Mechanism"*.

G. Geoffrey Meyerhof Award – Jean-Pierre Tournier, HYDRO-QUÉBEC

Thomas Roy Award – Iain Bruce, BGC Engineering

Roger J.E. Brown Award – Ed Hoeve, HoevEng Consulting Ltd.

Geoenvironmental Award - Steve Rose, Malroz Engineering Inc.

Robert N. Farvolden Award (Joint award with IAH-CNC) – Larry Bentley, University of Calgary

Robert Schuster Medal (Joint award with AEG) – Scott Burns, Portland State University

Graduate Student Paper Award

1st Prize - Bradley Forbes, *"The Application of Distributed Optical Strain Sensing (DOS) to Optimize Underground Support Design"*, Geological Sciences & Geological Engineering, Queen's University, Dr. Mark Diederichs & Dr. Nicholas Vlachopoulos

2nd Prize - Scott P. Coombs, *"Observed Increase in Mobility of Dry Granular Landslides, Corresponding to Increased Collisional Activity, Quantified by a Smart Rock Sensor"*, Civil Engineering, Queen's University, Dr. Andy Take

Undergraduate Student Report (Individual)

1st Prize - Jonathan Mole, *"Validation de la Méthode Pseudo-statique Spectrale dans le Logiciel SVSLOPE de Soil Vision"*, Université Laval, Dominique Turmel

2nd Prize - Faria Ahmed, *"Prediction of Resilient Modulus Using a Simplified Technique"*, Civil and Environmental Engineering, University of Ottawa, Dr. Sai K. Vanapelli

Undergraduate Student Report (Group)

1st Prize -Margie Banda, **Dazy Gosal**, **Adam Mickey**, and **Casey Watamaniuk**, *"Abundante Open Pit Design"*, Geological Engineering Program, University of British Columbia (Vancouver), Susan W Hollingshead

2nd Prize - Foamenom Tabou, **Gisèle Umuhire Dushime**, **Kenneth Onyekachi Omenogor**, **Qichen Liang**, **Saif El Husseini**, **Yu Bai**, *"Design of a Sustainable Condominium Complex in Ottawa Region Soils"*, Civil Engineering, University of Ottawa, Dr. Kris Dick

Canadian Foundation for Geotechnique Michael Bozozuk National Graduate Scholarship – Campbell W. Bryden, Department of Civil Engineering, University of New Brunswick

A.G. Stermac Awards

Mamadou Fall – University of Ottawa

Paul Simms – Carleton University

Michael Porter - BGC Engineering Inc.

CGS R.M. Hardy Keynote Address – C. Derek Martin, Canadian Rail Research Laboratory, University of Alberta

Canadian Geotechnical Colloquium – Matthew Lato, BGC Engineering Inc.

Cross Canada Lecture Tours -

Dr. Tom O' Rourke (Spring 2018), **Dr. Alex Sy** (Fall 2018)

Awards from the Engineering Institute of Canada (EIC) and Others

John B. Stirling Medal – Catherine Mulligan, Concordia University

K.Y. Lo Medal - Delwyn G. Fredlund, Golder Associates

Fellowship of the Institute (FEIC) - Dharma Wijewickreme

Fellowship of the Institute (FEIC) - Michel Julien

Fellowship of the Institute (FEIC) - Richard Brachman

Fellowship of the Institute (FEIC) - Kevin Biggar

Fellowship of the Institute (FEIC) - Robert Kenyon

Frederick W. Firlotte 2018 Career Prize - Michel Aubertin

Provided by Lisa McJunkin, Director, Communications and Member Services /

Directrice, Communications et services aux membres

2018 CGS Corporate Sponsors

The CGS would like to thank all 2018 Corporate Sponsors.

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If you would like to renew your sponsorship for 2019, or like to become a CGS Corporate Sponsor, please contact **Lisa McJunkin** *admin@cgs.ca* for more details.

CGS Membership Registration for 2019

It is time to renew your Canadian Geotechnical Society membership for 2019, please visit *www.cgs.ca* and renew online. We are increasing registration fees for regular members for the first time in 8 years.

Membership benefits include:

- online access to the monthly *Canadian Geotechnical Journal*, including all past issues, and special price for the printed and mailed *Canadian Geotechnical Journal*
- online and printed copies of the quarterly *Geotechnical News*, including *CGS News*
- the monthly electronic *CGS E-News*
- online access to all past CGS Conference proceedings and some special lectures
- special member price for all CGS conferences
- early information about the spring and fall CGS Cross Country Lecture Tours
- membership in one or more of 7 CGS technical divisions and associated international societies
- involvement in one of 20 CGS local sections
- involvement in any of the 8 CGS standing committees
- involvement in **THE** Society for all Canadian geotechnical professionals

We welcome all new and renewing members and look forward to your participation in 2019!

Adhésion à la SCG pour 2019

Si vous n'avez pas encore renouvelé votre adhésion à la Société canadienne de géotechnique pour 2019 ou désirez y adhérer pour la première fois... c'est le temps de le faire. Consultez la section <Devenir membre> du site *http://www.cgs.ca/index.php?lang=fr.*

Les avantages de l'adhésion comprennent :

- un accès en ligne à la *Revue canadienne de géotechnique* mensuelle, y compris à ses numéros précédents, et à un tarif spécial pour sa version imprimée;
- des versions en ligne et imprimée de la publication trimestrielle *Geotechnical New*, qui comprend *CGS News*;
- le bulletin électronique mensuel *Réseau de l'information géotechnique de la SCG*;
- un accès en ligne à tous les comptes-rendus des précédentes conférences de la SCG et à certaines conférences spéciales;
- des prix spéciaux pour toutes les conférences de la SCG;
- de l'information sur les Tournées de conférences transcanadiennes du printemps et de l'automne de la SCG;
- une adhésion à une ou à plusieurs des sept divisions techniques de la SCG et aux sociétés internationales associées;
- une participation dans l'une des 20 sections locales de la SCG;
- une participation à l'un des sept comités techniques de la SCG;

- une participation dans LA Société pour tous les professionnels en géotechnique canadiens.

Nous souhaitons la bienvenue à tous les nouveaux membres ainsi qu'à ceux qui renouvellent leur adhésion et sommes impatients de vous voir participer en 2019. Nous vous encourageons également à recommander la SCG à un ami ou à un collègue. Nous continuons à améliorer les avantages que la SCG offre à notre profession.

Follow Us On Social Media

Did you know that you can follow the CGS on various social media platforms? You can get the latest CGS news and follow trending geoscience conversations on LinkedIn, Facebook, Twitter an Instagram. Join over one thousand of your colleagues who are already following us on these platforms.

Canadian Foundation for Geotechique

Fall update

The Canadian Foundation for Geotechnique was proud to sponsor the award winners announced at GeoEdmonton during the week of 23 September. The awards and recipients are described in detail elsewhere in this issue. Sponsorship for these awards is made possible by individual and corporate donations from our members. You will note that most of the awards are for students and young professionals, who are the future of our profession and our society. If you believe, as I do, that promoting our young professionals in this manner is a worthy goal of the Foundation and the Society, please consider making a tax-deductible donation to the Foundation. This may be most easily accomplished when you renew your CGS membership.

I would like to take this opportunity to thank **Mrs. Elizabeth White** for encouraging donations to the Foundation in memory of her husband, the late **Dr. Owen White**. The Foundation received numerous donations in memoriam. She mentioned to me that CGS meant so much to Owen's life and hers, and that they met and learned from so many wonderful friends in the Society. Dr. White was a recipient of the R.F. Legget Medal and was the founder of the Engineering Geology Division of the CGS, in addition to his many other awards and contributions to our profession. He was also a strong proponent of education in developing countries. Additional details on Dr. White's accomplishments are contained in the September 2018 issue of Geotechnical News.

In a previous edition of our CFG news in Geotechnical News, we announced that a new graduate student award was being developed which is aimed specifically at Master's level students. We were pleased to announce at GeoEdmonton that the terms of reference have been finalized and that the award will be presented for the first time at the annual conference in 2019. We are also very pleased to announce that the Past President of the Foundation, **Dr. Dennis Becker**, has agreed to let us name the award after him, in honour of his numerous, significant contributions to the Society, including President of the CGS, as well as being a recipient of the R.F. Legget Medal. The Award will be named the Canadian Foundation for Geotechnique Dennis Becker M.Sc. Prize.

Two additional funding initiatives have been formalized in the past year. The CFG has committed to providing up to $5,000 a year for the CGS Colloquium recipient to tour various cities to deliver their presentation. The intent of this initiative it to have one of our best and brightest speak to students at universities, to highlight to them some of the great work going on in our profession and to encourage them to attend our annual conference and to join the Society. There have been two Colloquium tours; the first Colloquium tour was by **Dr. Greg Siemens** in the spring of 2017 where he visited the following Society member locations:

- March 19th, St. John's (Memorial University). to undergraduate and graduate students as well as faculty and consultants from St. John's
- March 20th, Halifax (Dalhousie University). to graduate students, faculty and consultants.
- April 3rd, Edmonton (University of Alberta). to graduate students and faculty
- April 3rd, Calgary (University of Calgary). to graduate students and faculty
- April 4th, Saskatoon (University of Saskatchewan). to graduate students, faculty and consultants

The second was by **Dr. Jasmin Raymond** in the fall of 2017. His Colloquium tour provided presentations to the following Society member locations:

- Feb 16th, Rouyn (UQAT), webcast to Polytechnique in Montreal
- Sept 12th, Québec (Université Laval), webcast to Baie Comeau and Saguenay
- Sept 14th, Halifax (Dalhousie University)
- Sept 15th, St. John's (Memorial University)
- Sept 18th, Winnipeg (Holiday Inn) with students from University of Manitoba
- Sept 19th, Edmonton (Woodvale facility), webcast in Fort McMurray, Whitehorse and Sudbury with students from University of Alberta
- Sept 20th, Calgary (Austrian Canadian Cultural Center) with students from University of Calgary

Additionally, funding has been formally written into the CGS Manual for a travel award of $2,000 to be provided by the Foundation for each of two recipients to attend the International Young Geotechnical Engineers Conference held in conjunction with the International Conference on Soil Mechanics and Geotechnical Engineering (from the ISSMGE) every 4 years. The CFG funding will be in addition to $1,500 provided to these individuals by the CGS to cover travel costs. This funding has been provided by the Foundation in the past, however it has only recently been formalized.

The Foundation is pleased and honoured to be able to provide funding for the awards and prizes to recognize excellence in our profession, and to encourage younger members to become active in the Society and to learn what a great Society it is. If you know of a worthy recipient for the Foundation-sponsored awards, please take the time to become familiar with the terms of reference (available on the CGS website) and nominate them.

Call for Nominations for the CGS Colloquium Deadline January 31, 2019

Established in 1977, the CGS Colloquium is an annual commissioned presentation and paper. Along with the honour comes a $5,000 honorarium provided by **Canadian Foundation for Geotechnique**. It is targeted towards a younger CGS member to provide information of particular interest to the geotechnical community on topics of importance to the Canadian geotechnical field. A younger CGS member is typically regarded as being less than 40 years of age, with preference given to candidates 33 to 38 years of age at time of nomination.

Nominations can be made by any CGS member. The nominations for the 46th CGS Geotechnical Colloquium, which will be presented at the CGS conference in Calgary, Alberta in the fall of 2020, are due by **January 31, 2019**. The selection will be made by the CGS Geotechnical Research Board in April 2019, 18 months prior to the presentation.

The nomination submission should include:

- a nomination letter that introduces the nominee with his/her main accomplishments
- an extended abstract of the proposed talk (approximately 2000 words), including a statement of the importance of the topic to the Canadian geotechnical community;
- the originality of the nominee's contribution, and
- the nominee's resume including practical experience relevant to the topic and publication record

The **45th Colloquium** will be presented at **GeoSt.Johns 2019** by **Kathy Kalenchuk** in **St. John's, NL**.

Contact CGS National office at *admin@cgs.ca* or 1-800-710-9867 for more information or to send in your nomination.

Appel de candidatures pour le Colloquium de la SCG Date limite: 31 janvier 2019

Établi en 1977, le Colloquium de la SCG consiste en une présentation et un article annuels commandités. Cet honneur est accompagné d'une rétribution de 5 000 $ offerte par la Fondation canadienne de géotechnique. Il vise à ce qu'un jeune membre de la SCG donne de l'information présentant un intérêt particulier pour la communauté géotechnique sur des sujets d'importance pour le domaine géotechnique canadien. On considère ici qu'un jeune membre de la SCG est habituellement considéré comme étant âgé de moins de 40 ans, avec une préférence pour les candidats âgés de 33 à 38 ans au moment de leur candidature.

Les candidatures peuvent être soumises par tout membre de la SCG. Les candidatures pour le 46e Colloquium géotechnique de la SCG, qui sera présentée à la conférence canadienne de géotechnique de Calgary, Alberta à l'automne 2020, doivent être reçues d'ici le **31 janvier 2019**. La sélection sera faite par le Conseil de recherche en géotechnique de la SCG en avril 2018, 18 mois avant la présentation.

Les candidatures doivent comprendre :

- une lettre de candidature présentant le/la candidat(e) ainsi que ses principales réalisations;
- un résumé détaillé de la conférence proposée (environ 2 000 mots), y compris un énoncé sur l'importance du sujet pour la communauté géotechnique canadienne;
- l'originalité des contributions du/de la candidat(e);
- le curriculum vitae du/de la candidat(e) comprenant l'expérience pratique pertinente au sujet et le dossier de publication.

Le **45e Colloquium** sera présenté à la conférence GéoStJohn's 2019 par le **Kathy Kalenchuk** en **St. John's, NL**.

Pour obtenir de plus amples renseignements ou soumettre une candidature, communiquez avec le siège social de la SCG à *admin@cgs.ca* ou au 1-800-710-9867.

Upcoming Conferences and Seminars

8th International Conference on Cold Regions Engineering and the 8th Canadian Permafrost Conference

August 18 - 22, 2019, Québec, QC

The 18th International Conference on Cold Regions Engineering and the 8th Canadian Permafrost Conference will be held at the Quebec City Convention Centre, in Canada, from August 18th to 22nd, 2019. Sustainable infrastructure development and permafrost science, in a climate change context, will be the focus of the discussions at this international conference.

For more information, visit our website at *www.agora-inscription.ca/iccre-cpc2019* or contact us at *iccre2019@*

agoraopus3.com. Join us in August 2019!

La 18e Conférence internationale sur l'ingénierie des régions froides et la 8e Conférence canadienne sur le pergélisol se tiendront à Québec, du 18 au 22 août 2019. Le développement d'infrastructures durables en régions froides et la science du pergélisol, dans un contexte de changements climatiques, seront au cœur des discussions de ce congrès international.

Joignez-vous à nous en août 2019!

72nd Canadian Geotechnical Conference

September 29 to October 2, 2019
St. John's, Newfoundland, Canada

The Geotechnical Society of St. John's and the Canadian Geotechnical Society (CGS) invite you to **GeoSt.John's 2019**, the 72nd Canadian Geotechnical Conference. The conference will be held at the St. John's Convention Centre in St. John's, Newfoundland and Labrador, Canada from **Sunday, September 29 to Wednesday, October 2, 2019**.

The theme for GeoSt.John's 2019 is **Under Land and Sea**. Growth of the offshore oil and gas industry in Atlantic Canada has created many opportunities for the geotechnical community. This conference intends to highlight recent achievements in offshore and nearshore geotechnical engineering. The technical program will also cover a wide range of geotechnical and hydrogeological topics, including specialty sessions that are of local and national relevance. In addition to the technical program and plenary sessions, GeoSt.John's 2019 will include a complement of distinguished keynote speakers, high calibre short courses, social events, and technical tours.

For over 500 years St. John's has been visited by explorers and adventurers. Rich with history, rife with culture, and sprawling with natural beauty, St. John's is a city of exaggerated proportions. All these wonders have been here for thousands of years, embraced by those who happened upon them. While finding the true spirit of this land, you'll stumble upon everything from wildlife, to people, to amazing vistas, to an abundance of culture. In fact, being the most easterly point in North America merits our very own time zone, half-an-hour off-kilter with the rest of the world! Around every corner, around every bend, you will find a little piece of heaven, an unexpected delight, and a playful breeze that will help your journey.

With a population of over 200,000, the metropolitan St. John's area is the economic and cultural centre of the province and offers a natural environment, clean air, safe streets and all the amenities of a larger city with a European flavour. Our rich history and culture and "small town" quality of life make St. John's a pleasure to visit.

Call for Abstracts/Papers

The **GeoSt.John's 2019** conference organizing committee invites members of the Canadian and international geotechnical and geoenvironmental communities to contribute recent research, developments and advancements in their respective fields of interest and practice. The technical program of the conference will cover a wide range of topics, including special sessions that are of local, national and international relevance to the fields of geotechnical and geoenvironmental engineering.

Authors are invited to submit abstracts of a maximum of 300 words by **December 15, 2018** through the Online Submission page of the conference website. Abstracts can be written in English or French

Abstracts should generally fall within the following themes:

St. John's Newfoundland.

- Soil Mechanics and Foundations
- Rock Mechanics and Engineering Geology
- Landslides and Geohazards
- Mining Geotechnics and Hydrogeology
- Geoenvironmental Engineering
- Transportation Geotechnics
- Geosynthetics
- Cold Regions Geotechnology
- Sustainable Geotechnics
- Professional Practice
- Special Geotechnical Themes
  - Offshore and Nearshore Geotechnical Issues
  - Dams and Embankments
  - Pipelines and Trenchless Technologies
  - Soft and Sensitive Clays
  - Application of Remote Sensing and Mapping

For more information, please check our website at *www.geostjohns2019.ca/* and sign up to receive our e-mail newsletter. We look forward to hosting you at **GeoSt.John's 2019** in Newfoundland and Labrador, Canada in 2019!

6th Canadian Young Geotechnical Engineers and Geoscientists Conference cYGEGC

September 26 - 29, 2019
St. John's, Newfoundland

The next Canadian Young Geotechnical Engineers and Geoscientists Conference (6th) will be held from September 26th to 29th 2019, in the beautiful port city of St. John's, Newfoundland. The event will be held the week prior to GeoSt.John's 2019, the 72nd Canadian Geotechnical Conference, making it easy for delegates to attend both conferences.

The Canadian Young Geotechnical Engineers and Geoscientists Conference (cYGEGC) is an event held every three years, that gathers students and young professionals from across Canada and beyond. The conference focuses on providing an opportunity to young professionals and students with geotechnical and geoscience backgrounds to meet their peers, exchange technical knowledge and interact with experts in a relaxed environment.

To learn more about the 6th cYGEGC, head to the conference website at *cygegc2019.com*.

Section News

Regina Geotechnical Group GeoCelebration 2018

On March 15, 2018 the Regina Geotechnical Group (RGG), the Southern Saskatchewan chapter of the Canadian Geotechnical Society, hosted a social event, **Geo-Celebration (2018)**. This event was the first of its kind in Saskatchewan and was an overwhelming success. The heart of the GeoCelebration 2018 mandate was a celebration of geotechnical practitioners in Saskatchewan, and the union of the industry (suppliers and contractors), practitioners and academics for fellowship and celebration.

The event recognized local geotechnical practitioners who received awards, and honours in the past two (2) years, and a keynote presentation by **Lynden Penner**, to honour the life and legacy of the late **Dr. Jack Mollard**. Suppliers and contractors from the geotechnical industry around Canada, as well as local learned societies contributed significantly to the event by way of sponsorship and attendance. Over 100 members of the geotechnical community attended the celebration.

The event, held in the Lloyd W. Johnson Hall at the Saskatchewan Science Centre, began with a short cocktail reception, allowing guests to network prior to the event. Table centre pieces were constructed by a local science camp of pre-school aged children and brought creative flavour to each table.

Student designed and built table centre pieces.

The formal events of the evening commenced with recognition of local practitioners that had received honours, recognitions or awards in the past 2 years. Opening remarks were presented by RGG Section Director, **Jasyn Henry**, and welcome messages by RGG Chair, **Harpreet Panesar**. RGG Treasurer, **Anna Gagnon** provided an update on the local group's financials and their outlook for the upcoming year.

The Canadian Geotechnical Society (CGS) Vice President Finance, **Kent Bannister** was in attendance and

Lynden Penner.

RGG Executive, left to right: Harpreet Panesar, Corey Gorrill, Kyle Mason, Jasyn Henbry, Krystin Lemmerick, Heather Duncan, Bret Dundas, Anna Gagnon.

provided welcoming words from the CGS. The guest of honour was Deputy Minister of Highways and Infrastructure, **Fred Antunes**, who shared his words of thanks.

Ultimately, the big draw to the event was the keynote presentation by **Lynden Penner.** Lynden's presentation, "Leadership and Legacy of Dr. Jack Mollard" provided some wonderful insight on a geotechnical legend, his life and accomplishments, and just how many lives and projects Jack influenced. Many of the surviving members or Dr. Mollard's family were able to grace the event with their presence.

The evening ended with smiles on people's faces, and many laughs from a local comedian, **Kelly Taylor**. It was deemed a wonderful night by many.

GeoCelebration 2019 will be hosted in March, 2019 in Regina, SK. Please join the RGG at its second annual celebration of the greatest profession on earth. Be sure to check the website *www.geocelebration.com* for details on both this past and upcoming events.

Submitted by Jasyn Henbry

Members in the News

Nicholas Beier.

Incoming Geotechnical News Editor - 2019-2021

Nicholas Beier - PhD, P.Eng. - University of Alberta

It is my pleasure to take over as Canadian Geotechnical Society (CGS) News Editor from **Don Lewycky**. I met Don while serving as the Student Representative (2009 and 2010) on the Executive Committee for the Geotechnical Society of Edmonton (GSE). I have been an active member of the GSE since 2003, the CGS since 2007, and a member of the CGS Geotechnical Research Board since 2016. I was introduced to the CGS in 2005 when I presented my Master's research at the 58th National CGS Conference held in Saskatoon. Since then, I have travelled coast-to-coast regularly attending and presenting at the National CGS Conferences.

Prior to entering graduate studies, I worked as an engineering consultant on environmental site remediation projects for the oil and gas industry. I completed an MSc Degree at the University of Alberta (UAlberta, 2006) on the *"Freeze Separation of Saline Mine Waste Water"*, which resulted in a cost-effective method for salinity separation in the mine industry and contributed toward an Environmental Excellence Award from APEGA in 2006. My PhD (UAlberta, 2015) research involved developing a tailings management simulation model to evaluate alternative tailings management technologies and understanding the geotechnical behavior of amended fine tailings. I have since been actively researching in the area of mine waste management and cold regions engineering as an Assistant Professor of Geoenvironmental Engineering at UAlberta.

As a graduate student, I was selected to represent UAlberta at the 2nd Canadian Young Geotechnical Engineers Conference (YGEC, 2007) and to represent the CGS at the 5th International YGEC as a Youth Representative (2013). In 2008, I also received the N.R. Morgenstern Award from the GSE for my PhD seminar presentation, which was open to the local geotechnical community. During my graduate studies, I assisted with the preparation, setup and operation of several of our annual UAlberta/GSE Retaining Wall Building Contests. Based on my experience in organizing

and running this event, I successfully coordinated the "Wall Building Contest" held at the 61st CGS Conference in Edmonton (2008).

During the past decade at UAlberta, I have been heavily involved in the planning of several high-impact international conferences that present state-of-the-art research in oil sands and mine waste management. I was part of the organizing and technical committees for the CGS-endorsed Tailings and Mine Waste Conference (2009, 2013, 2017), the CGS-sponsored David C. Sego Symposium (2012) and the International Oil Sands Tailings Conference (2008-2018), and have been an editor for eight of these conferences' proceedings. I was also invited to participate on the organizing committee for the Canadian YGEGC held in Vancouver (2016).

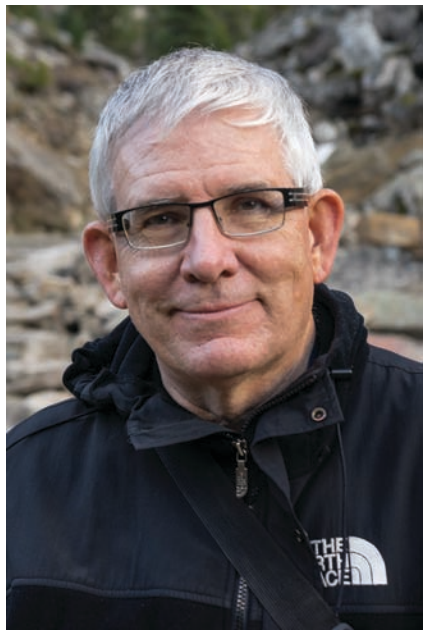
I have co-authored several articles in Geotechnical News over the years and am excited to now join the editorial board as the editor of the CGS News section. CGS News is a valuable source of information that serves to enhance members' knowledge and interests in the Society and promote the CGS to the geotechnical community. It is also a great medium for the recognition of awards and honours for our members. I plan to continue with the level of excellence that Don has set and to put forward a CGS News section that is captivating and informative to our regional, national and international readers. I also hope to reach out to, engage and encourage students and young professionals to get involved in the CGS.

Until next time,

Nicholas Beier, PhD, PEng
Edmonton, AB
E-Mail: nabeier@ualberta.ca

The Last Word

One of the privileges of being the CGS News Editor for the Geotechnical News is that I always have the opportunity to get in the last word with each submission. As noted in **Dharma Wijewickreme's** president's message and in **Nicholas Beier's** previous introduction, you are now aware that my second term as the CGS News Editor is coming to a close and this represents my 24th and last submission to Geotechnical News as CGS News Editor.



Don Lewycky.

I'm pleased to see that Nicholas Beier from the University of Alberta will be taking over the editing duties of the CGS News, beginning in January of 2019. To help him in the transition, we have already met and discussed the duties of the CGS News Editor and I transferred files and templates to help him start his first few submissions in 2019, before he starts placing his own stamp on subsequent issues. We also discussed the new and exciting changes that are coming in how the CGS will communicate with its members in the near future. He will be telling you much more of what is coming in future issues of Geotechnical News.

As I started to collect the CGS materials that I had accumulated over the years to hand over to Nicholas, it suddenly struck me that I have been on the CGS Board in various capacities for some 13 years! I have now served under seven different presidents and worked with four Secretary/Executive Directors. In the case of **Michel Aubertin**, I have had the privilege of being both his Vice President Finance and working with him in his current capacity as Executive Director. The CGS Board has in effect become my second, very large extended family with members across the country and I will cherish the many friendships that I have developed with various Board members over the years.

I wish to extend a very special thanks to **Lisa McJunkin**, who, along with Michel, have helped in getting material translated into French with very short notice and supplying me with information on the Society's activities. Finally, I have to acknowledge all the patience shown me over the last six years by my Managing Editor, **Lynn Pugh**. I'm sure she is more than happy to see me leave, along with all my last minutes edits. I will certainly miss working with her and wish her all the best in the future.

So what's next for Don? Well for starters, I have to finish the final closure of the activities for GeoEdmonton 2018 and I've also promised Nicholas a conference report for inclusion in the March 2019 issue of Geotechnical News. I will also will be acting as the temporary chair for the Transportation Committee. Apparently I won an election for the position by a landslide, but I suspect collusion between the incoming CGS President Mario Ruel and the Russian government and I'm demanding a full investigation into the entire election process. I've also offered Lisa McJunkin any help I can provide as she moves the Geotechnical News into a new era. Finally, I'm still on the Executive for the Geotechnical Society of Edmonton for at least one more year, so I won't be disappearing entirely, just yet.

Again, I would like to express my thanks for the many contributions made by a host of CGS and Board members over the last six years. It has been an interesting, sometimes frus-

trating, but always rewarding experience that I will fondly remember. I hope all members of the Board will continue to give Nicholas the support given to me over the last six years and I look forward to seeing him and Lisa take the Geotechnical News into a new and exciting future. I will certainly miss being an active part of the inner workings of the Society, but I wish everyone all the best in the future.

Editor
Don Lewycky, P.Eng.
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2018 R.F. Legget Medal Award - le médaillé R.F. Legget 2018 Awarded to Michel Aubertin

Introduction of 2018 R.F. Legget Medal Winner
by Michel Julien

Michel Julien.

Dear colleagues/chers collègues,

It is with my great pleasure and honor to announce that the 2018 Robert F. Legget Medal recipient is **Michel Aubertin**. **Suzanne Lacasse** from NGI has led Michel's nomination, which was supported by:

- **Lee Barbour** – University of Saskatchewan
- **Jim Graham** – University of Manitoba
- **Jim Hanson** – California Polytechnic State University (Cal Poly), USA
- **Thomas Pabst** – Ecole Polytechnique de Montréal
- **Ward Wilson** – University of Alberta
- **Nazli Yesiller** – California Polytechnic State University (Cal Poly), USA
- And myself from Agnico Eagle Mines Limited

Michel Aubertin was until 2017, Professor at the Department of Civil, Geological, and Mining Engineering at École Polytechnique de Montréal. He is presently the Executive Director of the CGS, and Professor Emeritus at Polytechnique. Il a reçu un baccalauréat en génie civil de l'Université de Sherbrooke, un MSc.A en géotechnique et un Ph.D. en géomécanique de l'École Polytechnique. Il a commencé sa carrière académique dans la très belle région de l'Abitibi, à l'Université du Québec en Abitibi-Témiscamingue (UQAT) en 1984. C'est là qu'il a véritablement été exposé pour la première fois aux enjeux environnementaux de l'industrie minière. Il est retourné à l'École Polytechnique en 1989 comme professeur et a pris sa retraite *officiellement* en 2017 et a été par la suite nommé Professeur Émérite. Il continue toujours d'être très actif au niveau de la recherche. Il a reçu plus de 15 honneurs et reconnaissances diverses: Pour ne nommer que quelques-unes: la Médaille Thomas C. Keefer de la SCGC/CSCE; la R. M. Hardy Address de la SCG/CGS, les médailles John B. Sterling et Julian C. Smith de l'ICI/EIC. He is also a Fellow of the Engineering Institute of Canada, the Canadian Academy of Engineering and the Canadian Society of Civil Engineering. He was also President of the Canadian Geotechnical Society in 2009-2010.

Michel Aubertin has made outstanding contributions to the development of Canada in the field of mining. His key contributions include: cover systems to control the production of acid mine drainage; original design of waste rock piles to control geotechnical and geochemical stability and minimize environmental impact; analysis of underground openings in rock masses (with or without backfill); and use of waste rock inclusions in tailings impoundments. He helped put together a large and integrated team that became a world-leading research group on environment and mine wastes management. More than 160 students were trained through the years by this group at Polytechnique and UQAT.

He is a deserving winner of the CGS highest award: Here are some excerpts of his supporting letters:

Thomas Pabst a reconnu sa contribution exceptionnelle qui fait maintenant partie intégrante de la pratique dans l'industrie minière et de la consultation. … et la création de l'Institut de Recherche en Mines et Environnement et qui a réuni deux universités et 5 compagnies minières dans le but de développer des projets de recherche pratiques et appliqués fournissant des résultats tangibles à toute la société.

Nazli Yesiller, recognized his high productivity in teaching, advising, research, and professional service throughout his entire career.

For **Jim Hanson**, about his yearly lectures at Cal Poly: "they *always have been captivating and represent-*

ing both the state of the art and state of the practice".

Lee Barbour was mentioning *"in addition to his outstanding research contributions, he has been struck by the energy and passion he pours into team efforts. It does not matter if these collaborative efforts are focused on research, management, or technical society activities. Michel's track record is repeatedly marked by a commitment to teams. Many people are happy to 'help' but Michel has repeatedly demonstrated the commitment to step up and lead*".

For **Ward Wilson** who knows him for more than 25 years, *"Michel is truly an extraordinary engineer, innovator, educator, and champion of sustainability in mining geotechnique*", and Ward could not think of a more deserving individual for the Leggett Medal. *"His contribution to the continued education of highly qualified personnel and the advancement of technology and sustainability in mining have had a profound impact on the Canadian engineering community*".

Personally**,** I could tell you many anecdotes, but I will contain myself. I have had the privilege to be exposed to a significant part of his contributions. As an example, a point quite remarkable and characteristic of his doctoral work which became one of his trademarks through his career, is his profound knowledge and respect of the available literature, which he always made a point of honor to cite appropriately (if not profusely).

I would say his contribution is at three levels:

His scientific contributions which are well known and recognized.

The industrial partnerships. He has contributed to an increased connectivity with the mining industry, and, contributed greatly in developing a community of experts and practitioners with collaboration spanning over 25 years.

His impact on people. His third and possibly greatest legacy, is the impact he has had on more than a generation of professionals, researchers, practitioners, whom he interested to mine waste management, rock mechanics, hydrogeology, soil mechanics and geochemistry. This one is quite important and remarkable. Beyond the larger than life person that we know who contributed so much to his field(s), there is this particularly charming, simple and good person. Michel has always shown a great sense of ethics and a profound respect for his students. I cannot count the number of persons, he truly gave a chance in life. These students who wanted to find their way as long, as they were willing to put the effort and contribute irrespective of where they came from and their background, he would find some funding and time, and give them a chance.

Having said that, Michel is also a passionate person. He enjoys good food with good wine. He is also not afraid to share his opinion or his position on different topics. He can be quite passionate on occasion, but his motivations are always noble and driven by the desire to improve the way things are done.

Au-delà de ses multiples accomplissements, il a été une inspiration et un mentor pour plusieurs personnes incluant moi.

Pour toutes ces raisons, et bien plus, c'est un honneur et un privilège de vous présenter Michel Aubertin comme récipiendaire de la Médaille R. F. Legget. He is truly deserving of this highest honour awarded by the Canadian Geotechnical Society

Michel Julien
September 2018

2018 R.F. Legget Medal Award Acceptance Speech
Michel Aubertin, Professor Emeritus
École Polytechnique de Montréal

Michel Aubertin.

Dear Colleagues,

Chers collègues,

Je suis très reconnaissant pour cette grande distinction professionnelle qui m'est aujourd'hui octroyée par la Société canadienne de géotechnique.

I am truly pleased to have been selected as the recipient of the **Robert F. Legget Medal** from the Canadian Geotechnical Society. This is a great honour and it will be a privilege to have my name included in the same list as the previous Legget Medal winners.

I would like to thank **Suzanne Lacasse**, from the Norwegian Geotechnical Institute, for nominating me; **Michel Julien**, from Agnico Eagle Mines, for introducing me at the GeoEdmonton 2018 Conference for this award; and those who wrote very kind words in their support letters. I also wish to express my sincere gratitude to the selection committee for this prestigious recognition.

This gives me the opportunity to briefly look back at my career, over four decades or so, and more importantly to acknowledge some key people who have been supportive and helpful over these years.

Cet honneur me permet de regarder en arrière, sans nostalgie, et de reconnaitre certaines des personnes qui ont contribué au cheminement et aux réalisations qui ont mené à ce prix.

As you know, professional success often results, in large part, from unforeseen opportunities and from positive interactions with others. In these regards, I have been very fortunate throughout my career. After graduation in Civil Engineering in 1979 from Université de Sherbrooke, I started working for a small soils and construction materials firm near Montreal. I soon realized that I needed further education to become a geotechnical engineer. I therefore enrolled in a Master's Program in Soil Mechanics at École Polytechnique de Montréal (Polytechnique) while still working part time. My research project, which dealt with the behavior of soft clays, was supervised by **Vincenzo Silvestri** who provided excellent guidance. The research investigation involved laboratory and field testing, and the development of analytical solutions, with a good dose of physics and mathematics. It opened my eyes to the many possibilities offered in geotechnique.

In the early 1980s, the Canadian economy was going through a difficult period and the civil engineering business was suffering. In parallel, one of the projects in which I was involved, after obtaining my Master's degree, dealt with rock mechanics issues, which were new to me at that time. These circumstances lead me to take two graduate courses in rock mechanics at Polytechnique. These classes, taught by **Branko Ladanyi** and **Denis E. Gill**, quickly raised my interest in the broad field of geomechanics. In the fall of 1983, I enrolled in a Ph.D. program under their co-supervision. They both became mentors and later colleagues at Polytechnique, and a major influence on my career. Je leur exprime ici ma plus sincère gratitude.

Another twist in my career path came shortly afterwards when Université du Québec en Abitibi-Témiscamingue (UQAT) started a new Engineering Program that was offered jointly with Polytechnique. Fortunate circumstances led me to apply for, and obtain, a junior faculty position at UQAT, where I later became responsible for the first year of the Undergraduate Program. I gained a lot of valuable experience and my wife and I really enjoyed living and working in Abitibi. This period also gave me the chance to discover the world of mining, initially through rock mechanics projects and later through a variety of geotechnical issues related to the surface disposal of mine waste and associated environmental concerns. During that time, I established contacts with professionals in the mining industry, which later led to many fruitful collaborations.

Michel Aubertin with Kevin Biggar, Michel Julien, Dharma Wijewickreme.

Après l'obtention de mon doctorat, j'ai été embauché comme professeur adjoint en génie des mines à Polytechnique, où j'ai eu l'opportunité de travailler sur plusieurs projets intéressants avec des collègues du milieu académique et de l'industrie. Ce fut une autre point tournant.

When I moved back to Montreal in 1989, as an Assistant Professor in Mining Engineering at Polytechnique, my teaching and research work hovered for about a decade between rock mechanics and hydro-geotechnical aspects of mine waste management, with the latter taking more and more of my time. The needs and opportunities were pushing me toward issues that had been largely ignored in mining programs, such as the geotechnical and geochemical stability of waste disposal sites, and the reclamation works required upon mine closure. A few successful industrial projects with mining companies and consulting firms later led to the creation, in 2001, of the NSERC Industrial Polytechnique-UQAT Chair in Environment and Mine Wastes Management. This Industrial Research Chair (IRC) involved 2 universities, with **Bruno Bussière** as the Associate Chair at UQAT. The R&D program was supported by mining companies (both large and small), consulting firms, and governmental agencies. During its 12-year mandate, the IRC addressed various fundamental and practical problems, and was also very active training highly qualified professionals

who became the much-needed specialists in the industry. A large part of the IRC success was due to the impressive work conducted by the many graduate students involved in the research program.

La Chaire Polytechnique-UQAT est devenue une pépinière de jeunes talents qui se sont développés pour devenir des joueurs d'impact dans le domaine de l'environnement et de la gestion des rejets miniers.

I enjoyed this period tremendously, despite the sometimes-overwhelming work load. The IRC gave us the chance to tackle a variety of geotechnical and environmental issues. Through its projects, the IRC addressed practical challenges and contributed to the development of solutions that are now being used on a large scale by mining operations. This type of collaborative work with mining companies and consulting firms continues to this day through the Research Institute on Mines and the Environment, RIME UQAT-Polytechnique, created in 2013 (of which I was the Director at Polytechnique for 3 years). I consider myself very fortunate to have played a role in the creation and evolution of a productive and respected research group that is recognized across the country and around the world.

I retired from Polytechnique in January 2017, with a plan to remain active on a part time basis, mainly as the Executive Director of the Canadian Geotechnique Society. I also had in mind a few other projects with colleagues and collaborators. The situation evolved somewhat unexpectedly, and I quickly found myself more involved than anticipated at Polytechnique, as Principal Investigator of a major industrial research project with RIME. I must admit, however, that I still enjoy conducting R&D with industrial partners and with colleagues, including **Robert Chapuis, Li Li, Richard Simon, Thomas Pabst, Michel Chouteau, Gérald Zagury** and **Samuel Yniesta** at Polytechnique, and **Bruno Bussière, Mamert Mbonimpa, Benoit Plante** and other collaborators at UQAT. I also still benefit greatly from my interaction with students and young researchers.

La Société Canadienne de geotechnique a également joué un rôle majeur dans ma carrière. J'ai pu y établir des liens durables avec plusieurs collègues d'un bout à l'autre du pays, qui se sont ajoutés aux échanges plus réguliers que j'ai eus avec mes collègues de Polytechnique et de l'UQAT.

I need to say a few more words here about the Canadian Geotechnical Society, which has long been a second professional home for me. I first became a CGS member in 1980, but my direct involvement really started in the early 1990s. Through the years, I was provided with opportunities to Chair the Rock Mechanics Division (1994-1996), the Geotechnical Research Board (2004-2009) and the Mining Geotechnique Committee (2011-2015). I was also part of the Executive Committee, first as Vice-President Finance (1997-1998) and then President of the Society (2009-2010). I became the CGS Executive Director in 2015; as such I have had the great pleasure of working with two highly dedicated CGS Presidents, **Doug VanDine** and **Dharma Wijewickreme**, and with dynamic and committed members of the CGS Executive Committee.

Through all these years, I have established fruitful relationships with many CGS colleagues, from coast to coast, and have made some friends along the way. I would like to express my special thanks here to a few key individuals who have influenced my involvement and contributed tremendously to the success of the Society. **James Graham**, CGS President (1997-1998) and Secretary General (1999-2008), has been a mentor and a role model that inspired me by his dedication and wisdom. **Peter Wu** was VP Finance before I took over the position, and he was CGS President before me; Peter did tremendous work for the Society at a time when big changes were taking place at the National Office. **Doug Stead** was the VP Technical when I was President; his commitment and contributions have been exemplary, as was also the case for my two other VPs, **Don Lewycky** and **Stéphanie Perret**. I also acknowledge the help provided by **Victor Sowa**, who was the CGS Secretary General from 2008 to 2014.

The success of the CGS has always been due to the active participation of many volunteers involved in the Executive Committee and the Board of Directors, and through the local Sections, Divisions, Committees and the Geotechnical Research Board; we owe a lot to these dedicated CGS members. I also want to express my gratitude to my colleagues at the CGS National Office: **Wayne Gibson, Lisa McJunkin,** and **Emily Fournier** who play an essential role for the smooth and efficient operation of the Society; I greatly appreciate their precious collaboration.

En terminant, je veux aussi remercier mes proches pour leur présence et leur support face à mes activités professionnelles, qui ont souvent affecté mes disponibilités familiales.

I want to end this by adding a few words about those closest to me, starting with **Colette**, my wife of 35 years.

Michel & Colette Aubertin.

Colette has been very supportive all these years, while expressing a heathy dose of skepticism whenever I mentioned a work load that was about to decrease (…after this next project, or this report, or this thesis…). Also, my son **Jonathan** and his wife **Julie**, with whom we share precious moments when we get together. Merci aussi à mes parents, Madeleine et Guy, qui ont su créer un foyer avec de bonnes valeurs, propice à l'épanouissement de leur famille.

This relatively short look back along memory lane serves to illustrate the fact that I have been very fortunate, personally and professionally. I am grateful for the opportunity given by the Robert F. Legget Medal to share these thoughts with you. Thank you very much to the Canadian Geotechnical Society. Un grand merci à la SCG!

Michel Aubertin, ing. Ph.D., FCAE, FEIC, FCSCE
Professeur Émérite, Polytechnique Montréal
September 2018

History of the Development of the Canadian Foundation Engineering Manual/ Manuel Canadien d'Ingénierie des Fondations Part 4 of 4

Doug VanDine

Parts 1, 2 and 3 of this series were published the March, June and September 2018 issues and cover the beginnings of the manual up to the '1994 French Edition'. *This last installment brings the story up to the present. The entire article is on the CGS website (see http://www.cgs.ca/engineering_manual_overview.php?lang=en)*

2006 Fourth Edition of the CFEM

The preface of the *2006 Fourth Edition* (CGS, 2006, Figure 1) identifies the specific individuals who contributed to this edition as follows (their organizations are not identified in this edition, but have been added where known).

D.E. (Dennis) Becker (Editor), Golder Associates and CGS President (2005-2006); I.D. (Ian) Moore (Editor), Queen's University; J. (Jean) Lafleur (Editor, French Edition), École Polytechnique; S.L. (Lee) Barbour, University of Saskatchewan; R.J. (Richard) Bathurst, Royal Military College; S. (Storer) Boone, Golder Associates; R.W.I. (Richard) Brachman, Queen's University; B. (Bill) Brockbank, Reinforced Earth Canada; M. (Mark) Diederichs, Queen's University; M.H. (Hesham) El Naggar, University of Western Ontario; J. (Jonathan) Fannin, University of British Columbia; D. (Del) Fredlund, Golder Associates; J. (John) Howie, University of British Columbia; D.J. (Jean) Hutchinson, Queen's University; J-M. (Jean-Marie) Konrad, Université Laval; S. (Serge) Leroueil, Université Laval; K. (Kent) Novakowski, Queen's University, and J. (Julie) Shang, University of Western Ontario

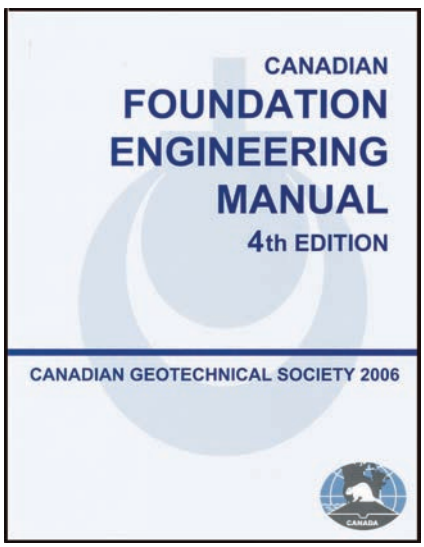

Figure 1: Cover of the 2006 Fourth Edition.

Of this group, only Ian Moore and Richard Bathurst were formally involved in the *1992 Third Edition*. Barbara Goulet, a publishing consultant in Calgary, is acknowledged in the preface to the *2006 Fourth Edition* as the individual who undertook the layout and design.

Dennis Becker recalls that he 'volunteered' to be a co-Editor of the 2006 Fourth Edition, because he saw the need for the Limit States Design chapter in the *1992 Third Edition* to be updated to be consistent with the, then, recently updated *NBCC* and the *Canadian Highway Bridge Design Code (CHBDC)*. Dennis Becker's background was appropriate for the task. His informal involvement with the *CFEM* began with the *1978 First Edition* when, as a PhD student (University of Western Ontario), he was asked to review several chapters by his supervisor, KY Lo. He was peripherally involved in the *1985 Second Edition* and the *1992 Third Edition*. In the 1990s he became quite involved in the technical committees associated with both the *NBCC* and the *CHBDC*.

The preface to the *2006 Fourth Edition* includes the following paragraph:

> "The Manual provides information on geotechnical aspects of foundation engineering, as practiced in Canada, so that the user will more readily be able to interpret the intent and performance requirements of the *National Building Code of Canada* (the release of this fourth edition coincides with publication of the *NBCC* (2005) and the *Canadian Highway Bridge [Design] Code* (2000). The Manual also provides additional material on matters not covered by these Codes."

The *2006 Fourth Edition* is the first edition in which the *CHBDC* was referenced.

Although some revisions and additions were made to the *2006 Fourth Edition*, the length of this edition was reduced to 488 pages, down slightly from the 512 pages of the *1992 Third Edition*. This reduction was accomplished by reducing the content of some chapters, such as "Background Information for Site Investigations", by combining a number of chapters, and by using a slightly smaller font and a wider column width. Chapters that were added or substantially enlarged included "Selection of Design Parameters", "Earthquake-Resistant Design", and "Machine Foundations".

As might be expected, the *1992 Third Edition* chapter on "Safety and Limit States Design" was totally revised in the *2006 Fourth Edition* and was renamed "Limit States and Limit States Design". The introduction to this chapter provides background to the development and benefits of using limit states design in geotechnical engineering practice, specifically when working on projects with structural engineering components. The introduction to the chapter indicates that some design codes in the early 2000s had already introduced or required limited states design for foundations. It concludes with the statement:

"LSD [limit states design] can be viewed as a logical extension to the traditional WSD [working (allowable) stress design] approach for foundation design. It is considered that LSD will eventually become the general state of practice by geotechnical engineers for foundation design."

The *2006 Fourth Edition* has been reprinted in 2008 (2nd printing), in 2012 (3rd printing) and again in 2017 (4th printing) but without any revisions. As with all English and French editions since 1985, the *2006 Fourth Edition* has been distributed by BiTech Publishers. Approximately 5,000 copies of the 2006 Fourth Edition have been printed in the four print runs. In 2006 the selling price was $160 for CGS members, $235 for non-members and $100 for students. Currently (2018) the selling price is $204 for CGS members, $284 for non-members and $139 for students. Most of the price increase over the years has been due to increased postage rates for this, almost 1.5 kg, document.

Any document of the size and complexity of the *CFEM* is bound to have a few corrigenda and errors. Those noted up to the end of March 2018, were corrected in an April 1, 2018 Errata, available on the CGS website *www.cgs.ca*.

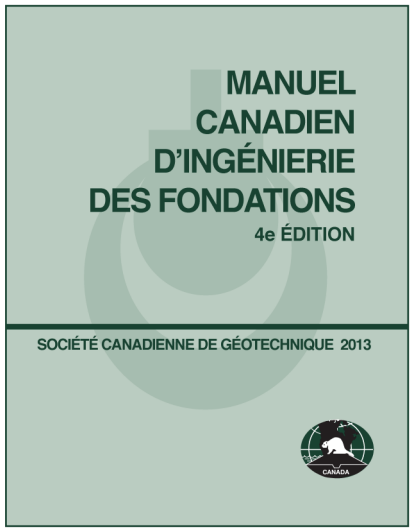

Figure 2: Cover of the 2013 Fourth French Edition (there was no Third French Edition).

2013 Fourth French Edition of the CFEM (MCIF)

In 2013, the French translation of the *2006 Fourth Edition* of the *CFEM* was completed under the editorship of Jean Lafleur (SCG, 2013, Figure 8). The 488-page French version is called *MCIF, 4e* (Fourth Edition). (There is no *Third Edition* of the *MCIF*. The numbering of editions jumped from the *1994 Second Edition* of the *MCIF,* a translation of the *1992 Third Edition* of the *CFEM*, to the *2013 Fourth Edition* of the *MCIF*, a translation of the *2006 Fourth Edition* of the *CFEM*).

Less than 1,000 copies of the *2013 Fourth French Edition* were printed and are being distributed by BiTech Publishers. The current (2018) prices for the *2013 Fourth French Edition* are the same as for the 2006 *Fourth (English) Edition;* $204 for CGS members, $284 for non-members and $139 for students.

Currently (2018)

The *2006 Fourth Edition* of the *CFEM* and the *2013 Fourth French Edition* of the *MCIF* are currently (2018) the most-up-to-date editions.

The CGS has purposely not scanned or otherwise made the *2006 Fourth Edition* and the *2013 Fourth French Edition* available "online". Besides being distributed by BiTech Publishers, new and used hardcopies of the current (and earlier editions) are sometimes available online through distributors such as Amazon and eBay.

The *CFEM* and *MCIF* continue to have a positive effect on CGS revenue, and this continues to subsidize many of the Society's other activities and keeps the membership fee relatively low.

Future Edition (Online)

In 2014, the CGS decided to start planning for a future edition of the *CFEM*, and proposed that this future edition would be an 'online' edition. Again it is changes to the *NBCC* and *CHBDC* that are driving the need to update *CFEM*, specifically with respect to limit states design for foundations. It's important, if not imperative, that the *CFEM* keep up to date because the *CFEM* is referenced by these codes and is the primary authoritative reference in Canada for foundation engineering.

In 2015 a CGS CFEM Technical Advisory Committee (TAC) was formed, chaired by Dennis Becker of Golder Associates (co-Editor of the *2004 Fourth Edition*). Shortly after the formation of the TAC, a search

began for an editor to oversee the new 'online' edition. After multiple unsuccessful attempts to secure an editor, the CGS Executive Committee took on a more active role to facilitate the update of the *CFEM*. This involved, in part, updating the 4th Edition errata, as noted above, and reviewing the existing model under which the manual had previously been developed. Following this review, and in consultation with the TAC, the current plan is to develop a formal call for a project coordinator to oversee the technical update of the manual.

A parallel effort was also launched by the CGS Vice President Technical to provide a digital update of Chapter 8 of the 4th Edition on Limit States and Limit States Design, and possibly other chapters, as an addendum(s) in early 2019. The next 'online' update of the CFEM is currently planned for completion by 2021.

Concluding Remarks

For more than 40 years, the *Canadian Foundation Engineering Manual* has greatly contributed to the field of foundation engineering in Canada. In its various editions, the *CFEM* and the *MCIF* have highlighted the technical advances made in the field. Because the *CFEM* and *MCIF* continue to be held in high regard, both nationally and internationally, they continue to enhance the status of the Canadian Geotechnical Society. (Over the many editions, it is estimated that approximately 85% of the copies distributed by BiTech Publishers have gone to Canadian addresses, and 15% to international addresses.) It truly has become an ambassador of the Society.

The various editions of the *CFEM* and *MCIF* have been, and continue to be, planned, organized, written, reviewed, updated, revised and translated by volunteer members of the Society. CGS members take a great deal of pride in the manual and the important part it plays in the *National Building Code of Canada*, the *Canadian Highway Bridge Design Code* and the continuing development of Canada, in general.

Acknowledgements:

The author would like to acknowledge the assistance of the following individuals in preparing this story. Don Shields and John Gadsby provided some of the early history on the subject. Heinrich Heinz and Steve Bean of Thurber Engineering, and Bryan Watts, Alex Sy and Ana Rose Blue of Klohn Crippen Berger assisted by lending the author, or providing information on, past editions of the *CFEM*. Robert Chapuis, Paul Chiasson, Serge Leroueil and Jean Lafleur did the same for past editions of the *MCIF*. Don Scott, Bengt Fellenius, Robert Chapuis, Peter Lighthall and Dennis Becker provided information on the specific editions with which they were involved. Lynn Pugh (BiTech Publishers) provided information on the number of copies printed and the pricing of the various editions. Don Shields, John Gadsby, Michel Aubertin (Past President, 2009-2010, and current CGS Executive Director), Jim Graham (Past President, 1997-1998, and past CGS Secretary General, 1999-2006), Suzanne Powell (past Chair of the CGS Heritage Committee and current CGS Vice President Technical) and Heinrich Heinz (current Chair of the CGS Heritage Committee) provided excellent review comments.

The author, however, accepts responsibility for any errors or misinterpretations of facts. If readers have any additional information, or comments, on the history of the development of the *CFEM* and the *MCIF*, please send them to the author at vandine@islandnet.com.

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Leveraging Three-Dimensional Remote Sensing in Geotechnical Engineering

Matt Lato

Dr. Matt Lato, of BGC Engineering Inc, presented the 42nd CGS Colloquium during GeoEdmonton 2018 in September. The following is an expanded abstract of that presentation. It is expected that Matt will write up his presentation and submit it for publication in the near future.

Matt Lato.

Robust and effective geotechnical outcomes emerge when the design is based on a thorough understanding of the geology and the environment, and the interaction of these systems over time. Traditionally, a significant challenge faced by geotechnical professionals is our ability to observe, interpret, and understand the physical environment, particularly as it applies to changes over time, and the effect of those changes. Examples of such changes include the displacement of a highway crossing a landslide, the effect on a pipeline crossing under a meandering river with shifting sediments, a dam deforming due to reservoir filling, or movement of a foundation due to permafrost degradation. State-of-the-art 3-dimensional (3D) data collection and analysis techniques are expanding our mapping and monitoring abilities, opening doors to solving problems with confidence previously not possible.

Traditional methods of identifying and mapping change on geotechnical projects have been limited to point-based systems, such as survey prisms, that require significant time, effort and cost to establish, monitor and interpret. These systems involve sparsely distributed nodes physically mounted to the ground surface that cannot be used easily to understand the 3D mechanics of large-scale movement, nor can they be used to map change over large areas or long periods of time with unknown rates of movement. Traditional methods also rely on a priori knowledge of where change, movement or deformation is likely to occur, in order to optimize the placement of monitoring instruments. New methods were needed.

In the mid-2000s, the application of Light Detection and Ranging (LiDAR)-based technologies for evaluating natural and constructed environments started gaining the attention of geotechnical researchers. LiDAR is a 3D remote imaging technique that can generate high-resolution (up to thousands of points per square metre) surface models (topology). LiDAR data can be collected from tripods at static locations (Figure 1), and from moving cars, boats, unmanned aerial vehicles (UAVs), helicopters and airplanes. LiDAR opened the possibility to monitor sites and to conduct detailed analysis of topographical change not reasonably practical with earlier stationary instruments.

Early research projects focused on applications of LiDAR technology at specific study sites to demonstrate proof-of-concept examples within the geoscience and engineering communities. But, like many new technologies, while LiDAR was emerging as a viable technology, data collection was expensive, processing techniques were not well understood or documented,

Figure: 1. Terrestrial LiDAR scanner collecting data at an open pit mine.

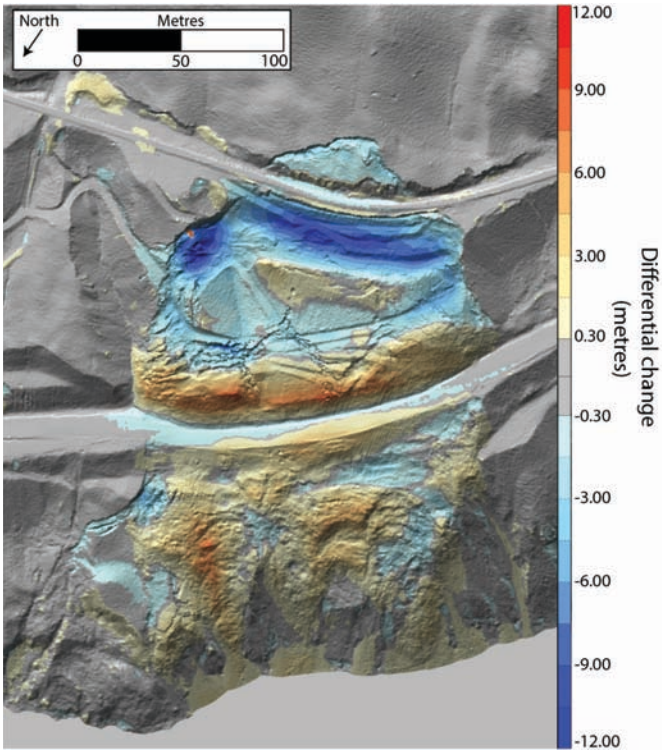

Figure 2: Differential airborne LiDAR analysis conducted between data collected in 2006 and 2016. Cool colours indicate negative deformation typical of the upper block of a landslide subsiding, warm colours indicate positive deformation typical of a landslide toe deforming outward.

there were no standard methods, and the full potential of the technology was unknown. There were few commercially available software packages for 3D data processing, and none dedicated to geotechnical applications.

In the early 2010s, LiDAR-based analyses became better documented by research groups and better understood within the practicing geotechnical community. This lead to a willingness to adopt the technology. Bare-earth (virtually stripping away of any vegetation) airborne LiDAR data became common for terrain evaluation and a critical part of assessing geohazards. Following this adoption, research shifted to expanding the applications of LiDAR data with automated data processing workflows for assessing differential change between datasets.

In parallel to the acceptance of LiDAR, the Structure from Motion (SfM) technique for generating 3D models from multiple overlapping photographs emerged in the early 2010s. The SfM method, originally developed in 1991, allowed for high-resolution, low-cost, 3D models and fuelled research efforts in the broader geoscience community. SfM 3D data generation techniques, and advanced 3D processing approaches, set the stage for future development of 3D data processing methods for landslide mapping and failure prediction by allowing a wider group of researchers and practitioners to collect and process data formerly restricted by the need for expensive equipment.

Researchers' sustained efforts on 3D remote sensing technologies and methods, their adoption by practitioners, and the evolution of data quality and processing capabilities in the past 20 years have generated revolutionary methods for detecting change in natural and constructed environments with unprecedented levels of accuracy and spatial extents. High resolution 3D topological data are transforming how we map natural terrain and understand movement over time across spatially extensive regions (Figure 2, as an example). Current research to push processing techniques further and exploit new data collection and computational processing capabilities is changing the foundation of geotechnical and geoscience topographical monitoring. Moreover, accuracy is expected to improve over time, and the costs of acquisition, processing and interpretation are expected to decrease. The current challenges faced when selecting and applying 3D remote sensing technologies are the need to keep up with their rapid advancement and expanding capabilities. Collaborative efforts between researchers and practitioners are needed to close this gap and provide the necessary information to those applying the techniques in practice.

As 3D data collection technologies and analysis methodologies continue to evolve, it is critical that we understand the capability of these tools to solve existing problems, and work with researchers to solve new ones. As we shift to designs with performance-based metrics, knowing how to accurately monitor and assess change will be pivotal to the success of future projects. LiDAR and SfM are routinely applied in some industries but only sparingly in others; this is likely to change as these new tools find routine use in the geotechnical profession.

Acknowledgements

The author would like to thank Dr. Scott McDougall, Dr. Jean Hutchinson, Dr. Pete Quinn and Mike Porter for supporting the Colloquium nomination. Various groups have been involved in research and consulting projects to support the development and adoption of LiDAR in the geosciences: special thanks to Queen's University, Rio Tinto, CN Railway, the Norwegian Geotechnical Institute, and BGC Engineering Inc. Specific collaborators include: Dr. Mark Diederichs, Dr. Malte Voege, Dr. Dave Gauthier, Dr. Ryan Kromer, Tom Edwards, Mario Ruel, Megan van Veen, Steph Fekete, Elin Morgan, and Rob Harrap.

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Introduction

Halloween fast approaches as I write these words and the leaves swirl in crackling piles on the streets. I often feel that fall is a good time to reflect on where we are, where we've been and where we are going. In this case, that reflection manifests as a brief summary of Geohazards 7 that wrapped up in June of this year. Hopefully the update gives you a sense of the progress we are making as a discipline.

Encyclopedia of Engineering Geology just released

Not long ago, I read an article on LinkedIn that asked if Engineering Geology, as a discipline, had become irrelevant. The essence of the opinion (written by an engineering geologist) seemed to say that the discipline was too specialized in obscure aspects of geological trivia like RQD, stratigraphy, and glacial epochs, to be practically useful.

I couldn't disagree more.

Engineering geologists and geomorphologists spend their days trying to understand the nature of earth materials and the processes that drive the physical landscape, thereby creating the world to which we most readily relate. We work with engineers, most closely with geotechnical, but also

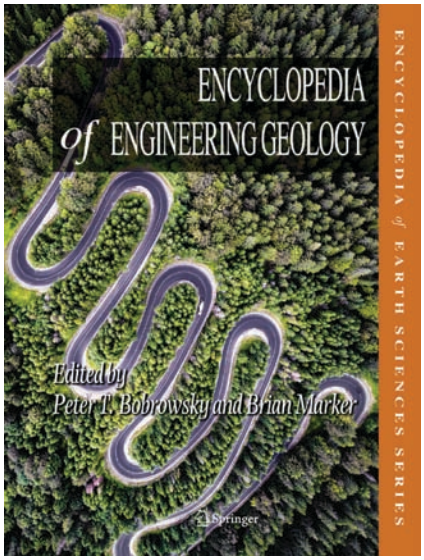

Figure 1. Cover of the new Encyclopedia of Engineering Geology.

with civil and structural engineers, to ensure that the designs on which humans rely, account for the environment within which they are expected to perform.

In my opinion, there has never been a better time for the field of engineering geology. Computational power, unprecedented views of the world simultaneously at both microscopic and macroscopic scales, and the widespread distribution of knowledge, all mean that we are able to characterize and quantify design parameters that are genuinely useful. As the global population approaches 8 billion and human growth increasingly pushes developmental boundaries, engineering geology is fundamentally necessary if we are to adequately manage that growth and ensure our continued success.

As with all fields, new and updated reference books are crucial. They help explain the depth and breadth of our scope, ensure a common language and understanding of phenomena, and provide resources to help answer new problems we may encounter.

Peter Bobrowsky and Brian Marker just released the "Encyclopedia of Engineering Geology" with the intent to provide just such a reference. While an encyclopedia, by nature, doesn't provide a comprehensive treatment of any one issue, at almost 1000 pages covering nearly 300 entries, written by noted experts in each field, it does aim to be the final authority on the current state of the art.

As with any major reference volume, it comes with a hefty price tag, about the same as my heavily tabbed Encyclopedia of Natural Hazards that Peter edited and released in 2013. If, like me, you're inspired by the subject material, the reference book deserves a look.

Geohazards: The State of the Art in Canada

Richard Guthrie

A history since 1992

In 1992, the Canadian Geotechnical Society (CGS) and the Vancouver Geotechnical Society jointly sponsored the first Geohazards Conference. Although CGS sponsored landslide-themed conferences occurred decades earlier, including Slope Stability (Vancouver 1976), Soft Soils (Quebec, 1979), and Landslide Case Histories (Toronto, 1984), the 1992 Geohazards conference really galvanized the Canadian scientific and engineering community around this field that grows more relevant with time. The first Geohazards conference covered, among other things, large and small landslides, risk assessment and

Figure 2. Room with a view – looking out at the devastation caused by the 2010 Mount Meager landslide (photo by R. Guthrie).

acceptability, specific hazards related to debris flows and landslide dams related to volcanism. The proceedings remain on my bookshelf today. Since 1992, the Canadian understanding of thematic elements widely discussed in the first conference has grown dramatically. Some key events (from the writer's perspective) in the history of this growth include:

- 1994: The Kwun Lung Lau landslide in Hong Kong (HK) materially affected the Slope Safety System employed by HK. While not widely known in Canada at the time, increased effort to reduce risk including use of FN curves and establishing tolerable risk limits, would ultimately guide Canadian practice.
- 1995: The Forest Practices Code was enacted in British Columbia. This act (and subsequent programs) pushed the assessment and management of geohazards (landslides, streams, flooding, erosion) into legislation and created the catalyst that gave rise to a new cohort of active scientists and engineers investigating and analyzing data, delivering geohazards programs, and creating more than 15 years of related literature.
- 1996: The US Transportation Research Board released Special Report 247: Landslides – Investigation and Mitigation. Building on previous work beginning in 1972, this volume became a definitive tool for a common understanding about landslides (including an update to the Varnes classification).
- 1997: The workshop on Landslide Risk Assessment in Honolulu Hawaii. This landmark workshop brought together multiple specialists to understand how to use new tools in hazard and risk assessment.
- 1997: Conrad Siding debris flow in BC derailed a train and caused 22 million dollars in damage.
- 2002: Zymoetz River rock slide debris flow in BC ruptured a pipeline, triggered a forest fire and dammed the Zymoetz river. 300 people were evacuated, and the cost was estimated at 33 million dollars.
- 2005: Berkley Escarpment landslide in the District of North Vancouver (DNV) caused the evacuation of 300 people, the loss of 2 homes and cost over four million dollars. More importantly, DNV became the first community in Canada to fully engage in a landslide risk assessment program and develop tolerability thresholds for new and existing development (based largely on the HK work).
- 2007: The Intergovernmental Panel on Climate Change published and won a Nobel Peace Prize for its Forth Assessment Report. Almost two decades after its inception, the focus on mitigation and adaptation garnered widespread acceptance and caused a sea-change in the understanding of a dynamic vs. static earth. Widespread acceptance led to flood protection works and the notion of building resilient communities across North America.
- 2010: Mount Meager landslide occurred (from the complex identified as problematic in Geohazards 1) becoming Canada's biggest historical landslide at 52 million square meters. 1,500 people evacuated due to potential for damage because of a landslide dam outburst flood associated with the landslide. Total cost was ten million dollars. New updates to the landslide have been acquired with structure from motion technology.
- 2010: Saint Jude lateral spread in sensitive marine clays, Quebec. At 6.5 million dollars of damage, this landslide also reminded the community about the considerable dangers of spreads, compound landslides and flow slides. This landslide type is typical of the marine clays in Quebec, but also reminiscent of the weak shales and glaciolacustrine soils in the Interior Plains (where, perhaps surprisingly, the most money is currently spent on landslide assessment, monitoring and mitigation). Improved analytical power also means that these landslides are better understood than ever before.

- 2013: Canmore floods. Debris floods in the Bow River valley in Alberta caused millions of dollars of damage and forced communities to consider the real hazards of building on steep mountain creeks. Building on work done for the DNV, Canmore developed a steep creek policy in 2016.
- 2014: Mount Polley tailings pond breach. 24 million cubic meters of water and mine tailings were released to BC waterways in Canada's first tailings dam failure. In addition to direct impacts, this failure resulted in substantial scrutiny of the company, individual engineers, and the regulation.
- 2016: Landslide generated pipeline rupture into the North Saskatchewan River. Costing on the order of 100 million dollars, this landslide resulted in dramatic increases in regulatory oversite in the province of Saskatchewan, and the bolstering of pipeline integrity programs for multiple companies, including a movement towards quantitative probability of (pipe) failure assessments.

Geohazards 7

Over this period, Geohazards conferences were held across the country, at Edmonton, Quebec City, Kelowna and Kingston. The papers presented at each conference were notoriously high caliber, and in their own way, mark the progress of the state of the art. Most recently, Geohazards 7 was held in Canmore Alberta, home to the debris floods of 2013, from the steep mountain streams that surround local communities in the Bow Valley. Like previous conferences, Geohazards 7 was a good proxy for the state of the art in Canada today. Below are some of the papers that I recall. The presenter's name is supplied in case the reader would like to follow up with one of them specifically.

Following a retrospective showing the evolution of landslide hazard and risk assessment in Canada (Doug Van Dine), the conference opened by focussing on communities and community emergency response: building flood resiliency through risk communication (Sandy Davis), protecting workers through field level hazard assessment tools (Katleen Baker), and lessons learned during steep creek mitigations (Emily Moase). We were introduced to community maps that showed probability of hazard by return period and to the challenges in designing effective debris flow structures.

Figure 3. The 2010 Saint Jude landslide in Quebec (photo by R. Couture).

We looked at how LiDAR is changing the way we identify landslides in eastern Canada, and how geotechnical data can provide clues about their sequence and activity state (Baolin Wang). We were introduced to new techniques (or testing of existing techniques) for estimating retrogression and runout hazards in sensitive clays (Dominique Turmel, Suzanne LaCasse) that substantially move the science forward. We were introduced to a new type of landslide (or new to this writer at least), the downward translational landslide, used to describe the mechanism behind the St. Fabien Landslide (F. Tremblay-Auger).

An up to the minute estimate of how climate change is manifesting was addressed in a keynote talk (Markus Schnorbus). Canada is, in general, experiencing an overall decrease in snow and increase in rain, leading to intensification of extreme storms (~5% intensification/degree of warming) with the top 1% of extremes seeing the biggest impacts. The 1950's 20-year storm is now the 15-year storm.

A changing climate drives material changes in geohazards and we discussed some the changes related to snow avalanche risk (Bruce Jamieson), tools and mitigation to address snow avalanches (Brian Gould, Michael Laws, Alan Jones), glacier retreat and landslides (Gio Roberti), and debris flood prediction and characterization (Matthias Jakob).

Canmore engineer Andy Esarte provided a compelling first-hand account of the 2013 floods, a cautionary tale of the danger of overlooking geohazards, and the dramatic impact they have on communities. This was followed by several talks on risk and mitigation of steep creeks (Félix Camiré, Kris Holm, Cesar Oboni) and rocky slopes (Renato Macciotta, Helene Hofmann, Andrew Mitchell, Kristen Tappenden, Gernot Stelzer, Jason Pellett, François Noël).

Innovative use of technology was demonstrated in a keynote that looked

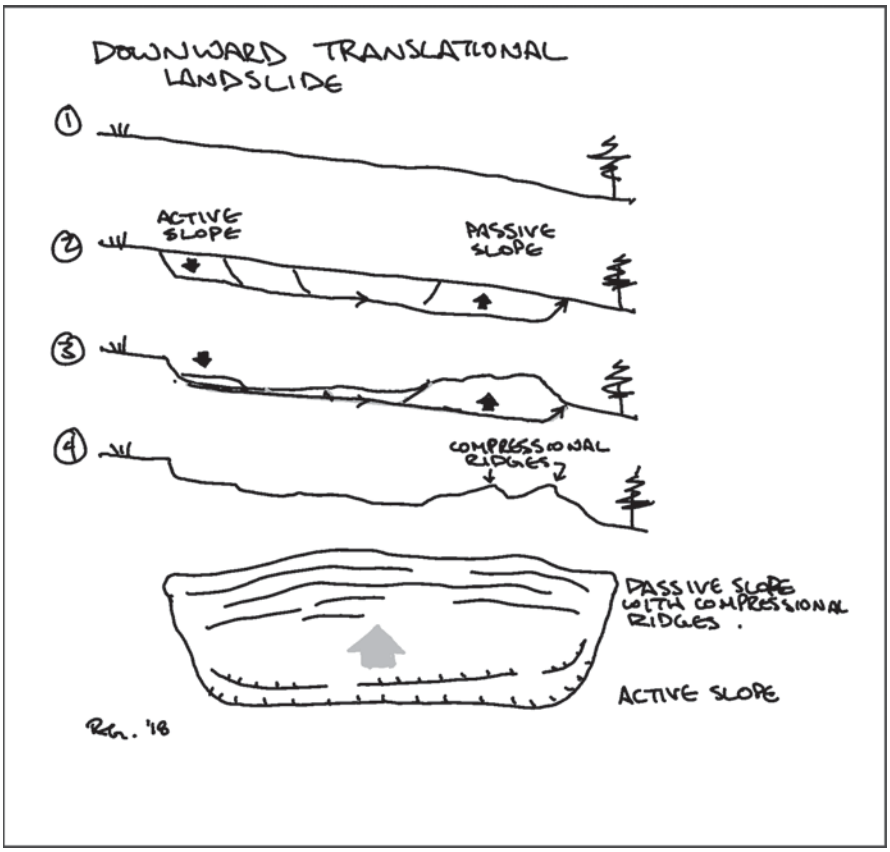

Figure 4. A sketch of a downward translational landslide (sketch by R. Guthrie, based on notes and presentation by F. Tremblay-Auger.)

at how fragmentation of rockfalls affected runout volume, distance and ultimately risk (Jordi Coriminas) and by several papers that followed including papers on structure from motion, InSAR, photogrammetry (Richard Carter, Dwayne Tannant, David Bonneau, Farnoush Hosseini, Lauren Hutchinson), and hazard and risk assessment related to landslide velocity (Michel Jaboydedoff).

Seismicity was discussed across several papers including a keynote talk on induced (man-made) seismicity in Western Canada (David Eaton), and a critical examination of seismically affected geotechnical stability and a framework for deciding how to approach performance-based design (Thuraisamy Thavaraj).

Other case studies and program updates were provided for multiple sites, and a poster session expanded considerably on the range of topics mentioned above.

Summary

By the end of Geohazards 7, the following was clear. In 26 years since the first Geohazards conference, Canada has grown in our technical understanding of both hazard and risk. Much of this is due to the application of technologies and computing power only recently available, while the remainder is due to the relentless pursuit of a mechanistic understanding of hazard and the iterative growth of that knowledge. Based largely on Geohazards 7 as a barometer, the state of the art in Canada has grown substantially. We have better runout models for rock fall, sensitive clay landslides, debris and rock avalanches and snow avalanches. We have better and more accurate tools overall. Our ability to detect and predict landslides and ground movement in general is increasing rapidly with the widespread use of new technologies. Snow avalanche control is getting more refined, and risk analysis, despite several decades of use, appears to be undergoing a step change in quality and accuracy. As we continue to develop and grow as a nation, solutions to geohazards problems will be increasingly important. And we're in good hands.

Closing notes

Thank you for your letters! If you have a paper or project related to Geohazards that you think would be interesting to GN readers, please send me note at *Richard.guthrie@stantec.com.*

Until the spring,

Rick

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Overture

52nd episode of the Grout Line. For this episode, no articles but some news about our grouting industry.

The first item is about a possible new International Grouting Committee that the Deep Foundation Institute (DFI) is in the process of creating. There are, to my knowledge, several Grouting organizations, official publications and grouting courses already in existence in NA and Europe, as follows (of course not fully completed):

All excellent documents/courses but, none of them, with the exception of the Austrian comments document and the Grouting Fundamentals Course, covers in detail all aspects and approaches in the industry for grouting in Rock and Soil.

This is the reason that DFI is trying to organize this International Committee that, we hope, will help to put some order in our industry, not necessarily agreeing on everything. We know that the "grouters" have very opinionated approaches and ideas, and some good confrontation, not necessarily physical ☺ of course, can help our industry to progress

The primary target of the DFI initiative would be the preparation, using the DFI „project fund initiative", of general guidelines and the following specific documents summarizing the different approaches and procedures existing in the industry. It is planned to review and summarize existing documents/specifications used in the worldwide grouting industry.

Stable organizations:	
North America	Europe
ASCE/GI Grouting Committee	EN Grouting Norm 12715 on Grouting (working group only?)
ASTM D18 Grouting	France: AFTES (working group only?)
Official publications (excluding conferences/books etc)	
North America	Europe
ASCE/GI Compaction Grouting Consensus Guide	EN Grouting Norm 12715 on Grouting
USACE EM_1110-2-3506_Grouting Technology Oct 2014	France: AFTES recommendations for grouting works - GT8
Bureau of Reclamation: Grouting for Embankment Dams (2014)	Austrian Society for Geomechanic (OeGG) Comments to EN 12715 Grouting 2017
API (test for slurries partially used also for grout mixes)	Italy: UNI- Grout mix tests-2005
ASTM (some standards used for grout mixes)	
Courses	
North America	Europe
Grouting Fundamentals Course: Austin University- 40 years	?
Material suppliers advertisement courses.	

It is anticipated that the documents should cover, at the minimum, the following aspects:

- Geotechnical investigation requirements
- Companies and key personnel qualification requirements
- Possible contractual methodologies
- PIMS requirements and data integrity verification
- Design (method, hole geometry and spacing, choice of the grouting type, grouting parameters, mix design, preliminary trials etc.)
- Risk evaluation, reduction and management
- Execution (drilling and grouting methodologies, data recording, quality controls, material testing, field testing, equipment requirements etc.)
- Final Verifications and Acceptance Criteria requirements

Additional specific projects will be evaluated by the members of the Committee/Group.

The proposed Committee will include Owners, Consultants, Contractors, Manufacturers/Suppliers/Service Providers and Academics.

The mission of the Committee should be to promote programs, technologies and specifications that will insure the quality of the work performed and the possibility to increase Safety, Quality, Durability and Sustainability to the benefits of the Clients, the Stakeholders, and the entire geo-foundation industry.

If you didn't know about this initiative and you are interested in finding out more, please contact me.

The second item is about the annual Grouting Fundamentals course detailed below, with the dates defined.

And, as usual for this time of the year, MERRY X-MAS AND HAPPY AND PROSPEROUS NEW YEAR!

I conclude with the same request, asking you to send me your grouting comments or grouting stories or case histories. My coordinates remain:

Paolo Gazzarrini, paolo@paologaz.com, paologaz@shaw.ca or paolo@groutline.com.

Ciao! Cheers!

Recap of Mining Geotechnique Initiatives in 2018

G. Ward Wilson, Nicholas Beier, Dave Sego, Paul Simms, Bruno Bussière

To begin, we would like to give a hearty congratulations to all 2018 Canadian Geotechnical Society (CGS) Award winners and honorees. In particular, we are most pleased to recognize Dr. Michel Aubertin, this year's prestigious Leggett Award winner, for his significant lifelong contributions to the geotechnical field in Canada. Several years ago, Dr. Aubertin and other CGS members recognized a need to establish an area focusing on mining geotechnique, and he led the initiative to propose the organization of a technical committee within the CGS.

The Technical Committee on Mining Geotechnique was created by the CGS Board of Directors in October 2011, with Dr. Aubertin as the inaugural committee chair. The mandate of the Committee is as follows:

- Organize and coordinate sessions on Mining Geotechnique at the annual Canadian Geotechnical Conference, in collaboration with the Technical Divisions of CGS;
- Act as a forum for discussion between industry, academics, and students on issues of research, education, and training;
- Promote awareness of Mining Geotechnique within the CGS, the geoscience community, and related fields;
- Liaise between CGS and other mining-related national and international organizations;
- Help publicize the importance of Mining Geotechnique to the Canadian public; and
- Contribute to efforts that may be beneficial to the Mining Geotechnique community.

Dr. Paul Simms was the committee chair between 2015 and 2018, and Dr. Thomas Pabst is the current committee chair. The Technical Committee on Mining Geotechnique will aim to increase the interaction of industry and academic researchers, and to provide added value to the general CGS membership. The committee is actively seeking a vice-chair from industry. If you have any interest in joining the committee, please contact Dr. Pabst at *mininggeotech@cgs.ca*.

Mining geotechnique has gained more visibility within the past few years. At GeoEdmonton 2018, there were five sessions presenting various aspects of mining geotechnique in research and practice. Recently in a joint collaboration, the NRC Research Press and the Canadian Geotechnical Journal chose a mining geotechnique research article to be featured among its Editor's Choice 2018 papers (to be released on the NRC Research Press website in January 2019). The Editor's Choice Award is a means of highlighting articles of particularly high caliber and topical importance. Further, in the latter half of 2018, we have had several high impact conferences regarding mining geotechnique.

In June, the Université du Québec en Abitibi-Témiscamingue (UQAT) and the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) hosted Symposium 2018 on Mines and the Environment in Rouyn-Noranda, Québec. With 420 delegates, the Symposium also offered three short courses related to applied mineralogy, mine waste treatment and mine site reclamation, as well as surface and underground site visits. The Symposium is the result of a collaboration between the Research Institute on Mines and Environment (RIME) UQAT-Polytechnique, the Unité de Recherche et de Service en Technologie Minérale (URSTM), and many government actors and mining companies. The objectives of the Symposium are to share recent knowledge and research developments and to discuss common practices to find solutions that reconcile profitability and environmental protection.

In October, 350 mine waste managers, engineers, regulators and researchers gathered at Keystone, Colorado, for the 22nd International Conference on Tailings and Mine Waste. Colorado State University hosted the conference, which provided attendees an opportunity to discuss the latest developments in tailings and mine waste management. Presentations covered an array of topics related to the engineering and management of tailings and mine waste, including case histories, design, operation, and disposal for mine waste management, geotechnical considerations, liners, covers and barriers for waste control, reclamation and remediation of mine impacted sites, oil sands issues, surface water and groundwater management and geochemistry, and policies, procedures and public safety. This conference began in 1978 at Colorado State University and is co-hosted with the University of Alberta and University

of British Columbia. The next Tailings and Mine Waste Conference hosted by the University of British Columbia will be held in Vancouver, BC, November 17-20, 2019.

Finally, the University of Alberta Geotechnical Centre and Oil Sands Tailings Research Facility (OSTRF) held the Sixth International Oil Sands Tailings Conference (IOSTC '18) in Edmonton, AB, in December. Over 200 delegates representing six countries attended, including mine waste managers, engineers, regulators and researchers. Exhibitors were also present at the conference to showcase their technologies and services. The conference had special keynote addresses from Dr. Peter Robertson (Evaluation of flow liquefaction in tailings and mine waste using the CPT); Les Sawatsky, Alexander Hyndman and Dr. Gord McKenna (Fluid Fine Tailings Processes – Disposal, Capping, and Closure Alternatives); and Dave Corriveau (Canada's Oil Sands Innovation Alliance – Leading Innovation in Oil Sands Tailings). IOSTC '18 conference is the premier platform for oil sands operators, consultants, regulators and academia to present and learn about oil sands tailings management state of practice, recent technological advancements and novel research. The presentations and conference proceedings highlighted the industry's extensive research efforts on topics including innovations in tailings management and dewatering technologies, regulatory policy and guidelines, mine waste structure integrity and closure/reclamation considerations.

We look forward to the start of a strong 2019 with many more opportunities to share stories and news of innovative work in the field mining geotechnique.

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In 1982 members of the Canadian Geotechnical Society conceived the idea of a book recording the development of geotechnical engineering in Canada. Since a number of the early practitioners were still living at the time, foremost among them Bob Hardy and Bob Legget, the approach was intended to create "a living history ... through the eyes and recollections of living engineers, to show the humanity that underlies the development of major geotechnical projects in Canada."

As this book is now out-of-print, we will be publishing excerpts from it over the next few editions of Geotechnical News. Ultimately, a pdf copy will be available.

Geotechnical Engineering in Canada An Historical Overview

Cyril E. Leonoff

Note: The previous excerpt appeared in the September 2017 issue of GN.

Robert (Bob) Peterson grew up on a farm near Plato, Saskatchewan, then completed high school in Saskatoon. He enrolled in the engineering college at the University of Saskatchewan in 1935, graduating with great distinction in 1939, when he joined the PFRA staff. Dean Mackenzie persuaded Peterson to take the Harvard graduate course in soil mechanics, which he undertook in 1940-1941.

After graduating with a master's degree Peterson returned to the PFRA, where be became Chief Soil Mechanics and Materials Engineer. An agreement was made between the PFRA and the university to establish a laboratory in the Engineering Building on the Saskatoon campus. The lab was made available to the students and Peterson also lectured on soil mechanics.

PFRA's first major dams, Pothole and St. Mary, were designed by Peterson and built in southern Alberta. St. Mary, one of the largest earth dam projects undertaken up to that time, was a precedent-setting dam in Canada. The technical concern was the strength of a 200-foot-high embankment of which the principal ingredient was clay till. It was the first design based on the application of soil mechanics to the investigation of foundation and construction soils, the first in which quality control of water content and compaction density was maintained during construction, and the first in which significant instrumentation was placed to monitor the performance.

Charles Ripley, an Alberta and Harvard graduate, was Peterson's resident engineer on the project from the summer of 1946 through 1948. Ripley has pointed out that the initial problem faced by the early practitioners of soil mechanics was to gain the confidence of the civil engineers administrating the project. According to Ripley, Bob Peterson possessed a marvelous ability in precisely that capacity: "He got along well with the district engineers, and he made a great contribution in demonstrating that there was a place for soil mechanics in engineering of dams."

When the Travers Dam was constructed on Bearpaw Shale foundation Peterson was the first person to investigate the treacherous expansive properties of this material. Peterson's crowning achievement was the successful completion in 1967 of the Gardiner Dam on the South Saskatchewan River, also built on the Bearpaw Shale. Bob Peterson spent his entire career with the PFRA. He also worked as a specialist consultant on review boards and became internationally recognized as an authority on earth dams. He died untimely in 1969 at the age of 51.

Karl Terzaghi had laid the foundations for a strong soil mechanics school at MIT. Among his successors were professors Glennon Gilboy, who joined the faculty in 1926, and Donald W. Taylor in 1932. Both of these men died relatively young, but both left a lasting impact on soil mechanics. Taylor's textbook, *Fundamentals of Soil Mechanics*, published in 1948, was an out growth of the lecture notes prepared by Terzaghi and Gilboy at MIT and became a standard textbook in American soil mechanics schools.

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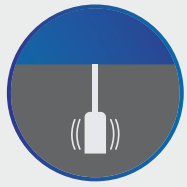

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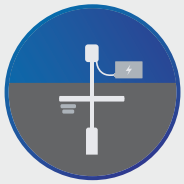

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