December 6, 2023 Project No. 21465813

Phil White, Quality Control
Thomas Cavanagh Construction Limited
9094 Cavanagh Road
Ashton, ON
K0A 1B0

MAXIMUM PREDICTED WATER TABLE REPORT, PROPOSED RENFREW GOLF PIT, HORTON TOWNSHIP, RENFREW COUNTY, ONTARIO

Dear Mr. White:

Thomas Cavanagh Construction Limited (Cavanagh) is applying for a Class 'A' licence for a Pit Below the Groundwater Table under the *Aggregate Resources Act* (ARA) for the proposed Renfrew Golf Pit located on Part Lots 23, 24 and 25, Concession 1, Horton Township, Renfrew County, Ontario (site). The area proposed to be licensed under the ARA is 40.5 hectares (ha) and the proposed extraction area is 31.6 ha. The proposed license area and extraction limit are shown on Figure 1. Based on the nature of the subsurface materials, the final pit floor elevation will vary from approximately 135 metres above sea level (mASL) to 154 mASL in the north/northwest portion of the site to 120 mASL in the southern portion of the site and will be primarily controlled by the elevation of the bedrock within the extraction area.

This report summarizes the results of the groundwater level monitoring completed on the site to fulfill the requirements of the Maximum Predicted Water Table Report as described in the Aggregate Resources Ontario: Technical Reports and Information Standards dated August 2020. The qualifications and experience of the report authors are presented in Attachment 1.

1.0 GROUNDWATER ELEVATIONS

Three monitoring wells (BH21-01, BH21-02 and BH21-04) were installed between June 16 and 17, 2021 to measure groundwater levels at the site. Groundwater levels were measured on a monthly basis by WSP Canada Inc. (WSP) staff at these monitoring wells as well as at two existing on-site monitoring wells (TW1 and TW5). The top of the piezometer at each monitoring well location was surveyed to a Geodetic datum in order to allow for calculation of the groundwater elevation based on the measured depth to groundwater. The locations of the monitoring wells included in the groundwater monitoring program are shown on Figure 1.

The available groundwater elevation data measured as part of the ongoing groundwater level monitoring program for the site are provided in Table 1 below.

Table 1: Groundwater Elevations Renfrew Golf Pit

Date	Groundwater Elevations (metres above sea level)				
	BH21-01	BH21-02	BH21-04	TW1	TW5
22-Jun-21	132.29	142.40	127.49	130.21	136.15
30-Jul-21	132.34	142.68	127.64	130.18	136.14
29-Aug-21	132.28	142.70	127.49	130.07	136.64
30-Sep-21	132.32	142.80	127.53	130.09	136.67
11-Oct-21	132.27	142.51	127.52	130.05	136.65
27-Nov-21	132.19	142.47	127.45	130.03	136.63
10-Dec-21	132.11	142.33	127.36	130.01	136.59
04-Jan-22	132.09	142.28	127.29	129.99	136.57
10-Feb-22	131.98	142.17	127.07	129.91	136.50
03-Mar-22	131.97	142.15	127.11	129.95	136.55
08-Apr-22	132.68	143.12	127.94	130.18	136.33
06-May-22	132.63	143.06	127.88	130.11	136.25
28-Jun-22	132.60	143.10	127.79	130.34	136.71
07-Jul-22	132.50	142.97	127.82	130.05	136.21
05-Aug-22	132.66	142.69	127.36	130.34	136.70
09-Sep-22	132.63	142.65	127.32	130.31	136.69
08-Oct-22	132.63	142.65	127.36	130.31	136.67
01-Nov-22	132.68	142.68	127.36	130.43	136.73
03-Dec-22	132.69	142.70	127.38	130.41	136.74
06-Jan-23	132.53	142.60	127.34	130.36	136.72
05-Feb-23	132.48	142.57	127.32	130.35	136.68
04-Mar-23	132.46	142.57	127.34	130.34	136.66

1.1 Discussion

As shown on Figure 2, the pre-development groundwater elevations (i.e., background conditions) in the vicinity of the site ranged from a low of 127.07 mASL at BH21-4 in March 2022 to a high of 143.12 mASL at BH21-2 in April 2022. Groundwater depths range from 2.6 metres below ground surface (mbgs; BH21-4) to 33.6 mbgs (TW-1) across the site. Table 2 provides a summary of the maximum, minimum and total variation in groundwater elevations at each monitoring well.

Table 2: Groundwater Elevation Summary

	Maximum Groundwater Elevation (metres asl)	Minimum Groundwater Elevation (metres asl)	Variation in Groundwater Elevations (metres)
BH21-01	132.69	131.97	0.72
BH21-02	143.12	142.15	1.05
BH21-04	127.94	127.07	0.87
TW-1	130.43	129.91	0.50
TW-5	136.74	136.14	0.60

Groundwater elevations in all monitoring wells are generally stable (i.e., vary by less than one metre) and display minor seasonal variations.

2.0 HORIZONTAL GROUNDWATER FLOW DIRECTION

Based on groundwater elevation data collected during the pre-development period, the general groundwater flow direction in the vicinity of the site is influenced by the topography of the site and seasonal water table fluctuations. Groundwater generally flows from northeast to southwest across the site towards Clubhouse Lake (see Figure 1).

3.0 MAXIMUM PREDICTED WATER TABLE

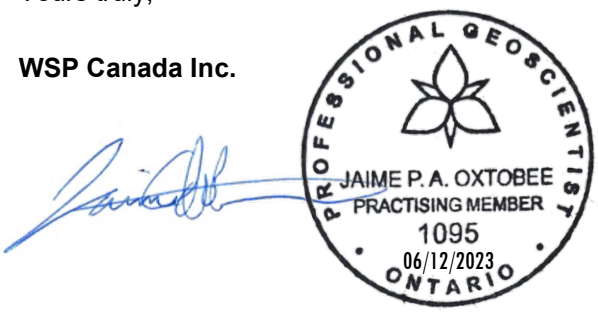
Based on the available groundwater elevation data, the maximum predicted water table within the overburden at the site is 143.12 mASL in the northeastern portion of the site (as measured at BH21-02). It is interpreted that the maximum water table is within the bedrock in the northern portion of the site and is at 150 masl (i.e., within the vicinity of TW-2). Based on the groundwater elevation data measured at BH21-04 located at the southern end of the site, the water table in the overburden slopes from northwest to south, and the maximum predicted water table on the southern end of the site is 127.94 mASL.

4.0 CLOSURE

If you have any questions, please do not hesitate to contact the undersigned.

Yours truly,

WSP Canada Inc.



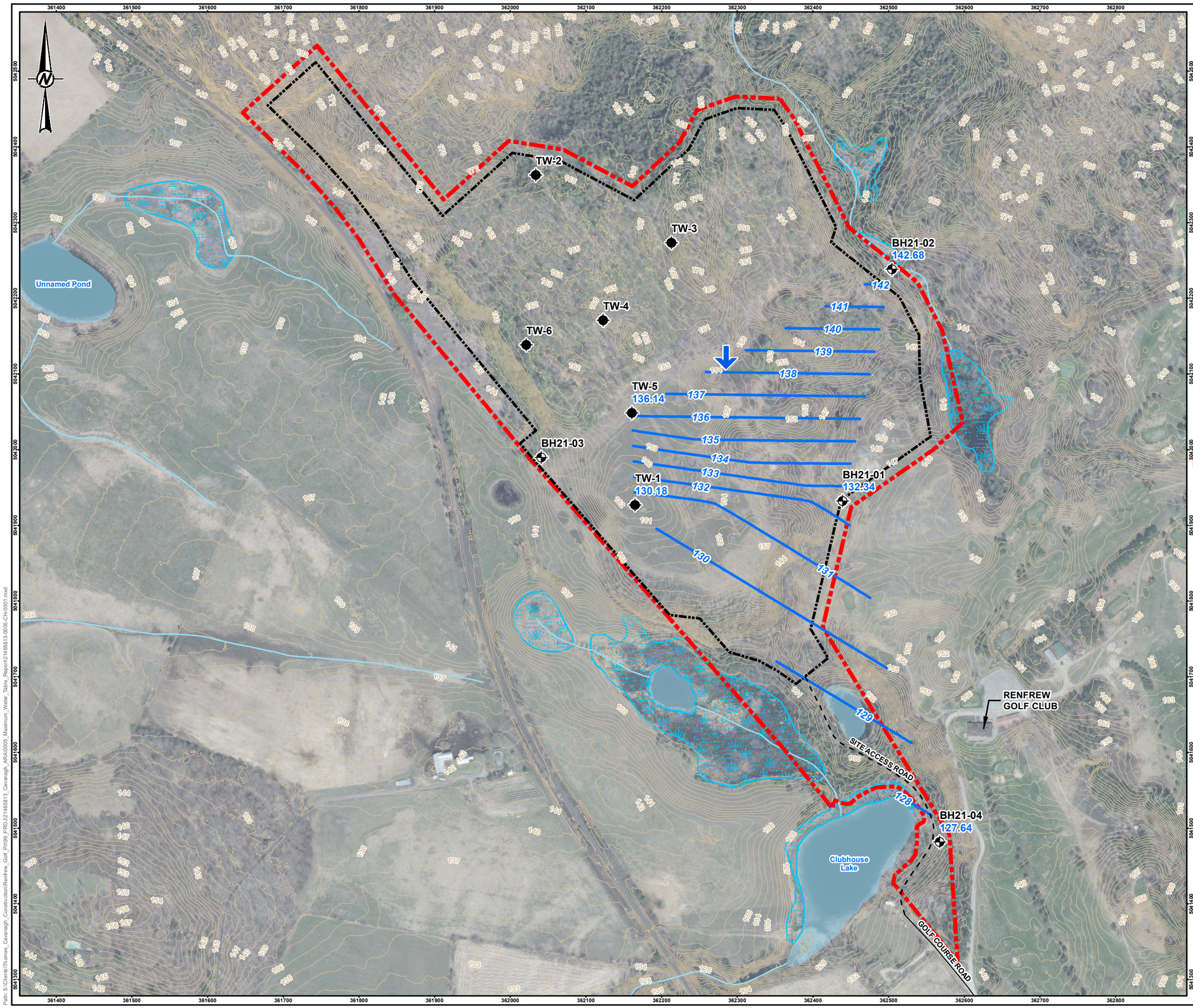
Jaime Oxtobee, M.Sc., P.Geo.
Senior Hydrogeologist

Kris Marentette, M.Sc., P.Geo.
Senior Hydrogeologist

JPAO/KAM/rk

Attachments: Figures 1 and 2
Attachment 1: Qualifications and Experience of Report Authors

https://golderassociates.sharepoint.com/sites/145731/project files/6 deliverables/max water table report/21465813-l-rev0-max wt report-renfrew golf pit_06-12-2023.docx



KEY MAP

SCALE 1:200,000

LEGEND

- APPROXIMATE BOREHOLE LOCATION
- APPROXIMATE BOREHOLE LOCATION BY OTHERS
- ROADWAY
- TOPOGRAPHIC CONTOUR, metres
- WATERCOURSE
- WATERBODY
- WETLAND
- PROPOSED EXTRACTION BOUNDARY
- PROPOSED LICENSE BOUNDARY
- 9999 GROUNDWATER ELEVATION, mASL (JULY 31, 2021)
- GROUNDWATER ELEVATION CONTOUR, mASL
- INTERPRETED GROUNDWATER FLOW DIRECTION

DRAFT

0 50 100 200
1:5,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2020
2. KEY MAP: © OPENSTREETMAP (AND) CONTRIBUTORS, CC-BY-SA
COUNTY OF RENFREW
3. BING IMAGERY SUPPLIED BY ESRI AND MICROSOFT © 2020 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS. IMAGERY DATE: 10/10/2016
4. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

CLIENT
THOMAS CAVANAGH CONSTRUCTION LIMITED

PROJECT
MAXIMUM PREDICTED WATER TABLE REPORT, RENFREW GOLF PIT, HORTON TOWNSHIP, ONTARIO

TITLE
SITE PLAN

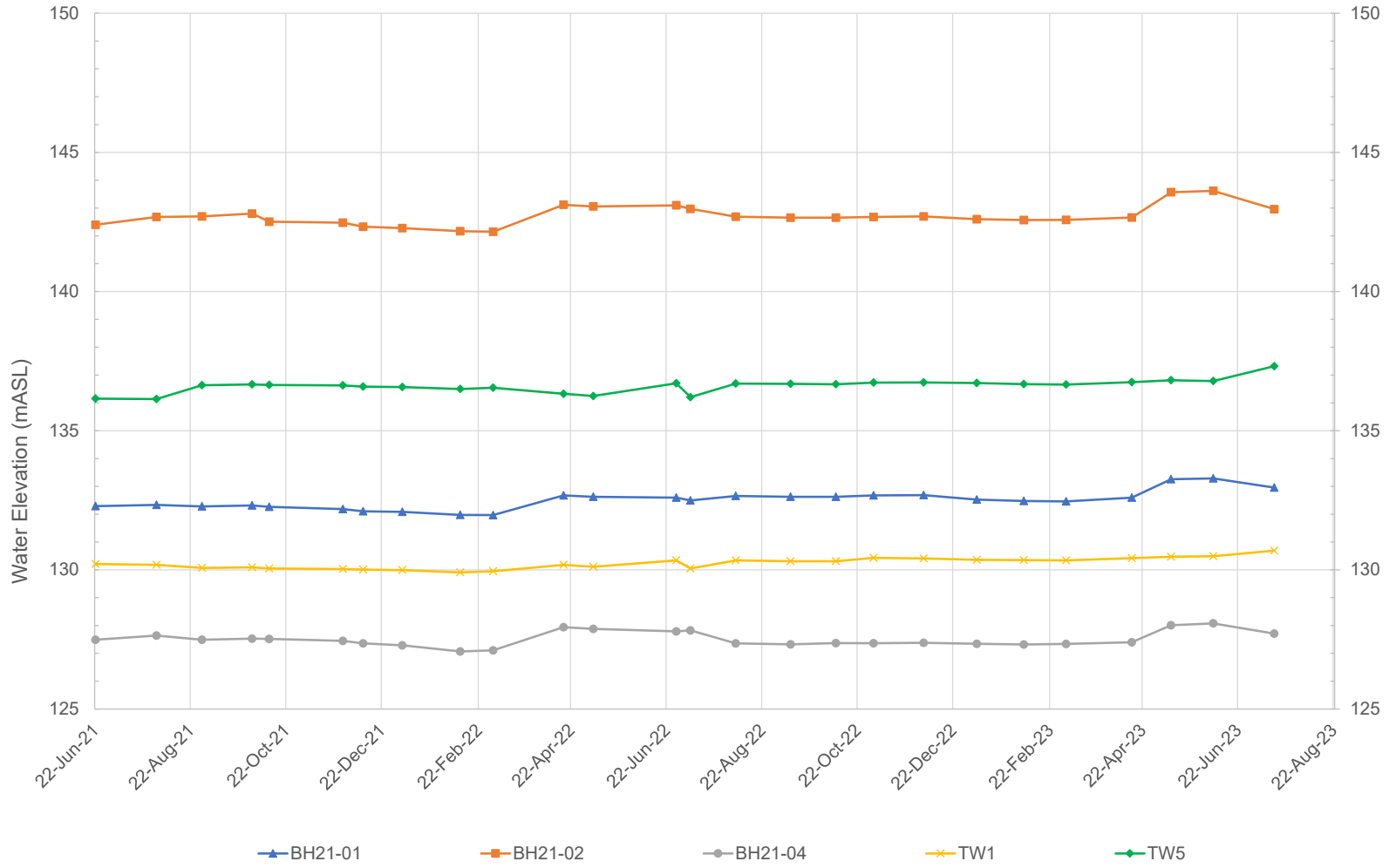
CONSULTANT
wsp

YYYY-MM-DD	2023-11-10
DESIGNED	LB
PREPARED	JEM/BR
REVIEWED	JPAO
APPROVED	KAM

PROJECT NO.	CONTROL	REV.	FIGURE
21465813	0005	A	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

Path: S:\Clients\Thomas_Cavanagh_Construction\Renfrew_Golf_Pit\6b_PRO\21465813_Cavanagh_ARA\0005_Maximum_Water_Table_Report\21465813-0005-CH-0001.mxd



CLIENT
THOMAS CAVANAGH CONSTRUCTION LIMITED

PROJECT
MAXIMUM WATER TABLE REPORT, RENFREW GOLF PIT, HORTON TOWNSHIP, ONTARIO

CONSULTANT
wsp

YYYY-MM-DD	2023/04/06
PREPARED	LEB
DESIGN	LEB
REVIEW	JPAO
APPROVED	JPAO

TITLE
GROUNDWATER ELEVATION DATA (JUNE 2021 TO MARCH 2023)

PROJECT No.	PHASE	Rev.	FIGURE
21465813			2

ATTACHMENT 1

Qualifications and Experience of Report Authors

Education

M.Sc. Civil Engineering: Hydrogeology
Queen's University
Kingston, Ontario, 2001

B.Sc. Environmental Science: Earth Sciences Stream, Honours
Brock University
St. Catharines, Ontario
1998

Certifications

Registered Professional Geoscientist Ontario

WSP Canada Inc. – Ottawa

Senior Hydrogeologist

Jaime Oxtobee has over 20 years of broad experience in the field of physical hydrogeology that includes hydrogeological impact assessments in support of the licensing of pits and quarries under the *Aggregate Resources Act*, water supply development and regional scale groundwater studies.

Employment History

Golder Associates Ltd./WSP Canada Inc. – Ottawa
Senior Hydrogeologist (2001 to Present)

Jaime is responsible for project management, technical analysis and reporting for a variety of hydrogeological and environmental projects. Jaime is also often responsible for senior technical review of hydrogeological investigations.

Projects have included groundwater resources studies; hydrogeological investigation programs in support of licensing/permitting pits and quarries and in support of Permit to Take Water applications for local construction dewatering projects, ready-mix concrete plants, golf courses and quarries; communal water supply investigations; wellhead protection studies; contaminated site investigations; and, providing senior review for landfill, pit and quarry monitoring reports.

Queen's University – Kingston, Ontario
Teaching Assistant (2000 to 2001)

Teaching assistant for university courses relating to groundwater flow and contaminant transport in porous media and fractured rock environments.

Phase IV Bedrock Remediation Program – Smithville, Ontario
Project Manager (1999)

Coordinated and conducted a groundwater/surface water interaction study downgradient from the PCB-contaminated site in Smithville, Ontario. The study involved detailed numerical modelling, as well as an extensive field program including stream surveys, stream gauging, construction and installation of mini-piezometers, seepage meters and weirs, fracture mapping, groundwater and surface water sampling.

SELECTED PROJECT EXPERIENCE – AGGREGATE INDUSTRY

Hydrogeological and Hydrological Assessments for Quarry Licensing
Township of Drummond-North Elmsley, Ontario, Canada

Golder (now WSP) carried out the necessary hydrogeological, hydrological ecological and archaeological studies to support an application under the *Aggregate Resource Act* for licensing the extension of an existing quarry. The application was for two new below water quarries on either side of an existing below water quarry. Jaime led the hydrogeological/hydrological assessment component of the project, and was responsible for coordinating the multi-disciplinary team. Jaime was responsible for the development and execution of the hydrogeology field program, development of the site conceptual model and completion of the hydrogeological impact assessment/reporting. Jaime also provided input to the integration of the findings from the multiple disciplines.

Hydrogeological Assessments for Pit Licensing Township of Lanark, Ontario, Canada

Golder (now WSP) carried out the necessary hydrogeological, ecological and archaeological studies to support an application under the *Aggregate Resource Act* for licensing a new pit above the water table. Jaime led the hydrogeological assessment component of the project and was responsible for coordinating the multi-disciplinary team. Jaime was responsible for the development and execution of the hydrogeology field program and preparing the required reporting.

Hydrogeological and Hydrological Assessments for Quarry Licensing
Ramara, Ontario, Canada

Golder (now WSP) carried out the necessary hydrogeological, hydrological and archaeological studies to support an application under the *Aggregate Resource Act* for licensing the extension of an existing quarry. The application was for one new below water quarry adjacent to an existing below water quarry. Jaime led the hydrogeological and hydrological assessment component of the project. Jaime was responsible for development and execution of the hydrogeology field program, development of the site conceptual model and completion of the hydrogeological impact assessment/reporting.

Hydrogeological Assessments for Pit Licensing
Township of Leeds and Thousand Islands, Ontario, Canada

Golder (now WSP) carried out the necessary hydrogeological studies to support an application under the *Aggregate Resource Act* for licensing a new pit below the water table. Jaime led the hydrogeological assessment component of the project. Jaime was responsible for the development and execution of the hydrogeology field program and completing the hydrogeological impact assessment/reporting.

Hydrogeological Assessment for Quarry Permitting
Township of Bomby

Golder (now WSP) carried out the necessary hydrogeological, ecological and archaeological studies to support an application under the *Aggregate Resource Act* for permitting a new quarry. The application was for a below water quarry located on Crown Land. Jaime led the hydrogeological assessment component of the project and was responsible for coordinating the multi-disciplinary team. Jaime was responsible for the development and execution of the hydrogeology field program, development of the site conceptual model and completion of the hydrogeological impact assessment/reporting. Jaime also provided input to the integration of the findings from the multiple disciplines.

Hydrogeological Assessment for Pit Permitting
District of Kenora, Ontario, Canada

Golder (now WSP) carried out the necessary hydrogeological, ecological and archaeological studies to support an application under the *Aggregate Resource Act* for permitting a new pit. The application was for a below water pit located on Crown Land. Jaime provided input to the hydrogeological assessment component of the project and was responsible for coordinating the multi-disciplinary team. Jaime was responsible for the development of the site conceptual model in the vicinity of the pit and completion of the hydrogeological impact
assessment/reporting. Jamie also provided input to the integration of the findings from the multiple disciplines.

Hydrogeological Assessment for Quarry Permitting
District of Kenora, Ontario, Canada

Golder (now WSP) carried out the necessary hydrogeological, ecological and archaeological studies to support an application under the *Aggregate Resource Act* for permitting a new quarry. The application was for a below water quarry located on Crown Land. Jaime provided input to the hydrogeological assessment component of the project and was responsible for coordinating the multi-disciplinary team. Jaime was responsible for the development of the site conceptual model in the vicinity of the quarry and completion of the hydrogeological impact assessment/reporting. Jamie also provided input to the integration of the findings from the multiple disciplines.

Hydrogeological and Hydrological Assessment for Quarry Licensing City of Kawartha Lakes, Ontario, Canada

Golder (now WSP) carried out the necessary hydrogeological, hydrological and ecological studies to support an application under the *Aggregate Resource Act* for licensing a new quarry. The application was for a below water quarry located adjacent to a provincially significant wetland. Jaime provided input to the hydrogeological assessment component of the project, which included the installation of over 80 monitoring intervals and the completing of three pumping tests. Jaime was involved in data analysis and the completion of the impact assessment and reporting for the hydrogeology assessment.

TRAINING

Beyond Data: Conceptual Site Models in Environmental Site Assessments
Golder U, 2011

Critical Thinking in Aquifer Test Interpretation
Golder U, 2011

HydroBench (Proprietary Aquifer Test Interpretation Software)
Golder U, 2011

Project Management
Golder U, 2007

Short course: Environmental Isotopes in Groundwater Resource and Contaminant Hydrogeology
2007

Short course: Hydrogeology of Fractured Rock – Characterization, Monitoring, Assessment and Remediation
2002

PROFESSIONAL AFFILIATIONS

Member, Association of Professional Geoscientist of Ontario Member,

Ottawa Geotechnical Group

PUBLICATIONS

Conference Proceedings

West, A.L., K.A. Marentette and J.P.A. Oxtobee. 2009. *Quantifying Cumulative Effects of Multiple Rock Quarries on Aquifers*. 2009 Joint Assembly, May. Toronto, Canada.

Novakowski, K.S., P.A. Lapcivic, J.P.A. Oxtobee and L. Zanini. 2000. *Groundwater Flow in the Lockport Formation Underlying the Smithville Ontario Area*. 1st IAH-CNC and CGS Groundwater Specialty Conference, October. Montreal, Canada.

Oxtobee, J.P.A. and K.S. Novakowski. 2001. *A Study of groundwater/Surface Water Interaction in a Fractured Bedrock Environment*. Fractured Rock 2001 Conference, March. Toronto, Canada.

Journal Articles

Oxtobee, J.P.A. and K.S. Novakowski. Groundwater/Surface Water Interaction in a Fractured Rock Aquifer. *Journal of Ground Water*, 41(5) (2003), 667-681.

Oxtobee, J.P.A. and K.S. Novakowski. A Field Investigation of Groundwater/Surface Water Interaction in a Fractured Bedrock Environment. *Journal of Hydrology*, 269 (2002), 169-193.

Other

Oxtobee, J.P.A., 1998. Environmental Assessment of Grapeview, Francis and Richardson's Creeks, St. Catharines, Ontario. B.Sc. Thesis, Brock University, Earth Sciences Department pp.119.

Education

M.Sc. Geology, University of Windsor, Windsor, Ontario, 1988

B.Sc. Geology, Honours, University of Windsor, Windsor, Ontario, 1986

Certifications

Registered Professional Geoscientist, 2002

Languages

English – Fluent

WSP Canada Inc. – Ottawa, Ontario

Employment History

Career Summary

Principal/Senior Hydrogeologist (1997 to Present)

Mr. Kris A. Marentette, M.Sc., P.Geo., is a Principal and Senior Hydrogeologist in the Ottawa office of WSP Canada Inc. (previously Golder Associates), and has 20 years of broad experience in the fields of water supply development, physical hydrogeological characterization studies, regional scale groundwater studies, waste management, contaminated sites assessment /remediation, aggregate resource evaluations and the licensing and permitting of quarry development and expansion projects. Kris is responsible for business development, project management, and senior technical review of hydrogeology, quarry and sand and gravel pit development and expansion, golf course irrigation, site assessment and remediation projects, and waste facility siting, design, operation and environmental compliance monitoring assignments from the Ottawa office.

From 1997 to 2001, Mr. Marentette was Project Manager for Golder Associates' component of one of the largest Environmental Site Assessment (ESA) contracts in Canada which involved the assessment of over 780 sites which were being transferred from Transport Canada to NAV CANADA. Golder Associates completed Phase I ESA of approximately 400 sites of which about 130 sites required Phase II ESA activities. The sites ranged from small antennas towers to large, complex international airports. Project involved considerable logistic planning to mobilize personnel across the country, familiarity with federal and provincial soil and groundwater remediation criteria, development of site-specific remediation options (including permafrost sites), and ongoing interaction with consultant team and Transport Canada/NAV CANADA.

Kris has also been involved as principal consultant or senior reviewer for over 100 Phase I ESAs and over 50 Phase II ESAs completed by the Ottawa office. These projects included industrial, commercial, and residential properties ranging from former coal gasification plants to microcircuit manufacturers. Projects have included an evaluation of permitting requirements related to waste water discharges and air emissions as well as designated substances surveys. Kris has also conducted subsurface investigations at numerous bulk storage, fuel dispensing and pipeline sites; development of groundwater and soil vapour monitoring programs; design and permitting of remedial measures including product recovery and excavation of contaminated soil; supervision and verification of site remediation.

Kris has provided environmental consultation services to many wood product manufacturers in Renfrew County and Lanark County in the context of assessing environmental impacts of wood waste storage and lumber yard and sawmill operations on the natural environment. While working for the wood product manufacturers, Kris established a consistent approach to site investigations and set a focused list of leachate indicator parameters for groundwater and surface water assessments which has met with Ontario Ministry of Environment (MOE) approval.

Kris has been the Golder Associates Project Manager on a number of Ministry of Natural Resources quarry and pit licensing projects for both new operations and expansions to existing operations and has extensive experience in managing these complex, multi-disciplinary projects. Participated in comprehensive aggregate resource evaluations of Paleozoic sedimentary sequences (limestone) and Precambrian marble deposits at quarries in eastern Ottawa for the purpose of developing preferred site development plans to maximize the production of high quality aggregate products. The aggregate resource evaluations have typically included borehole coring, geological core logging, geophysical evaluations and comprehensive laboratory testing programs. Participated in other quarry-related projects associated with the Ministry of Environment Permit to Take Water Program and the issuance of Certificates of Approval (Industrial Sewage Works) under Section 53 of the Ontario Water Resources Act as well as studies undertaken for the purpose of complying with requirements under the Aggregate Resources Act. In the case of the Permit to Take Water approvals and industrial sewage works applications under Sections 34 and 53 of the Ontario Water Resources Act, Kris has consulted with, and interacted extensively, with MOE personnel in both the local District and Regional offices and with key personnel within the Environmental Assessment and Approvals Branch of the MOE in Toronto. Kris was the Project Manager assigned to assist the City of Ottawa in a comprehensive project focused on assisting City staff in understanding the intricate details of the MOE's Permit to Take Water Program. Kris is also well known to the local conservation authorities (Rideau Valley Conservation Authority, Mississippi Valley Conservation Authority and South Nation Conservation) as a result of involvement in water supply and quarry-related projects in the Ottawa area and has interacted with the Ontario Stone, Sand & Gravel Association on various issues related to the aggregate industry (e.g., addressing the MOE concern associated with the potential presence of dinitrotoluene in quarry discharge water, source water protection, etc.). Kris has appeared as an expert witness before the Ontario Municipal Board on quarry-related applications.

Golder Associates Ltd. – Ottawa, Ontario
Hydrogeologist/Senior Hydrogeologist (1988 to 1997)

Responsible for business development and the initiation, implementation and direction of hydrogeological investigations from the Ottawa office. Projects have included test well drilling programs for private services developments; subsurface investigations as related to the installation of subsurface sewage disposal systems; communal water supply investigations; and, regional hydrogeological studies to assist in establishing planning policies for future private services developments and to develop standards for water well construction.

Project manager for numerous hydrogeological studies of existing/proposed landfill sites including the assessment of impacts on water resources and developing and implementing monitoring programs and contingency and remedial action plans. Participated in hydrogeological aspects of waste management studies, preparation and submission of documentation to obtain Emergency Certificates of Approval and Site Interim Expansions of landfill sites under both the Environmental Assessment Act and Environmental Protection Act. Projects have included preparation of landfill site development and

operations plans including evaluations of landfill final cover design options. Expert testimony at hearings before the Environmental Assessment Board.

Also responsible for investigation, design and implementation of soil and groundwater remediation programs at hydrocarbons, metals, solvents, and PAH contaminated sites including the risk assessment approach to site management. Projects have included third party peer review of site remediation programs.

Conducted hydrogeological assessments of quarry developments/expansions and pre-acquisition environmental site audits.

PROJECT EXPERIENCE – WATER RESOURCES MANAGEMENT

Village of Winchester Water Supply Project
Ontario, Canada

Project Hydrogeologist for the Village of Winchester Water Supply Expansion Project. This project included the preliminary evaluation of potential target aquifers followed by a comprehensive test well investigation and aquifer characterization program. Participated in the development of a comprehensive Water Resources Protection Strategy.

Rural Subdivision Development
Ontario, Canada

Supervised test well drilling programs for numerous residential, industrial and commercial private services subdivision developments including evaluation and selection of target aquifers, development of site specific well construction requirements, analysis and interpretation of physical hydrogeological data and groundwater chemical data and preparation and submission of detailed hydrogeological reports. Responsible for conducting many subsurface investigations as related to the installation of small and large subsurface septic sewage disposal systems for private services developments including projects subject to the Ontario Ministry of the Environment Reasonable Use Guideline B-7.

Communal / Commercial Water Supply Evaluation
Ontario, Canada

Project Manager for communal water supply investigations for non-profit housing developments in Elgin and Clayton, Ontario and time share condominium development in Cobden, Ontario; responsible for groundwater resource evaluation with respect to project specific water supply requirements. Conducted hydrogeological assessment of the Evergreen Spring Water Site in the Township of Sebastopol, Ontario for Cott Beverages Ltd.; assessment included characterization of geological setting, quantity, quality and age of spring water and evaluation of potential sources of contamination in the vicinity of the spring.

Township of Kingston Planning Study
Ontario

Conducted hydrogeological study and general terrain analysis of rural Kingston Township to characterize the present status of the Township's groundwater resources to assist in establishing planning policies for locating new developments on private services and to provide standards for water well construction within the Municipality.

Land Development Evaluation
Ontario

Conducted a preliminary hydrogeological and terrain evaluation of a 400 acre parcel of land south of the Ottawa International Airport with respect to the feasibility of developing the site as a rural residential subdivision on private services.

PROJECT EXPERIENCE – WASTE MANAGEMENT

Township of Clarence Landfill Buchanan Landfill
Bourget, Ontario/Chalk River, Ontario, Canada

Preparation and submission of documentation to the Ontario Ministry of the Environment to obtain an exemption from the Environmental Assessment Act and approval under the Environmental Protection Act for interim expansions of the Township of Clarence Landfill and Buchanan Landfill. Project involved detailed hydrogeological and geophysical site characterization studies, development of mitigation measures to address existing off-site impacts on groundwater and surface water resources and participation in the preparation of the site development and operations reports, trigger mechanisms, and contingency measures, site closure plans, public participation/presentations, document preparation and representation to regulatory agencies. Expert testimony at the Environmental Assessment Board hearings resulting in successful applications.

Dodge Landfill
Espanola, Ontario, Canada

Project Hydrogeologist responsible for hydrogeological studies of existing landfill in support of an application to the Ontario Ministry of Environment for a long-term site expansion.

Lanark County Waste Management Master Plan City/Township of Kingston Waste Management Master Plan
Ontario, Canada

Hydrogeological consultant on the master plan study teams involving technical aspects and document preparation, Environmental Assessment process, EA level field investigations and evaluation of site-specific engineered containment system requirements at the preferred sites and presentations to the steering committees and the public.

Armbro Mine Landfill Development
Marmora, Ontario, Canada

Project Hydrogeologist as part of the Metro Toronto area landfill site search, for hydrogeological assessment, conceptual design and technical feasibility evaluation of constructing a municipal landfill in the 250 metre deep former open pit iron ore mine.

Township of Clarence Waste Management Planning Study
Ontario, Canada

As part of a multi-disciplinary team, responsible for the hydrogeological aspects of a long term waste management planning study under the Environmental Assessment Act and Environmental Protection Act, including development and evaluation of alternative waste management components and systems, a systematic landfill site selection process and interaction with the Public Liaison Committee, municipal council and the public.

Municipal Waste Management Planning Studies
Ontario, Canada

Participated in hydrogeological aspects of waste management planning studies to identify potentially suitable areas for landfill development to satisfy the long term waste disposal requirements for the Township of Grattan, Township of Pittsburgh and the Townships of Palmerston, North and South Canonto.

Various Landfill Sites
Eastern and Northern Ontario, Canada

Responsible for undertaking and/or managing hydrogeological and waste management studies at in excess of 50 municipal landfill sites. The typical objectives of these studies have been to define the physical and contaminant hydrogeology including use of geophysical methods; undertake site-specific impact assessments on groundwater and surface water resources and gas migration; complete site performance evaluations in terms of current regulatory requirements; develop site-specific remedial action plans; design and implement annual hydrogeological monitoring programs; assist in the preparation of site development, operations and contingency and remedial action plans; and, to assemble the necessary documentation required to apply to the Ontario Ministry of Environment for Certificate of Approval revisions to permit continued disposal. Conducted evaluations of final cover design options using the Hydrologic Evaluation of Landfill Performance (HELP) computer model for the purpose of selecting the most appropriate final cover design for numerous landfills based on hydrogeological considerations, economics and availability of construction materials in the vicinity of the sites.

PROJECT EXPERIENCE – CONTAMINATED SITES INVESTIGATION AND REMEDIATION

Nation-Wide Environmental Site Assessments
Canada

Project Manager for Golder Associates' component of one of the largest environmental site assessment contracts in Canada which involved the assessment of over 780 sites which were being transferred from Transport Canada to NAV CANADA. Golder Associates completed Phase I ESAs of approximately 400 sites of which about 130 sites required Phase II ESA activities. The sites ranged from small antenna towers to large, complex international airports. Project involved considerable logistic planning to mobilize personnel across the country, familiarity with federal and provincial soil and groundwater remediation criteria, development of site-specific remediation options (including permafrost sites), and ongoing interaction with consultant team and Transport Canada/NAV CANADA.

Assessment of Rockcliffe Airbase Lands
Ottawa, Ontario, Canada

Project Manager to participate as part of a multi-disciplinary team assembled to conduct an existing conditions assessment related to potential redevelopment of the Rockcliffe site for residential land use. Completed a review of subsurface environmental investigation reports in terms of identifying potential development constraints associated with soil and groundwater conditions at the site. Presented recommended actions for evaluating issues of potential environmental concern including development of cost estimates to address these concerns.

Environmental Site Assessments
Eastern Ontario, Canada

Senior Reviewer for over 100 Phase I ESAs and over 50 Phase II ESAs completed by the Ottawa office. These projects included industrial, commercial and residential properties ranging from former coal gasification plants to microcircuit manufacturers. Projects have included an evaluation of permitting requirements related to waste-water discharges and air emissions as well as designated substances surveys.

Assessment of Diesel Fuel Release
Smiths Falls, Ontario, Canada

Project Manager for an environmental impact study which focused on a diesel fuel leak at a large industrial site and included the delineation of the areal extent of contamination, assessment with respect to current soil and groundwater remediation criteria and participation in the development and implementation of a site specific monitoring program and evaluation of remedial options.

Petroleum Hydrocarbon Releases
Eastern Ontario, Canada

Conducted subsurface investigations at numerous bulk storage, fuel dispensing and pipeline sites; development of groundwater and soil vapour monitoring programs; design and permitting of remedial measures including product recovery and excavation of contaminated soil; supervision and verification of site remediation.

Investigation of Salt Storage Facilities
Eastern Ontario, Canada

Project Manager for hydrogeological investigation relating to an assessment of poor groundwater quality adjacent to a salt dome near Almonte, Ontario. Project involved an evaluation of existing water quality data, development and implementation of a replacement well drilling program and long term groundwater quality monitoring program; project involved extensive consultation with municipal officials, affected homeowners and representatives from the Ontario Ministry of the Environment. Responsible for hydrogeological impact assessments relating to salt storage facilities near Eganville and Deep River, Ontario. Investigations included reconnaissance level geophysical surveys to characterize general dimension of the contaminant plumes followed by confirmation drilling, monitoring well installation and groundwater sampling programs to delineate the nature and extent of the contaminant plumes originating from the salt storage facilities and to differentiate between groundwater impacts from the salt storage facilities and that from nearby landfill sites.

PROJECT EXPERIENCE – AGGREGATE INDUSTRY

Stittsville Quarry
Township of Goulbourn (Ottawa), Ontario, Canada

Project Manager and Project Hydrogeologist retained by R.W. Tomlinson Limited to provide geoscience and engineering services and to co-ordinate a multi-disciplinary study team in the preparation of the supporting documents, for a submission to the Ontario Ministry of Natural Resources, in support of an application for a Category 2, Class “A” quarry license to extract limestone from below the established groundwater table. Assignment also included preparation and submission of applications to the Ontario Ministry of Environment for approval under Section 34 (Permit to Take Water) and Section 53 (Industrial Sewage Works) of the Ontario Water Resources Act. All required approvals were obtained and the quarry became operational in September 2002. Kris continues to be involved as Project Director on all environmental compliance monitoring requirements associated with the Ministry of Natural Resources aggregate license and the Ministry of Environment approvals under Section 34 and 53 on the Ontario Water Resources Act.

Rideau Road Quarries
City of Gloucester (Ottawa), Ontario, Canada

In 2003, Golder Associates was retained by R.W. Tomlinson Limited to provide geoscience and engineering services and to co-ordinate a multi-disciplinary study team in the preparation of the supporting documents, for a submission to the Ontario Ministry of Natural Resources, in support of an application for a Category 2, Class "A" quarry license for a parcel of land adjacent to Tomlinson's existing quarry operations. The quarry was designed to extract limestone from below the established groundwater table for the production of high quality aggregate suitable for all types of asphalt pavements. Kris was Project Director and Project Hydrogeologist for this assignment and Golder Associates' primary responsibilities included preparation of Level 1 and Level 2 Hydrogeological studies and Natural Environment evaluations of the property. Of particular significant for this project was the innovative approach develop by Golder Associates (in consultation with the Ministry of Natural Resources) for the purpose of addressing the presence of the American ginseng plant species and butternut trees on the property. The aggregate license was issued by the Ministry of Natural Resources in 2006.

Tatlock Quarry
Township of Lanark Highlands, Ontario, Canada

Project Director and Project Hydrogeologist retained in 2002 by Omya Canada Inc. to conduct Level 1 and Level 2 hydrogeological studies in support of an application to the Ministry of Natural Resources for a Category 2, Class "A" license for the extraction of calcitic marble (crystalline limestone) at the Omya Tatlock Quarry located northwest of Perth, Ontario. Golder Associates was also responsible for the preparation of an application for an industrial sewage works approval under Section 53 of the Ontario Water Resources Act. The quarry license application was issued by the Ministry of Natural Resources in April 2006 and the industrial sewage works approval was issued by the Ministry of Environment in March 2006. Kris continues to advise Omya Canada Inc. on matters related to environmental compliance monitoring and other issues pertaining to Ministry of Natural Resources aggregate license and the Ministry of Environment approvals under Section 34 and 53 on the Ontario Water Resources Act.

Dunvegan Quarry
Township of North Glengarry, Ontario, Canada

Project Hydrogeologist retained by the Township of North Glengarry to conducted a peer review of the hydrogeological aspects of the Cornwall Gravel Company Ltd. Dunvegan Quarry license application. The peer review focused on developing an opinion as to whether the Hydrogeological Assessment Report addressed the various components specified as part of a Hydrogeological Level 1 study and Hydrogeological Level 2 study in the context of a Category 2, Class "A" Quarry Below Water.

Klock Quarry
Aylmer, Quebec, Canada

Golder Associates was retained by Lafarge Canada Inc. to conduct the hydrogeological and natural environment assessments associated with obtaining approval for the extraction of limestone from a property situated adjacent to the existing Klock Quarry. Kris is responsible for overall project co-ordination and direction of a multi-disciplinary team.

Brechin Quarry
City of Kawartha Lakes, Ontario, Canada

Project Manager and Project Hydrogeologist retained by R.W. Tomlinson Limited to complete the necessary hydrogeological, hydrological and ecological studies to support an application under the Aggregate Resources Act. The proposed Brechin Quarry is located in the former Township of Carden within the City of Kawartha Lakes, Ontario. The assignment involves a comprehensive assessment of the potential effects of quarry development on private water supply wells and an adjacent Provincially Significant Wetland and other natural environment (biological) features as well as consideration of the potential cumulative impacts associated with multiple quarry developments in the area of the proposed Tomlinson Brechin Quarry. This project involves extensive municipal and public consultation as well as interaction with representatives of the Ontario Ministry of Natural Resources and Ontario Ministry of Environment. The aggregate license was issued by the Ministry of Natural Resources in 2009.

TRAINING

Ministry of Environment Approvals Reform and Air Emission Summary and Dispersion Modelling Report Workshop
Ministry of the Environment, 1998

Site Specific Risk Assessment Seminar
Ottawa, 1998

Contaminated and Hazardous Waste Site Management
1997

Occupational Health and Safety Course
1989, 1995

Groundwater Protection in Ontario Conference
Toronto, 1991

Short Course in Dense, Immiscible Phase Liquid Contaminants (DNAPLs) in Porous and Fractured Media
Waterloo Centre for Groundwater Research, 1990

PROFESSIONAL AFFILIATIONS

Associate Member, Ontario Stone Sand and Gravel Association (OSSGA)

Member, Association of Groundwater Scientists and Engineers (N.G.W.A.)

Member, International Association of Hydrogeologists

Member, Ottawa Geotechnical Group, The Canadian Geotechnical Society

Member, Ontario Water Well Association