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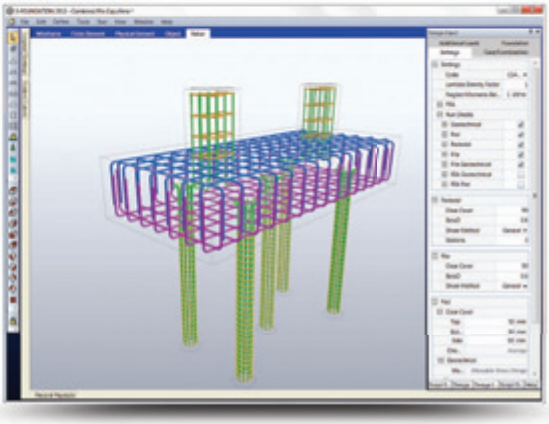

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contents

SUMMER 2014/ÉTÉ 2014 | VOLUME 31.3

IN VIEW: PROJECTS

On the cover: Photo courtesy of the Government of British Columbia

TECHNICAL: PERSPECTIVES IN HYDROTECHNICAL ENGINEERING | SECTION TECHNIQUE : LES PERSPECTIVES EN GÉNIE HYDROTECHNIQUE

FORUM ON SUSTAINABILITY

NEWS, VIEWS & DEPARTMENTS
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Are We Advocates or Grinders in the Back Room?

The headline in my morning paper one day in June was a bold, single word -- APPROVED. The Canadian government had approved construction of the $7.9 billion Northern Gateway project. Describing the initiative as controversial is an understatement. Political opponents vow to kill the project, citing the danger of spills while piping crude oil across Northern B.C. to the Pacific and through coastal waters in supertankers.

Editorial commentary identified three critics of the project. Environmentalists who oppose the expansion of the oil sands in Alberta are concerned with the climate-change dangers of continued reliance on fossil fuel energy. Environmentalists concerned with the effects of a crude oil spill on northern British Columbia and coastal waterways from pipeline and tanker ship failures are a second group of opponents. Finally, First Nations along the proposed route are insisting on proper attention to aboriginal rights, suggesting the Northern Gateway is viewed by First Nations people as a significant turning point in their role in national economic development and environmental protection.

A few days prior to the federal government's decision, a letter to Canadians in support of the project was published in the same newspaper. The letter, with signatories of the influential, educated, and politically connected cadres, offers a viewpoint of the importance of natural resources as a foundation of Canada's economy. It suggests Canada is standing on the edge of an unprecedented opportunity to strengthen our nation.

Many opinions and many issues lie ahead for the Northern Gateway project. My question is, where should the civil engineering community and CSCE position themselves with regard to this significant national project? In the end, engineers will be a key player in the implementation of this project. As it moves forward, do we stay off the stage, wait for the decisions and quietly do our work in the planning, design and construction of this major piece of infrastructure, as grinders in the back room? Do we take a pro or con position and become an advocate? As advocates we would stand up and join the debate. As grinders we would rationalize to ourselves that we need to be here to make sure the job is done right (i.e. environmentally safe, robust, etc.).

You may recall an incident I described in one of my CSCE e-Letters (July 2013) that occured during a CSCE-led town hall meeting about 15 years ago. I was challenged with the question: "When was the last time you heard an engineer say anything of social value?"

Well, it is time for civil engineers to say something of social value. I would add that the issue is larger than the Northern Gateway project. As the project name implies, Canada is at the doorstep of major development activity in the Arctic. Canada's northern territories cover

more than 1.5 million square miles of virgin territory (almost 40% of Canada's total area), rich with resources and changing daily due to climate change. The Gateway project is just the beginning.

This is a test for the civil engineering community, to engage in one of the most crucial issues facing Canadian society and the global community today. Consider what we are trying to address in the developed areas of our country relative to sustainability. How would we have done it differently when development of our nation was in its infancy if we knew then what we know now? We have an opportunity and a responsibility to "do it right" from the beginning, focusing on the sustainability performance of our work, which will have global impacts. Failure to engage is not an option. ■

Sommes-nous des défenseurs ou des travailleurs acharnés dans l'anonymat ?

Un jour de juin, le gros titre de mon journal du matin n'était qu'un seul mot en gras – APPROUVÉ. Le gouvernement canadien a approuvé la construction du projet d'oléoduc Northern Gateway d'une somme de 7,9 milliards de dollars. Décrire l'initiative comme étant controversée est un euphémisme. Les opposants politiques jurent mettre fin au projet en citant les risques de déversement lorsque les tuyaux transportent du pétrole brut du nord de la C.-B. au Pacifique et également dans les eaux côtières à l'intérieur de superpétroliers.

Un commentaire éditorial a identifié trois critiques à l'égard de ce projet. Les écologistes qui s'opposent à l'exploitation des sables bitumineux en Alberta sont préoccupés par les dangers des changements climatiques causés par un recours ininterrompu des combustibles fossiles. Les écologistes qui s'inquiètent des effets du déversement de pétrole brut au nord de la Colombie-Britannique et dans les voies de navigation côtières occasionnés par des défaillances des oléoducs ou des pétroliers constituent un second groupe d'opposants. Finalement, les Premières Nations qui se trouvent le long de la route prévue pour le projet insistent pour que l'on porte l'attention nécessaire aux droits ancestraux, si l'on sous-entend que le Northern Gateway est vu par les Autochtones comme étant un point tournant important dans le rôle qu'ils jouent au sein du développement économique national et dans celui de la protection environnementale.

Quelques jours avant la décision du gouvernement fédéral, une lettre adressée aux Canadiens afin de soutenir le projet a été publiée dans ce même journal. La lettre, comprenant des signatures de dirigeants influents, éduqués et liés au système politique, présente un point de vue sur l'importance des ressources naturelles en tant que fondement de l'économie canadienne. La lettre indique que le Canada est à deux doigts d'une occasion unique de renforcer notre pays.

Bien des opinions et des questions se profilent à l'horizon avec le projet d'oléoduc Northern Gateway. Ma question est la suivante : où devraient se positionner l'ensemble des ingénieurs civils et la SCGC quant à cet important projet national ? En fin de compte, les ingénieurs joueront un rôle clé dans la mise en œuvre de ce projet. Au fur et à mesure que le projet avancera, devrons-nous rester en dehors de la scène, attendre les décisions et silencieusement effectuer notre travail en ce qui a trait à la planification, à la conception et à la construction de cette grande pièce d'infrastructure, comme des travailleurs acharnés dans l'anonymat ? Devons-nous nous prononcer pour ou contre et devenir des défenseurs ? En tant que défenseurs, nous saurons prêts à nous défendre et nous prendrons part au débat. En tant que travailleurs acharnés, nous nous justifierons en nous disant que nous devons être présents pour nous assurer que le travail est bien fait (p. ex. le rendre écologique, solide, etc.).

Vous vous souviendrez peut-être d'un incident que je décris dans une de mes lettres numériques de la SCGC (juillet 2013) qui est survenu lors d'une assemblée publique menée par la SCGC il y a environ 15 ans. Je devais faire face à la question : « À quand remonte la dernière fois où [vous] avez entendu un ingénieur dire quelque chose qui a une valeur sociale ? »

Eh bien, le moment est venu pour les ingénieurs civils de dire quelque chose qui a une valeur social. J'ajouterais que le problème est plus grand que le projet d'oléoduc Northern Gateway. Comme le nom du projet l'indique, le Canada est tout près d'un développement majeur des activités en Arctique. Les territoires du Nord canadien couvrent plus de 1,5 million de pieds carrés (près de 40 % du territoire du Canada) de territoires vierges qui sont riches en ressources et qui se transforment quotidiennement en raison des changements climatiques. Le projet Gateway n'en est que le commencement.

C'est une épreuve pour l'ensemble des ingénieurs civils que de s'engager dans une des questions les plus cruciales que se posent la société canadienne et la communauté mondiale d'aujourd'hui. Considérez que ce que nous tentons d'aborder dans les régions développées de notre pays est par rapport à la durabilité. Comment aurions-nous pu faire autrement lorsque le développement de notre pays était à ses débuts si nous avions su à ce moment-là, ce que nous savons maintenant ? Nous avons l'occasion et la responsabilité de « bien faire » depuis le début en nous concentrant sur la performance durable de notre travail, ce qui entraînera des répercussions mondiales. Un manque d'engagement n'est pas une option. ■

Saskatchewan: The Place to Be in 2015

By Harold Retzlaff, P. Eng., FCSCE
VICE-PRESIDENT, PRAIRIE REGION, CSCE

Your travel destination is Regina, Sask., in the CSCE Prairie Region.

Why? To attend the 2015 CSCE Conference.

When? May 27 -30, 2015

My co-chair, Cathy Lynn Borbely, and I extend an invitation to join us for the 2015 CSCE Annual Conference to be held in Regina.

We are organizing an exciting program with both technical and social events to inspire you professionally and provide a dynamic atmosphere to renew old acquaintances and establish new connections. This is an opportunity to share the accomplishments we are making as civil engineers in our communities.

Our conference theme for 2015 is "Building on Our Growth Opportunities."

Saskatchewan is currently home to more than 1.1 million people and is among the leaders in population growth in Canada. We are a thriving province, leading technology development in three main areas – food, fuel and fertilizer. We have built upon our agricultural heritage, taken that pioneer spirit and used it to develop our resource industries, such as potash, uranium, and oil and gas extraction. We are leaders in the development of clean coal and carbon storage processes. Export trade is our backbone and we have the natural resources to world wants.

As civil engineers we are tasked to design, build, operate and maintain the infrastructure needed to support the economy and a world-class quality of life.

We are excited to welcome you to our province and let you in on the secret. Saskatchewan is no longer the place to be from. It is the place to be. ■

Harold Retzlaff is director of transportation planning, Government of Saskatchewan.

Saskatchewan : L'endroit où se trouver en 2015

Par Harold Retzlaff, ing., FSCGC
VICE-PRÉSIDENT,
RÉGION DES PRAIRIES, SCGC

Votre destination de voyage est Regina, Sask., dans la Région des Prairies de la SCGC.

Pourquoi ? Pour assister au Congrès annuel 2015 de la SCGC.

Quand ? Du 27 au 30 mai 2015.

Ma coprésidente, Cathy Lynn Borbely, et moi-même vous invitons à nous joindre pour le Congrès annuel 2015 de la SCGC qui aura lieu à Regina.

Nous organisons un programme intéressant qui comprend des événements techniques et sociaux pour vous motiver professionnellement et pour apporter une ambiance dynamique afin de renouer avec d'anciennes connaissances ou de créer de nouveaux liens. C'est l'occasion d'y partager les réalisations que nous faisons dans nos communautés en tant qu'ingénieurs civils.

Le thème de notre congrès pour 2015 est : « Miser sur les opportunités de croissances. »

La Saskatchewan abrite plus de 1,1 million de personnes et elle fait partie des meneurs au niveau de la croissance démographique au Canada. Nous sommes une province prospère qui joue un rôle majeur dans le développement technologique dans trois domaines principaux – la nourriture, le combustible et l'engrais. Nous avons tiré profit de notre patrimoine agricole en prenant cet esprit pionnier et l'avons utilisé pour développer nos ressources naturelles telles que la potasse, l'uranium et l'extraction de pétrole et de gaz. Nous sommes des meneurs dans le développement du charbon propre et du procédé de stockage de carbone.

Le commerce d'exportation est l'épine dorsale et nous avons les ressources naturelles que les gens désirent.

En tant qu'ingénieurs civils, notre rôle est de concevoir, de construire et d'assurer le fonctionnement et le maintien des infrastructures dont on a besoin pour soutenir l'économie et une qualité de vie de calibre mondial.

Nous sommes impatients de vous accueillir dans notre province et de vous faire partager le secret. La Saskatchewan n'est plus l'endroit d'où l'on doit venir. C'est l'endroit où se trouver. ■

Harold Retzlaff est directeur de la planification des transports, Government de la Saskatchewan.

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University of Waterloo Handles the Challenges of Co-op Students

Andrew Easton,
PRESIDENT, CSCE UW STUDENT CHAPTER

The recently revitalized CSCE Student Chapter at the University of Waterloo (UW) is taking steps to ensure that its civil and environmental engineering (CEE) student membership can enter the workforce with a competitive edge.

The UW student leaders are determined to promote the professional development of the membership and are planning technical lectures. These will give students an opportunity to learn about topics that are not normally covered in traditional civil engineering courses. There will also be site tours of local civil engineering projects, where students can gain an appreciation for practical considerations when applying theory learned in class.

While the UW chapter has competed regularly over the years in national competitions such as the Concrete Toboggan Competition, additional efforts are underway to encourage full participation in other competitions such as the National Capstone Design competition.

Waterloo's CSCE Student Chapter faces unique challenges, due to the university's co-op program, which sees a rotation of "on stream" students every four months, unlike the traditional September to April school year. The student leadership is, however, working together to put measures in place to mitigate the challenge. We are currently developing a UW CSCE web space, utilizing SharePoint to store information pertaining to the operations of the chapter to insure continuity. We have also formed mirror executive committees, which alternate every four months. In order to keep the "off stream" executives in the loop, email updates, a joint

The chapter was honored to welcome the Chair of CSCE Student Affairs, Professor Charles-Darwin Annan, to Waterloo. Professor Annan met and interacted with the UW Faculty Advisor, Professor Scott Walbridge, and the current chapter executives./Le chapitre a eu l'honneur d'accueillir le président des affaires étudiantes de la SCGC, le professeur Charles-Darwin Annan, à Waterloo. Le professeur Annan a rencontré et discuté avec le conseiller académique de l'UW, le professeur Scott Walbridge, et avec les cadres actuels des chapitres.

From left to right/De gauche à droite : Walbridge, Andrew Easton, Nissrine Bouslama, Tim Tedford, Annan, Norman Fong et Nouha Javed.

UW-CSCE Facebook page, and Skype meetings are being planned. We also make every effort to meet in person when the opportunity arises.

The UW Student Chapter is back to stay and we will be reaching out to other Student Chapters within our region for multi-chapter events. ■

L'Université de Waterloo relève les défis d'un programme coopératif

Andrew Easton,
PRÉSIDENT, CHAPITRE ÉTUDIANT DE LA SCGC À L'UW

Le chapitre étudiant de la SCGC à l'Université de Waterloo (UW), récemment revitalisé, prend des mesures pour s'assurer que ses membres étudiants en génie civil et en génie de l'environnement puissent entrer sur le marché du travail avec un avantage concurrentiel.

Les leaders étudiants de l'UW ont la ferme volonté de promouvoir le perfectionnement professionnel des membres et planifient des exposés techniques. Ces derniers donneront aux étudiants l'occasion d'apprendre sur des sujets qui ne sont normalement pas abordés dans les cours traditionnels de génie civil. Il y aura également des visites guidées des projets locaux en génie civil où les étudiants peuvent obtenir une appréciation pour des raisons pratiques lorsqu'ils appliquent des théories vues en classe.

Bien que le chapitre de l'UW ait régulièrement pris part, au fil des ans, à des compétitions nationales telles que la Compétition du toboggan de béton, des efforts supplémentaires sont nécessaires pour encourager la pleine participation au sein d'autres compétitions comme le Concours national de conception Capstone.

En raison du programme coopératif de l'université, le chapitre étudiant de la SCGC à Waterloo est confronté à des enjeux particuliers. Il observe une rotation des étudiants « actifs » tous les quatre mois, contrairement à l'année scolaire traditionnelle de septembre à avril. Cependant, le leadership étudiant travaille ensemble pour mettre en place des mesures afin de relever le défi. Nous sommes présentement en train de développer un espace Web de la SCGC à l'UW qui utilise SharePoint pour emmagasiner de l'information sur les activités du chapitre pour en assurer la continuité. De plus, nous avons créé des comités de direction parallèles qui changent tous les quatre mois. Dans le but de tenir les cadres « isolés » au courant, des mises à jour de courriel, une page Facebook SCGC-UW commune et des réunions sur Skype sont planifiées. Nous faisons également tout notre possible pour faire des rencontres en personne lorsque l'occasion se présente.

Le chapitre étudiant de l'UW est là pour rester et nous tendrons la main à d'autres chapitres étudiants au sein de notre région lors des événements multichapitres. ■

Young Professionals Across Canada: Ontario Region

National Capital Section

The National Capital Region has two very active student chapters – one at Carleton University and another at the University of Ottawa. With the strong presence of these two chapters, the focus of our YP program has naturally been geared towards providing them with support, and encouraging the development of these young professionals at the onset of their professional careers.

The University of Ottawa has had success hosting events such as the Sub-Olympics (an amazing engineering race), a popsicle bridge competition, a graduate poster competition, and guest speaker nights. Carleton University has also had success with their social events such as CSCE Net Night, Castigliano's birthday celebration, and a canal skate.

This past May, both chapters had the opportunity to send representatives to the CSCE annual conference in Halifax, where they attended the technical and social sessions, including the Capstone Competition.

– Jasmin Sidhu, EIT, AMCSCE

Toronto Section

The Toronto Section YP Committee has spent the first part of 2014 refocusing and determining what events are likely to best serve our membership going forward.

In April, Mark Bruder of R.V. Anderson gave a talk entitled "A Young Professional's Survival Guide," providing material useful to YPs as they transition from school to the workplace.

In the upcoming fall/winter seasons, we look forward to providing more programming for young professionals and we are excited to continue to support and work with the Ryerson and U of T chapters, and to provide support to the 2015 CSCE Canadian National Concrete Canoe Competition hosted by the University of Toronto. ■

– George Crouch, EIT, AMCSCE

If you are interested in getting involved or want more information about any of the events above, please get in touch.

Winners of the University of Ottawa Sub-Olympics./Vainqueurs des Sub-Olympics de l'Université d'Ottawa. Photo : Jasmin Sidhu

Speaker night at University of Ottawa./Soirée des conférenciers à l'Université d'Ottawa. Photo: Jasmin Sidhu

Les jeunes professionnels à travers le Canada : Région de l'Ontario

La capitale nationale

La région de la capitale nationale dispose de deux chapitres étudiants très actifs – un à l'Université Carleton et un autre à l'Université d'Ottawa. Avec la forte présence de ces deux chapitres, l'objectif du programme des JP a naturellement été de leur apporter du soutien et d'encourager le développement de ces jeunes professionnels en début de carrière.

L'Université d'Ottawa avait eu du succès dans l'organisation d'événements tels que les Sub-Olympics (une course de génie spectaculaire), la compétition de ponts en bâtons de sucettes glacées, le concours d'affiches et la soirée des conférenciers invités. L'Université de Carleton avait aussi eu du succès avec ses activités sociales comme la Net Night de la SCGC, l'anniversaire de Castigliano et le patinage sur le canal.

En mai dernier, les deux chapitres ont eu l'occasion d'envoyer leurs représentants au Congrès annuel de la SCGC à Halifax où ils ont assisté aux séances techniques et sociales, y compris à la compétition Capstone.

– Jasmin Sidhu, EIT, AMSCGC

La section de Toronto

Le comité des JP de la section de Toronto a passé la première partie de 2014 à recentrer et à déterminer les événements qui ont de fortes chances de mieux servir nos membres à l'avenir.

En avril, Mark Bruder, de R.V. Anderson, a donné une conférence intitulée « Guide de survie pour les jeunes professionnels », laquelle a fourni de la documentation utile aux JP qui leur servira lorsqu'ils feront la transition de l'école au milieu de travail.

Au cours des prochaines saisons automne/hiver, nous comptons fournir plus de programmes aux jeunes professionnels et nous sommes très enthousiastes à l'idée de continuer de soutenir et de travailler avec les chapitres de l'Université Ryerson et de l'Université de Toronto ainsi qu'à l'idée de fournir un appui à la Compétition canadienne nationale 2015 de canoë de béton de la SCGC, organisée par l'Université de Toronto. ■

– George Crouch, EIT, AMSCGC

Si vous souhaitez vous impliquer ou si vous voulez plus d'information sur l'un des événements ci-dessus, n'hésitez pas à communiquer avec nous.

2014 CSCE Hydrotechnical Engineering Award

Peter John Thompson

The CSCE Hydrotechnical Division is pleased to announce Peter John Thompson, of the University of Waterloo, Department of Civil Engineering, as the winner of the 2014 Hydrotechnical Engineering Award for the best Masters thesis in Canada related to water engineering and water management. The award, sponsored by Golder Associates Ltd., is presented for the thesis: "Event Based Characterization of Hydrologic Change in Urbanizing Southern Ontario Watersheds via High Resolution Stream Gauge Data," prepared under the supervision of Dr. William K. Annable. ■

Le Prix d'excellence en génie hydrotechnique de la SCGC pour l'année 2014

La division du génie hydrotechnique de la SCGC est heureuse d'annoncer Peter John Thompson, du département de génie civil à l'Université de Waterloo, comme vainqueur du Prix d'excellence en génie hydrotechnique pour l'année 2014 pour la meilleure mémoire de maîtrise au Canada en lien avec le génie de l'eau et la gestion de l'eau. Le prix, financé par Golder Associates Ltd., est présenté pour la mémoire : « Event Based Characterization of Hydrologic Change in Urbanizing Southern Ontario Watersheds via High Resolution Stream Gauge Data », élaborée sous la supervision de William K. Annable. ■

New edition: CSA-S-06 Canadian Highway Bridge Design Code

CSCE will be offering a one-day course on the new edition of the Canadian Highway Bridge Design Code. The course will be held throughout Canada starting in the fall of 2014. Authors of the code will present and explain the major changes made to four main sections of the code: Section 4: Seismic Design, Section 5: Methods of Analysis, Section 6: Foundations and Geotechnical Systems and Section 12: Barriers and Highway Accessory Supports.

The 11th edition of CSA-S6 Canadian Highway Bridge Design Code applies to the design, evaluation and structural rehabilitation design of fixed and movable highway bridges. The code establishes safety and reliability levels that are consistent across all jurisdictions in Canada.

Nouvelle édition: CSA-S-06 Code canadien sur le calcul des ponts routiers

À compter de l'automne 2014, la SCGC présentera une formation d'une journée sur la nouvelle édition du Code canadien sur le calcul des ponts routiers. La formation sera offerte dans tout le Canada. Les auteurs du code présenteront les modifications importantes apportées à quatre principaux chapitres du code : Chapitre 4 : Conception parasismique; Chapitre 5 : Méthodes d'analyse; Chapitre 6 : Fondations et systèmes géotechniques et Chapitre 12 : Dispositifs de retenue et supports d'équipements routiers.

La 11e édition du CSA-S-06 Code canadien sur le calcul des ponts routiers couvre la conception, l'évaluation et la conception de réhabilitation de la structure des ponts routiers fixes et mobiles. Le code établit les niveaux de sécurité et de fiabilité conformes à toutes les juridictions du Canada.

CALL FOR CASE STUDIES

CIVIL magazine invites members and sponsors of CSCE/SCGC to submit case studies of infrastructure projects for publication.

Projects will be selected for publication based on various criteria, including their sustainability qualities.

Suggested projects include transportation (transit, bridges, etc.), water-wastewater infrastructure, power generation, industrial plants, etc. The project can be either in Canada or international and should have been completed in the last two years.

Submit an 800-word description plus photos to:
Bronwen Parsons, Associate Editor, CIVIL magazine. E-mail: bparsons@ccemag.com.
Tel. 416-510-5119.

civil
CANADIAN CIVIL ENGINEER
L'INGÉNIEUR CIVIL CANADIEN

Enhancement of Windermere Basin

Massive amounts of earth and sediment were re-sculpted to create a natural wetland aquatic habitat at the east end of Hamilton Harbour in southern Ontario.

By Mark Bassingthwaite, P.Eng., Cole Engineering Group & John Helka, C.E.T., City of Hamilton

Windermere Basin is located in the east end of the Hamilton Harbour, at the mouth of the Red Hill Creek in the City of Hamilton. Between 1954 and 1972 the basin had been transformed from its original condition of natural wetland and mud flat area due to extensive lake filling and land reclamation activities.

A rehabilitation project had been completed between 1988 and 1990 which removed contaminated sediments from the basin and included the construction of a sediment trap to help prevent sediment from entering the harbour.

In October 2000, the Hamilton Port Authority transferred ownership of the basin and surrounding lands to the City of Hamilton. The city took over maintenance dredging to ensure that the build-up of sediment would not impinge upon the downstream part of Hamilton Harbour's shipping, navigation, transportation and operational needs.

Cole Engineering was retained in 2007 to provide engineering services, including the completion of a Municipal Class Environmental Assessment (Class EA), a Canadian Environmental Assessment Act (CEAA), preliminary and detailed designs, and contract administration services for the enhancement of the basin. The Class EA was to determine the best option for enhancing, restoring and protecting the natural environment and maintaining the downstream harbour needs.

Creating a watercourse and wetland

During the EA it was concluded that the preferred approach was to construct a watercourse to direct the flow of Red Hill Creek to the harbour. This work involved constructing approximately 700 m of earthen dykes, 4 to 5 m high. The dykes were designed to be stable

Images courtesy of Cole Engineering

Aerial view of basin after construction. Red Hill Creek to Hamilton Harbour is redirected around a new wetland created by contouring and capping sediments.

during storm events, to not increase flood elevations, and to maintain sediment transport downstream.

In the remainder of the basin a wetland aquatic habitat was created by contouring and capping the sediments to achieve suitable grades for wetland vegetation. A fishway structure was built to permit fish passage into the wetland, and a pump chamber was constructed to control water levels.

The project presented many design challenges given the difficult site conditions and unique nature of the work. Several issues were identified, including: mitigating potential contamination from the adjacent Parkdale Combined Sewer Overflow, dealing with impacted site sediments, and maintaining water levels. The project also had to protect and enhance the use of the site by wildlife, including the common tern, and facilitate passage of desirable fish (bass, pike, white sucker) into and out of the basin, while excluding undesirable species such as carp. The upland habitat and aesthetic values of the basin were also enhanced.

Dykes and cap

Construction of the dykes and cap was challenging due to the required large volume of imported fill (approx. 490,000 tonnes) and the difficult geotechnical conditions. The existing sediments were saturated, soft, and not capable of supporting loads.

Fishway structure.

Trucks building new landforms in what was once open water.

The dykes were constructed by advancing clay material using bulldozers, excavators and trucks. In most areas, imported and compacted clay material displaced the in-situ soft sediments. However, geotechnical investigations indicated that significant depths of peat material were present in some areas. Therefore for critical areas peat was pre-dredged in advance of the dyke construction to reduce anticipated post-construction settlement.

The large area of approximately 14 ha of sediment to be capped was divided into smaller areas of various sizes by creating internal dykes composed of shale. These dykes were ideally spaced so that long-reach excavators could place material in between them. Due to insufficient frost in the warm winter of 2011-2012, the cap could not be placed, but following a series of trials it was found that the use of a layer of woven geotextile directly over the sediments worked most effectively for maintaining the cap.

Plantings for ecological restoration

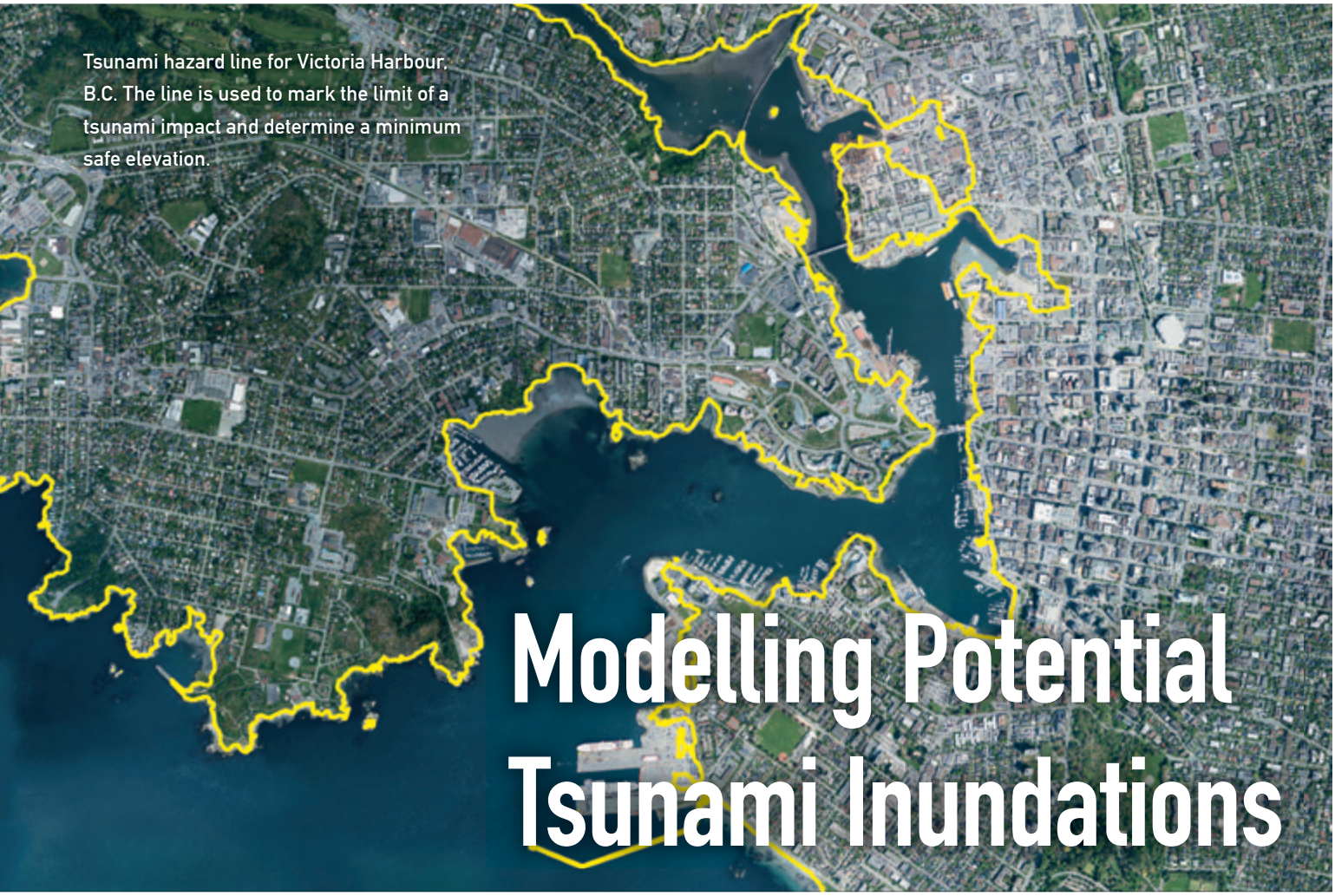
The planting of native vegetation and other features improved the aquatic and terrestrial habitat to benefit a variety of birds, fish and other wildlife. A sub-contractor specializing in ecological restoration plantings was retained and over 23,000 trees were planted around the basin. The additional trees will create a large forested backdrop in the next few years, which will assist in the ecological recovery.

The construction cost was $18 million. Since the cost of dredging the entire basin to restore it had been estimated at $34 million, the city saved approximately $17 million.

The city partnered with the federal and provincial governments to provide funding for the project, which was completed in 2012, on schedule and on budget. It has transformed the basin into a healthy and diverse Great Lakes coastal wetland which will also increase the aesthetic appeal of the Hamilton Waterfront. Furthermore, the project will assist in delisting Hamilton Harbour as an Area of Concern for the Great Lakes Water Quality Agreement. ■

Mark Bassingthwaite, P.Eng., is a water resources engineer with Cole Engineering Group, Markham, Ont. John Helka, C.E.T., is senior project manager, Hamilton Water, Public Works Department, City of Hamilton.

OWNER/CLIENT: City of Hamilton
PRIME CONSULTANT: Cole Engineering Group (environmental assessment, design, tender and contract administration/inspection)
SUBCONSULTANTS: W.F. Baird and Associates (coastal engineers); Terraprobe (geotechnical engineers); SLR Consulting (ecologists); AECOM (landscape architect)
CONTRACTOR: Metric Contracting Services



Tsunami hazard line for Victoria Harbour, B.C. The line is used to mark the limit of a tsunami impact and determine a minimum safe elevation.

Modelling Potential Tsunami Inundations

Images courtesy of AECOM

Computer models have helped to predict the impacts of a 9.0 magnitude earthquake-generated tsunami along the coastline of the Capital Regional District in Vancouver Island.

By Mike Brady, P.Eng., AECOM

The last major earthquake and tsunami off Vancouver Island is estimated to have occurred on January 26, 1700. We know this because of evidence from the study of tree rings in the forests of the Pacific Northwest, contemporary written records of a tsunami hitting Japan, and through the oral traditions of the local First Nations peoples. What we don't know, however, is how long it will be until the next one.

The Capital Regional District (CRD), which represents 13 municipalities on the southern end of Vancouver Island including the City of Victoria, recognized the need to improve its earthquake and tsunami emergency preparation, planning, evacuation and awareness programs. CRD's jurisdiction covers more than 1,000 kilometres of coastline and has more than 350,000 residents.

Knowing how to respond to the next "big one" begins with first understanding its potential impact. So to improve the effectiveness of its preparedness and response plans, CRD commissioned AECOM and Dr. K.F. Cheung, a leading global expert in tsunami modelling and computation, to model and develop a report based on the impact of a 9.0 magnitude earthquake-generated tsunami across its jurisdiction.

By delivering a more detailed and accurate model of a tsunami impact than was previously available, AECOM's and Dr. Cheung's work has, according to CRD's Planning and Protection Services Committee, provided "an important planning tool as we improve emergency preparedness and coordination across the region."

Digital elevation model from multiple sources

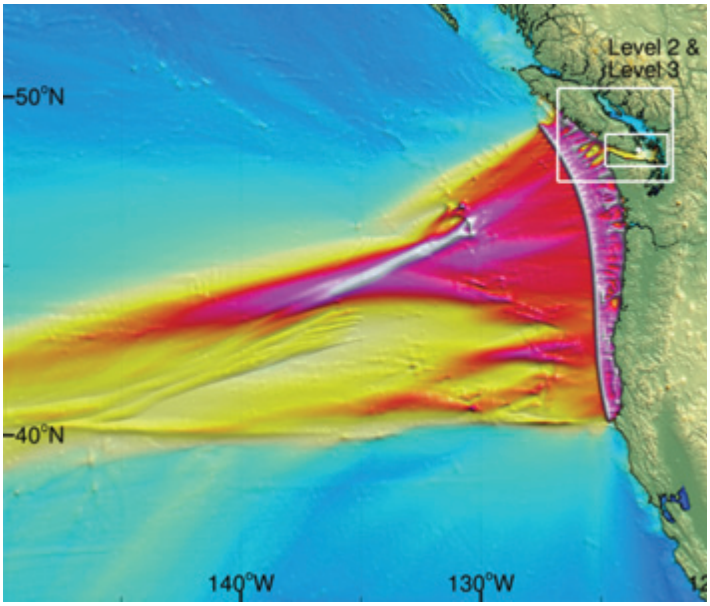
The source of the threat is the Cascadia subduction zone (CSZ), part of which is located approximately 100 kilometres west of Vancouver Island. Experts have estimated the CSZ has caused at least seven major earthquakes, including the one in 1700, over the last 3,500 years.

While experts can offer various predictions on the time and

strength of the next event, if Japan's Tohoku earthquake and tsunami in 2011 are anything to go by, the impact on infrastructure and populations of urban areas could be significant.

For the CRD's hypothetical earthquake and its impact, topographic (land) and bathymetric (sea-floor) information was collected to accurately model the propagation of the tsunami.

Understanding how the area's natural features would influence the tsunami was important. One particular challenge of this effort was working with the sheer size and scope of the study area. Along with CRD's coastline, additional areas farther south in the United States, including the Olympic Peninsula, the San Juan Islands and portions of Puget Sound, were included. This process involved compiling data from multiple original sources (sometimes overlapping), which had varying accuracies, resolutions and reliabilities. These differences were identified and resolved by preparing a complete and seamless digital elevation model of the area.

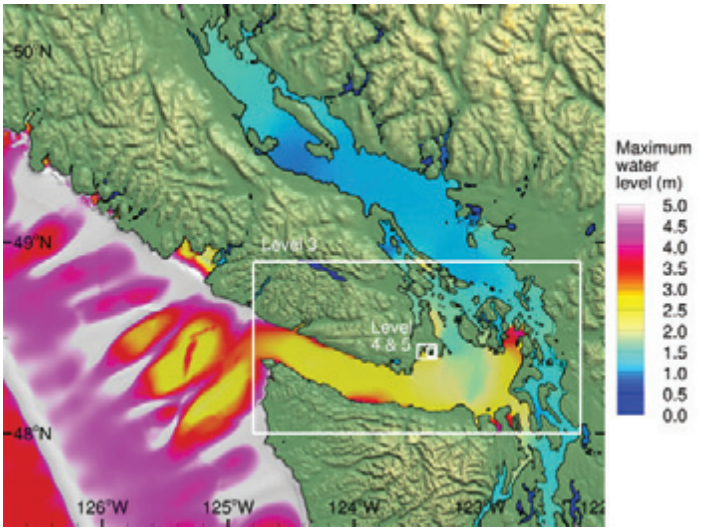


Model of tsunami hitting the Capital Regional District on Vancouver Island, B.C. The model simulated a period of approximately eight hours after the earthquake.

Wave propagation modelling

Using the digital elevation model, a series of five nested grids was created to represent specific regions within the study area. These regional grids, which ranged in size from the North Pacific Ocean to Victoria Harbour, contained the collected topographic and bathymetric data. The grids were then fed into a tsunami modelling software called NEOWAVE.

Developed by Dr. Cheung and his team at the University of Hawaii, NEOWAVE is a depth-integrated, non-hydrostatic model for wave propagation, transformation, breaking and run-up. The smaller, more detailed grids allowed various landforms such as islands, points



NEOWAVE model of the maximum water level of the scenario's tsunami.

and embayments to have a greater influence on wave oscillations, water levels and inundation run-ups.

NEOWAVE simulated a period of approximately eight hours after the onset of the earthquake for each of the grids. It provided values for maximum water level, maximum drawdown of water, maximum water flow speed, and the time to tsunami arrival and time to maximum water level along the entire CRD coastline.

The modelling predictions generated by NEOWAVE resulted in a revised and significantly more accurate tsunami hazard line. The line is used to mark the limit of a tsunami impact and determine a minimum safe elevation.

CRD's existing tsunami hazard line, devised in 2004, was based on limited coastline data, but with this study's updated and complete data a continuous tsunami hazard line was created, varying from six metres on the exposed western coast to three metres along the sheltered eastern coast. (In comparison, the maximum water level for the Tohoku tsunami was estimated at 40 metres.)

The study's results have been used to guide CRD's emergency preparedness plans and public outreach and information programs. The modelling data was also used to update CRD's GIS mapping information, which makes it easier for policymakers, municipal officials and residents to understand better the warning signs and what to do. As a result they will be better prepared to survive and address emergency events. ■

OWNER-CLIENT: Capital Region District
PRIME CONSULTANT: AECOM, Victoria, B.C. (Mike Brady, P.Eng.)
CONSULTANT: Applied Research International (Dr. K.F. Cheung)

Apply the Intergenerational Perspective

Commitment will be required to change the tendency of the buyers of infrastructure projects to focus on short term, local, unilateral procurement criteria.

Peter Halsall, MASc, PEng, FCAE
CANADIAN URBAN INSTITUTE

I would like to propose "intergenerational respect" as a good way to think about sustainability. To paraphrase a popular adage about being prepared to have anything you do show up on the front page of the paper, we should live our lives so that those in following generations see our actions as good. This is certainly aspirational and worth thinking about professionally while chasing that next project proposal, budget or deadline.

This challenge is especially relevant to the engineering profession. Engineered infrastructure is something passed on from generation to generation. It shelters, moves, supplies and fuels the future operation of our society. The decisions made by engineers and engineering enterprises define how well that infrastructure performs now and usually for generations. Even if not explicitly stated at the outset, these decisions will ultimately be evaluated across financial, social and environmental impacts over time. Projects need to prove that they will deliver returns that are respected by future generations as "investments" rather than just being financial "expenditures," burdened with debt and unfunded operating costs.

In the light of new understanding and metrics, it has become clear that some engineering decisions have created larger and longer-term problems than the immediate ones they were intended to solve.

At the global level, exponential population growth means unprecedented global demand for the services provided by infrastructure. This increasing demand means that every practice will be copied more times in more locations. This makes each decision more impactful, good or bad.

Identify and apply best practices

Einstein observed that we can't solve problems by using the same kind of thinking we used when we created them. The thinking applied to infrastructure design, maintenance and renewal needs to progress at a rate more like the thinking applied to the automotive, medical or retail sectors if the next generations are going to respect our decisions. To attract the appropriate share of the limited funding supply, we need to demonstrate that best practices are being identified and applied at an appropriate rate.

McKinsey, a global management consulting firm, has done research on global infrastructure practices to identify opportunities to reduce the overall cost for delivering infrastructure. Its analysts identified five key changes to current processes that they predict would achieve equal or better outcomes at 40% less cost than current processes (see www.McKinsey.com/insights and search for infrastructure productivity). They are not proposing new technology or practices, but rather just the application of good practices. I wonder if engineering companies should be concerned that McKinsey, an organization that does not design, maintain or renew infrastructure, seized the opportunity to define necessary changes to the infrastructure delivery process?

In the building industry, significant change has been achieved in design and operation by creating rating tools and measuring performance outcomes against targets. Technology has made it increasingly practical to track and communicate performance against benchmarks. The infrastructure industry has been slow to adopt these tools and capabilities.

If future generations are to thank us for our work, the consulting engineering industry must change and muster its collective creativity and initiative. Is there too much inertia within the industry to support true leadership? What responsibility do engineering companies have for accepting bad procurement practices? How does the industry attract the leaders of tomorrow if real change is being led outside the industry?

People want to do good

Luckily, people in general, and engineers in particular, are wired to do good deeds. Once it is clear that there is a significant gap between current practice and "good", there is little doubt that change will occur. However, fully engaging this innate desire to "do good" requires "good" to be understood in an intergenerational and more global perspective. Commitment will be required to help change the tendency of the buyers of infrastructure projects to focus on short term, local, unilateral procurement criteria. Meeting the challenge will require better solutions and better communication.

Getting to better solutions will be achieved by sharing best practices more effectively. Investing in the research process of collecting, analyzing and communicating information is a relatively straightforward approach to finding better solutions. An approach we use at the Canadian Urban Institute (CUI) is to assemble partnerships of public and private sector organizations who can share in the costs and outcomes of this research to accel-

Photo: iStock

erate the change process beyond that which would be possible going it alone.

Better solutions will also be driven by creating industry-wide benchmarks for evaluating performance in terms of economic, social and environment impact over time. By participating in creating benchmarks and setting change targets, the engineering community can demonstrate clear leadership. There are already initiatives underway that demonstrate this.

The Envision infrastructure tool in the U.S. (www.sustainableinfrastructure.org/rating) expands on the rating tools for buildings to create a framework for driving change through benchmarking and communication. This initiative received philanthropic funding and leadership from within the engineering community to engage the public sector clients.

Infrastructure Report Card continues

In Canada, the Canadian Infrastructure Report Card was developed through the leadership of four organizations comprising the Canadian Society for Civil Engineering, Canadian Construction Association, Canadian Public Works Association and the Federation of Canadian Municipalities. They convened 20 industry groups to advise on the process so that the outcomes were a broad consensus rather an opinion from any one perspective. The first Report Card was issued in 2012 (see www.canadainfrastructure.ca). It identified a wide variation in conditions of infrastructure, a significant funding shortfall, and significant differences between municipalities across the country in their knowledge of and ability to report on the condition of their infrastructure assets. The Report Card is intended to be used by stakeholders to drive positive change in national infrastructure funding and delivery.

CUI has been tasked with managing the next iterations of the Infrastructure Report Card. As Canada's applied urban policy institute, the work fits our mission: build wisdom to inspire leadership for healthy urban development. We will be reviewing best practices; updating the survey to consider new asset classes, including bridges, transit and sports and recreation facilities; incorporating a section on asset management; supporting respondents; collating and analyzing responses; and drafting the report for finalization by the committee. CSCE's leadership role on this project demonstrates its commitment to creating an infrastructure platform that will serve the country's future well.

In summary, improving how the impacts of civil engineering work are measured and communicated is a good start to increasing the sustainability of our infrastructure. This information needs to be made accessible to the average person and politician, but also inspiring to the really engaged stakeholders. Measurement tools already exist to make the performance more transparent. Engaging the positive spirit of engineers to make things better will accelerate the change for the benefit of current and future generations. ■

Lessons in Flood Management

21st Canadian Hydrotechnical Conference: Recent Flood Management Lessons in Canada

Kerry Mazurek, Ph.D., P.Eng.

From May 14-17, 2013, hydrotechnical engineers from across Canada gathered for the Canadian Hydrotechnical Conference in Banff, Alta. This was the bi-annual conference sponsored by CSCE's Hydrotechnical Division. The conference covers the broad areas of practice in hydrotechnical engineering and papers were presented from both research and practice in sessions on stream geomorphology and processes, flooding, turbulent jets and hydraulic jumps, hydraulic structures, ecohydraulics, sediment transport and erosion, modelling for hydroelectric projects, water management, computational fluid dynamics, bridge hydraulics and scour, impacts of climate change, environmental hydraulics, municipal engineering and coastal engineering. There were 67 papers presented, with the proceedings soon to be available for purchase from CSCE.

For this 21st conference, the conference chair, Michael Bender of Golder Associates Ltd. in Calgary, brought together six keynote speakers with experience in flood management from across the country. These speakers included Mike Feduk from the B.C. Ministry of Highways and Infrastructure along with Bill Cheung of McElhanney Consulting Services and Des Goold of Northwest Hydraulic Consultants to talk about the 2011 floods in B.C.; Terrance Larazus and Evan Friesenham of Alberta Environment and Sustainable Resource Development to talk of the flooding experienced in 2010 in southern Alberta; Twyla Hutchison of the City of Calgary Water Services to discuss the city's flood preparedness; Doug Johnson of the Saskatchewan Water Security Agency to discuss the damage and issues with flooding seen in 2011 in southern Saskatchewan; Steve Topping of Manitoba Infrastructure and Transportation discussing Manitoba's actions and decision-making when trying to handle the same 2011 flood; and Slobodan Simonovic of the University of Western Ontario, who discussed his state-of-the-art modelling work.

Ross Phillips, now a Junior Water Resources at Golder Associates, related his very direct and challenging experiences with waters across Canada. He described his cross-country canoe trip in a presentation at the conference banquet.

In the article that follows, Christa Bedwin of Golder Associates relates both the atmosphere of the event and some key observations taken from these speakers.

I acted as technical chair of the conference. In attending the keynote speeches and reviewing the papers submitted to the conference, there were two issues that were pronounced. First, there is a need to push all levels of government to better understand that for water-related infrastructure to be better designed, improved data collection is needed (e.g. more streamflow gauging). The lack of data appears to be even more serious with respect to water quality. The cost of not undertaking measurements needs to be considered, since uncertainty and failure of structures due to uncertainty also costs. Secondly, there is a need for better understanding by the public of the work that hydrotehnical engineers do and its implications. Several attendees expressed concern that messages about government not allowing building in floodplains were going unheard. (This was just a few weeks before the flooding in Southern Alberta in 2013.)

The 22nd Canadian Hydrotechnical Conference will be held in Montreal in the summer of 2015. We look forward to seeing you at the event! ■

Kerry Mazurek is Associate Professor, Water Resources Engineering, Dept. of Civil and Geological Engineering, University of Saskatchewan.

Leçons sur la gestion des inondations

La 21e Conférence canadienne sur l'hydrotechnique : Leçons récentes sur la gestion des inondations au Canada

Kerry Mazurek, Ph.D., ing.

Du 14 au 17 mai 2013, des ingénieurs hydrotechniques de partout au Canada se sont rassemblés pour la Conférence canadienne sur l'hydrotechnique à Banff, Alb. C'était la conférence semestrielle financée par la division de l'hydrotechnique de la SCGC. La conférence couvre les vastes secteurs de la pratique du génie hydrotechnique. Des rapports ont été présentés par la recherche et la pratique lors de séances sur la géomorphologie des cours d'eau et des procédés, sur les inondations, les jets turbulents et les ressauts hydrauliques, les structures hydrauliques, les éco-hydrauliques, le transport de sédiments et l'érosion, la modélisation pour des projets hydrauliques, la gestion de l'eau, la dynamique des fluides numériques, l'hydraulique du pont et l'affouillement, les répercussions des changements climatiques, l'hydraulique de l'environnement, le génie municipal et le génie côtier. En tout, 67 rapports ont été présentés et on pourra bientôt acheter les comptes rendus de la SCGC.

Pour cette 21e conférence, le président de la conférence, Michael Bender, de Golder Associates Ltd. à Calgary, a réuni six principaux conférenciers des quatre coins du pays qui ont de l'expérience en ce qui concerne la gestion d'inondations. Ces conférenciers comprennent Mike Feduk, du ministère des Routes et de l'Infrastructure de la C.-B., ainsi que Bill Cheung, des services d'experts-conseils McElhanney, et Des Goold, de la société Northwest Hydraulics Consultants, pour parler des inondations de 2011 en C.-B. ; Terrance Larazus et Evan Friesenham, de l'Environnement et du Développement durable des ressources de l'Alberta, pour parler de l'inondation que le sud de l'Alberta a connu en 2010 ; Twyla Hutchison, du Service d'eau de la Ville de Calgary, pour discuter de l'état de préparation de la ville en cas d'inondation ; Doug Johnson, de l'Agence de sécurité de l'eau de la Saskatchewan, pour échanger sur les dommages et les problèmes d'inondations que l'on a vu dans le sud de la Saskatchewan en 2011 ; Steve Topping, de l'Infrastructure et des Transports du Manitoba, a discuté des mesures et des décisions prises par les dirigeants du Manitoba lorsqu'ils ont tenté de s'occuper de cette même inondation de 2011 ; et Slobodan Simonovic, de la University of Western Ontario, qui a parlé de son travail de modélisation de pointe. Ross Phillips, à présent spécialiste junior en eau chez Golder Associates, a fait part de ses expériences très directes et de ses défis avec les eaux à travers le Canada. Il décrit son voyage en canot à travers le pays lors d'une présentation au banquet de la conférence.

Dans l'article qui suit, Christa Bedwin, de Golder Associates, s'intéresse à la fois à l'ambiance de l'événement et à quelques observations clés tirées de ces conférenciers.

J'ai occupé la fonction de présidente technique de la conférence. En assistant aux discours clés et en révisant les comptes rendus soumis lors de la conférence, deux questions ont été soulevées. Premièrement, il est essentiel de pousser tous les niveaux de gouvernement afin de mieux comprendre que pour que les infrastructures liées à l'eau soient mieux conçues, l'amélioration de la collecte de données est nécessaire (p. ex. plus de débits jaugés). Le manque de données semble être encore plus grave en ce qui concerne la qualité de l'eau. Le coût de ne pas mettre en œuvre des mesures doit être pris en considération, car l'incertitude et les défaillances des structures en raison de l'incertitude engendrent aussi des coûts. Deuxièmement, il faut que le public ait une meilleure idée du travail que font les ingénieurs hydrotechniques et de ses répercussions. Plusieurs participants sont inquiets du fait que les messages du gouvernement stipulant qu'il n'est pas permis de construire dans les plaines inondables passent inaperçus. (Cela s'est produit seulement quelques semaines avant l'inondation dans le sud de l'Alberta en 2013.)

La 22e Conférence canadienne sur l'hydrotechnique se tiendra à Montréal l'été prochain. Nous avons hâte de vous retrouver à l'événement ! ■

Kerry Mazurek est professeure adjointe, génie des ressources en eau, Dép. de génie civil et géologique, Université de la Saskatchewan.

21st Canadian Hydrotechnical Conference: Modelling and Prediction

By Christa Bedwin, BEd, PChem

The rain poured down on folks arriving at the Banff Springs Hotel on May 14, 2013, for the Canadian Hydrotechnical Conference. The weather was fitting, as conference delegates were arriving to talk about recent extreme flood events in Canada, what we have learned from them, how we measure and model them, and how we can prepare for and manage them better in the future.

In addition to the technical presentations, six keynote speeches summarized some of the major issues that hydrotechnical engineers in Canada are facing with respect to predicting, managing, and mitigating the effects of flooding.

Why is it flooding more often? Or is it?

Canada has experienced a series of extreme floods in the past decade. Is it the result of global warming and climate change? Probably not, said several of the people who were asked at the beginning of the conference.

"I blame frequency analysis," said Marcel Chichak of AMEC. The floods aren't much worse than they ever were, he suggested, but the regulations are less cautious than they were in the past, and the impact of extreme floods is larger (at least in the dollar-measure of damage) due to construction on flood plains. Paving over wetlands means that there is less capacity for the land to hold extra water. And houses and other buildings in low areas mean that the financial costs are greater when the damage is done.

Extreme floods have happened in the past, as well. Perhaps the extreme nature of recent flood events is part of a natural cycle of climate change. Some people opined that the volume of water that is flowing through waterways hasn't changed much, but the precipitation is "more flashy", i.e., the normal flow is slower, and the flood events are more extreme.

Twyla Hutchison, hydrotechnical engineer with the City of Calgary, showed data going back before the turn of the century, which shows extreme floods for several years in a row before 1900. We had a dry century, she says, but people need to understand that the 2005 flood which so astonished Calgarians was only a 20-year event. She cautioned that we need to expect that much larger floods will come. (She certainly called that one correctly. One month later, 100,000 residents were displaced by flooding in Calgary and parts of southern Alberta).

Everybody wants waterfront property

Many a pioneer farm and ranch was built on a flood plain or valley bottom. Low-lying land is fertile, flat, and often lovely.

An example is this century ranch on Fur Thief Creek (Figure 1). It's likely that the original homesteader expected the creek to flood now and then, but considered it a worthwhile inconvenience in the cost-benefit trade-off for the lush land and easy access to water for livestock and agriculture.

It seems unlikely that any non-scientist would have expected the sheer volume of mud that came down the small Fur Thief Creek due to the long, soaking rain that B.C. experienced in 2011.

Landslides are worst when the rain comes down over a long period of time, soaking into the earth and destabilizing the soil. A fast rain might run over the top of land and into established streams and low areas, but a slow rain really digs deep.

How could a farmer have expected that? Most laypeople don't understand how small mountain watersheds work. Look at the Pine River right next door. Though it is a much larger volume of water, it didn't even touch the houses on its bank. From a layperson's viewpoint, that seems surprising.

But people these days who buy existing homes tend to assume that the people who built them properly thought through all the engineering issues. So they look at the kitchen conveniences, the colour of the deck

Figure 1: Aftermath of flooding in B.C. in 2011, showing Fur Thief Creek (left) and Pine River (right). Photo: Bill Cheung

Figure 2: Assiniboine River between Portage and Winnipeg, Man., during the flood in 2011.

boards, and the lovely waterfront view but they don't even dream of the hundred-year flood event that we haven't seen in a century. Blinded by the glitz of a new home, home buyers don't seem to assess the safety of a location on a flood plain, or further, the potential problems of digging a basement in that flood plain.

And they expect us to protect it

Homeowners also assume that municipalities allocate building permits based on sound engineering and reasonable caution. However, as you can see in this picture from the 2011 Manitoba floods, that is not always a safe or smart assumption (Figure 2). Home buyers, inspectors, and realtors should consider flood potential before making decisions to purchase or build.

Steve Topping, executive director of Manitoba Infrastructure and Transportation, in charge of the planning and mitigation for that 500-year flood, showed the audience an aerial photo and blew air out in a snort of disbelief (Figure 2). "We had been counting on this bend of the river as a reservoir to store some of the water," he said. "When the time came to use it, this was a total surprise. We had no idea that these houses were there." There had not been any communications from the municipal level about their planning decisions.

If people persist in building on flood plains, they should consider implementing sensible engineering and construction measures, as with the community building in a riverfront park in Regina cited by Doug Johnson of the Saskatchewan Water Security Agency. Though this building was underwater in the 2011 flood, Johnson said it wasn't a problem. The building was engineered and built with the assumptions that it would occasionally experience flooding up to the gunnels. There's no basement, and the main floor is concrete only. The electrical work is set up higher in the room.

Soon after the flood waters receded, Johnson said, the building was cleaned and functional again.

Development vs. planning

Charles Neill, a mentor to many of the engineers in the room and the man who started the hydrotechnical specialties conferences forty years ago, asked, "Is there legislation in place against building where flood damage is likely to occur?"

Terrence Lazarus of the Alberta ESRD said, "Effectively, no. Municipalities are in charge of development plans and by-laws." In some cases, he said, in theory, the prov-

21ST CANADIAN HYDROTECHNICAL CONFERENCE QUICK FACTS

- 170 delegates
- 67 conference papers
- 11 trade show exhibitors
- 6 keynote addresses
- 4 short courses
- 2 Hydrotechnical Award winners

Figure 3: Southern Alberta has reservoirs, dams and other tools to manage water. Photo: Terrence Lazarus

ince may be able to deny disaster money on the basis that the builder should have known better. In practice, however, he feels that the province still pays out a lot of flood disaster funds.

This problem was oft-discussed during the conference break times. Municipalities tend to be run by elected officials, with a naturally high turnover rate. Even when proper surveys and engineering studies are conducted, the memories of elected councils tend to be short. One city council will assess a flood plain and wisely decide to leave it as park land, but the next elected council sees fertile, empty land with a beautiful view and decides to cash in on it.

Irrigation districts are designed to make sustainable communities by providing irrigation systems for successful farming and flood protection.

Terrence Lazarus of the ESRD showed aerial photos of elegant, intricate patterns for controlling the flow of water through southern Alberta (Figure 3).

From Waterton, the Old Man River reservoir empties into the Belly River, which empties into the Milk River. There are in-stream reservoirs to handle high water levels, and off-stream reservoirs where flow is diverted and used for recreation and irrigation. There are dams, diversion headworks, canals, and drainage districts. Together, all these elements create a wonderful orchestrated symphony that ESRD can manage easily as water ebbs and flows.

When the reservoirs fill up, the dams are opened to let some flow out. When that doesn't provide enough room for extra capacity, there is a network of canals and spillways that usually works like a charm.

Most times, that is. But in 2010 there was more water than any of the models predicted. "We had descriptions like "there's a wall of water coming at my farm"," said Lazarus. "There wasn't much we could do in a situation like that."

Figure 4: Damage from the 2011 floods in B.C. Photo: Bill Cheung.

Figure 5: Damage from the 2011 floods in B.C. Photo: Bill Cheung

They just didn't know

Some of the most significant challenges that flood engineers face when the waters rise have to do with the structures that humans have built, sometimes long in the past. How could an engineer in 1920, for example, predict how extensive a flood would be 90 years later? There was no data to go on.

The floods in B.C in 2011 affected 200 roads and caused $70 million of damage to transportation systems. Many of the overpasses, bridges, and culverts that had served just fine for decades in areas where roads crossed flood paths were suddenly too small for the rush of water and debris, including full grown trees, that swept down the mountains (Figures 4 and 5).

Logs and bedload (dirt and rocks) came down the slopes and quickly created dam-like pileups. When the water couldn't get under a bridge (as often happened with older bridges that were supported in the middle with piers) or through a culvert, it gushed alongside the roads, in some cases carrying away a full lane and several hundred feet of cliff along with it (Figure 6).

British Columbia Ministry of Transportation engineer Mike Feduk brought in his colleagues Bill Cheung of McElhanney Consulting Services Ltd. and Des Goold of Northwest Hydraulic Consultants Ltd. to help organize the enormous task of getting the province's traffic flowing again.

As engineers Cheung and Goold point out, however, you can't really blame the people who installed the bridges and culverts in the first place. They didn't have any data on the water flows when they built the roads, apart from the small bit of anecdotal data they may have been able to collect.

Models meet practical considerations

The British Columbia recovery team relied heavily on data monitoring to prioritize tasks when they had 200 sites that needed repair in 2011. Obviously, it was a gargantuan task

KEYNOTE SPEAKERS SHARED FLOOD EXPERIENCES

BRITISH COLUMBIA: Representing government and the consulting sector, Mike Feduk, Bill Cheung, and Des Goold spoke about their challenges and methods in dealing with the 2011 floods in B.C. on the Peace River, south of Pine Pass. Two hundred roads were damaged, and on top of managing the water that was flowing out of control, the speakers had to find ways to get traffic flowing around the province again, and soon.

ALBERTA: Terrence Lazarus and Evan Friesenham from Alberta Environment and Sustainable Resource Development (ESRD) spoke of the challenges they faced when an elegant system of reservoirs, diversion canals, and dams overflowed in southern Alberta in 2010. Despite the exquisite engineering, the populace still managed to be dissatisfied when Nature showed her power and sent way too much water for the infrastructure to handle.

ALBERTA: More than a month before Calgary's catastrophic floods, Twyla Hutchison of the City of Calgary predicted that a much larger flood than anyone in living memory had seen was on the way. She explained the technical details of modelling and preparing for flooding in the city, which generally can happen just 9–12 hours after snow starts seriously melting or rain starts falling in the nearby mountains and foothills. It's not a lot of time to make a call on draining reservoirs and getting barriers in place, so advance preparation is key.

ONTARIO: Professor Slobodan Simonovic explained how he has used models not just to predict how flooding levels are likely to change with climate change, but also how he has convinced the municipal authorities in London, Ontario, to take his modelling and predictions seriously, and to base future planning on that mapping.

MANITOBA: Steve Topping of Manitoba Infrastructure and Transportation told attendees an exciting adventure tale, complete with many frightening photos, of the 100-plus days that he was constantly on-call and on the job to manage the floods that deluged Manitoba in 2011. It's truly Canadian flood planning, starting every year in the spring with ice breakers on the river upstream of Winnipeg, and constant monitoring and planning on the rivers as the ice melts. He presented useful information about his experience with various technologies including water tubes, rock-filled gabion cages, sand bags, earthen dams, ice breakers, and rip rap.

SASKATCHEWAN: Doug Johnson of the Saskatchewan Water Agency experienced the same 2011 flood that Topping had to deal with, though Saskatchewan's situation was not quite as severe. Johnson explained Saskatchewan's Emergency Flood Damage Repair Program and how that worked in the wake of the extensive damage in 2011.

COAST TO COAST BY CANOE: At the conference's closing dinner, hydrogeologist Ross Phillips described his 2010–2011 canoe journey from Canada's west coast to its east. He and a handful of compatriots paddled and portaged their way across the country, gaining an intimate knowledge of Canada's waterways (and floodways – they sailed directly over several fence lines in Manitoba, experiencing first-hand the biggest flood in memory in that province).

Figure 6: Logs and bedload quickly created dam-like pileups in B.C.'s 2011 floods. Photo: Bill Cheung

of triaging sites: Which sites had the highest traffic volume, so merited the quickest fixing? Where were the resources? What was the scope of fixing each site? Was damage continuing to occur? Decades of past data helped answer these questions and resulted in being able to make rapid decisions and repairs on the spot.

"It wasn't a job for inexperienced staff," said Cheung. Aside from the fact that there wasn't time in this situation to pull out a calculator, pencil, and paper, he noted that "it was really important to have experience of how materials behave in the field."

Models might call for the largest culvert allowable in a certain location. "Sometimes, though, if we got on the cell phone and found out that a slightly smaller one was available at the yard down the road, and we could get it immediately and get the road fixed and the traffic going and on to the next site, we made that call," said Cheung. In that large-scale emergency, it was all a balancing act.

Traffic, ongoing water flow, and finding the materials and labour to get the roads fixed made a complex multivariate analysis for the engineers on the ground. Without the experienced team's familiarity with the models and the incredible data available, including through Google Earth, it would have been a much slower and more inefficient job.

Figure 7: This shows the British Columbia recovery team's mapping effort for the 2011 disaster, with sites colour-coded according to priority. Image: Bill Cheung

Figure 7 shows the team's mapping effort for the disaster, with sites colour-coded according to priority.

Modelling doesn't always work, though. Steve Topping, as the head of Manitoba's flood team, experienced the worst flooding of any of the keynote speakers at the conference. Parts of Manitoba were at what the current models would have called 500-year flood level depths.

"Our teams did some fantastic jobs of building breakers around neighbourhoods that our models predicted would be inundated. They used gabion cages on top of a large earthen berm," he said. The elevations of the fortified berm were well above what the models suggested would be needed for a hundred-year flood.

However, the Souris, the Qu'Appelle, the Assiniboine, and the Red rivers all reached their peak flows about the same time that year. (Normally, they take turns, making the typical floods more manageable.) "We just watched the water come rolling right over top of the barriers we built," said Topping.

Communication

Talking about Alberta's situation, Terrance Lazarus had quite a bit to say about communication. In his role managing water in southern Alberta, he is often on the phone with farmers. They will call him to ask advice about rearranging their irrigation equipment as water levels rise or fall.

In the 2011 B.C. floods, communication was key as the province and its consultants worked to get traffic flowing again. However, in those mountain passes, there is often no cell signal or Internet access. It was tricky and time-consuming to organize all the reconstruction details.

In Saskatchewan and Manitoba, websites, television, radio, and the telephone were all crucial to communicating with the public to

Figure 8: Photos from Ross Phillips and companions taken during their 2010-2011 canoe trek across Canada.

make sure that those who had to evacuate, did. Communication is absolutely crucial to save lives.

Modern modelling triumphs: gathering data and flood preparation

"Flood management is a social issue, not an engineering problem," said Dr. Slobodan Simonovic. He was feeling a major sense of triumph at the 2013 conference, because after years of studying climate change and flood modelling, including dozens of models from around the world, he was able to convince the city of London, Ont., to take his calculations and flood mapping seriously enough to affect — and even change — their planning decisions.

Development was planned for an area of the university that Dr. Simonovic's flood modelling and mapping predicted would be troublesome. Through repeated, fervent mathematical explanations, he was finally able to convince planning authorities to take him seriously, and the zone has been declared a no-build area. "Not everyone was happy with me, I can tell you that," stated Simonovic.

"The take-home message I got from Dr. Simonovic's talk," said Michael Bender, conference organizer, "is that the 'hundred-year flood' is not the hundred-year flood. What we thought the hundred-year flood would be twenty years ago, is not what the hundred-year flood will be twenty years from now." Precipitation and temperature patterns have changed over time, and are continuing to change.

Dr. Simonovic's rigorous modelling work, gathering, calculating, and recalculating using models from other researchers all over the world and across time, is helping to prove this. Even if we discount whatever might be causing climate change, the fact is, things are changing. And if municipalities want to avoid escalating repair costs, their best option is to pay attention to the engineers who have studied the flood patterns.

The big flood makes great data

Despite the hardships, costs, and tragedies of floods, it has to be said that these people who spend their lives preparing for them speak of floods with almost glee.

Of course nobody is happy when property or lives are lost. But to people who spend every day trying to figure out where flood water will go when it inundates, purchasing disaster management equipment, and creating flood evacuation plans, there is great satisfaction in actually getting the opportunity to put those plans to the test.

"We got some great data from the 2005 (20-year level) flood to help us prepare for the next one. And we got aerial photos," said city engineer Twyla Hutchison. You can imagine the fun of comparing maps you've been pondering for years with the actual data of a photo.

But, as Ross Phillips told conference attendees, by the time he and his friends had canoed from Vancouver to New Brunswick, he needed to see the doctor about his rotting feet, and though it was cool to canoe right over top of fence lines in Manitoba, the extra water on the prairie sure made it hard to find a place to sleep (Figure 8). ■

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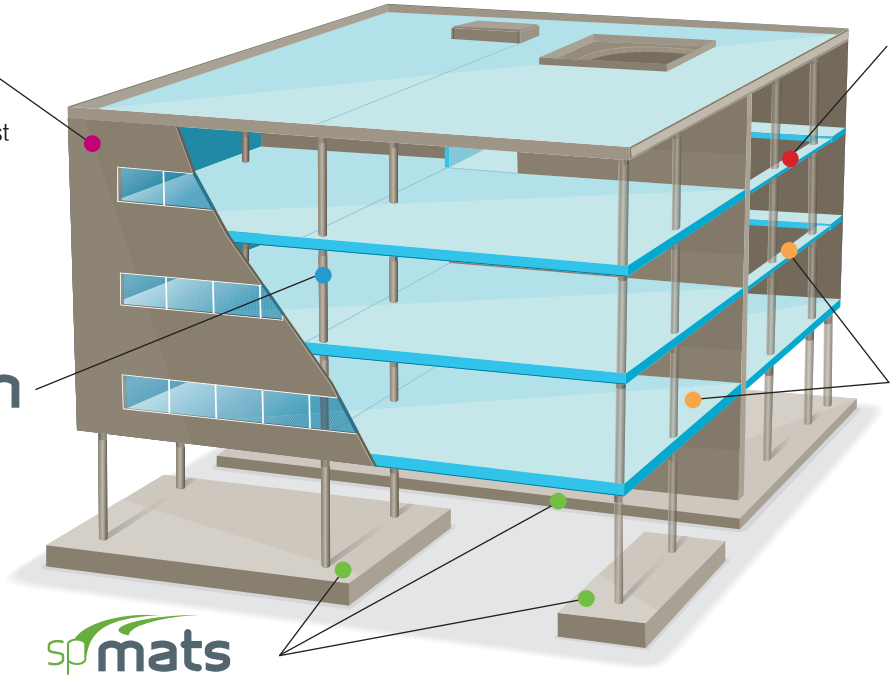

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