



Surface Water Mining

Statement of Qualifications



BGC Engineering Inc.

Vancouver | Victoria | Kelowna | Kamloops | Calgary | Edmonton | Toronto | Kingston
Ottawa | Halifax | Fredericton | Golden | Nashville | Santiago | Santo Domingo | Brisbane

bgcengineering.ca

Services

Our Surface Water Team provides comprehensive engineering and geoscience-based water resources solutions for mining projects through all stages of project development—from baseline studies and environmental assessments to prefeasibility, feasibility, and detailed engineering design, continuing through construction, operations, closure, and post-closure. We work closely with our geochemistry and hydrogeology teams and apply our specialized knowledge of hydrology, hydraulics, geomorphology, data science, and numerical modelling to help understand water-related challenges that have the potential to impact mine operations related to:

- Climate and Hydrology Baseline Assessments, including Climate Change
- Water Balance Modelling
- Water Management Planning
- Hydrologic and Hydraulic Modelling
- Hydrotechnical Design to Construction Monitoring
- Geohazards Assessments
- Tailings Dam Breach Assessments
- Spillway Scour Assessments
- Permitting Support
- Independent Review and Expert Legal Opinion

CLIMATE AND HYDROLOGY BASELINE ASSESSMENTS INCLUDING CLIMATE CHANGE

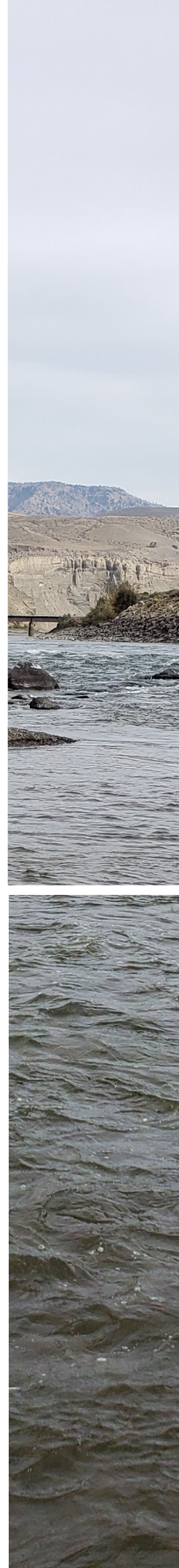
BGC has experience collecting and analyzing local and regional climatic and hydrologic data to characterize baseline climate and hydrology conditions in support of environmental impact assessment (EIA) studies, hydrologic and hydraulic modelling, and design. We use in-house tools and publicly available frequency analysis packages to conduct frequency analyses. We recognize that global and regional climates are changing on time scales pertinent to engineered structures. As such, we integrate the effects of climate change into our estimates of precipitation and runoff, and to our engineering analyses and designs throughout the design process.

WATER BALANCE MODELLING

Water balance models (WBMs) are critical in guiding the development of water management plans for mine projects and mine operations, supporting the design of water management structures, and operation of water and tailings management facilities. We have developed numerous site-wide and facility-specific WBMs for both operational and proposed mine projects, using GoldSim (industry standard for mine WBMs) and Microsoft Excel, when required. The models are developed with daily, weekly, or monthly timesteps and with consideration of both deterministic and stochastic approaches. Our models are built to be flexible to easily incorporate a contaminant transport module to assess water quality conditions. The WBMs are integrated through all stages of project development from construction, operations, closure, and post-closure.

WATER MANAGEMENT PLANNING

BGC has experience in the development of water management plans (WMPs) for operational and proposed mines and in support of mine owners to implement WMPs. The WMP is a main requirement for obtaining a mine permit and, once the mine is in operation, it represents a key tool for managing on and off-site water while meeting operational and permitting requirements. WMPs provide the framework and guidance for water quantity and quality modelling, hydrologic and hydraulic modelling, operational procedures and permitting support. During the development of a WMP, we work with local mine sites and corporate teams to develop a collaborative framework with concepts, ideas, and designs aligning with site-specific and overarching water stewardship goals.





HYDROLOGIC AND HYDRAULIC MODELLING

BGC merges process-based geoscience with modelling to meet project needs, including projections of climate change impacts, reservoir sediment modelling, snowmelt modelling, landslide wave modelling, and river hydraulics that includes the use of advanced computational fluid dynamics (CFD) modelling.

HYDROTECHNICAL DESIGN TO CONSTRUCTION MONITORING

BGC provides comprehensive design and operational support through all stages of the project cycle specific to hydrotechnical related issues that have the potential to impact infrastructure. We lead challenging hydrotechnical projects from concept to detailed design, construction, and monitoring related to water management infrastructure (e.g., channel designs and spillways for mine operations and closure), transportation structures (e.g., bridges) and pipeline watercourse crossings impacted by natural hazards (e.g., scour, bank erosion, avulsion).

Our hydrotechnical expertise for dam safety includes development of environmental design flood (EDF), inflow design floods (IDF), and freeboard analysis, and development of trigger actions response plans (TARP) for tailings and water dams. We also support our Engineers of Record (EoR) providing hydrologic, hydraulic and water management inputs to the annual dam safety inspections and other EoR scopes.

GEOHAZARD ASSESSMENTS

BGC provides geohazard mapping, characterization, risk management planning, and mitigation design at all phases of mining projects, from risk identification at scoping level through operations and closure, and for single projects and larger portfolios. Our multidisciplinary teams connect surface water and geologic expertise to understand how water acts on landscape, quantifying risk scenarios that require both regional context and site-scale granularity.

Through a recognized risk management framework, our regional assessments help clients understand how scenarios such as floods and debris flows affect asset function and worker safety, and we provide tools to inform financial decisions to allocate resources to the highest priority sites. Our workflows enable steps of geohazards assessment to build on one another as a project proceeds towards and through operation, enabling ongoing risk monitoring and change management. Where clients must demonstrate geohazards management success through a regulatory process, we help define target risk reduction levels and design approaches to demonstrate the effectiveness of proposed or existing mitigation in relation to cost. Our experts are accustomed to working with larger teams to make geohazards resiliency an integral part of mine development in a changing climate, avoiding geohazards where possible and mitigating where necessary.



TAILINGS DAM BREACH ASSESSMENTS

BGC is experienced in preparing tailings dam breach assessments (TDBA). Our expertise encompasses the required disciplines, from geotechnical, soil mechanics (i.e., tailings), and water resources to social and economic assessments and risk-informed decision making. We approach each TDBA through a collaborative lens by actively engaging with the dam owner.

We have successfully completed numerous TDBAs for facilities around the world. Our experience covers project management, stakeholder engagement, definition of credible failure modes, release volume and breach hydrograph estimates, tailings rheology, state of the art computational fluid dynamic modelling of Newtonian and non-Newtonian tailings flows and producing defensible/credible inundation maps.

SPILLWAY SCOUR ASSESSMENTS

BGC provides specialized services related to scour of spillways. Scour is a critical issue for tailings and water dam safety during normal or extreme flood conditions as excessive erosion of the spillway can be costly to remediate or even lead to loss of life should progression of scour causes failure of the dam. Proper quantification of the scour process is required to ensure the continued and reliable operation of these structures and necessitates multidisciplinary knowledge spanning areas of geologic/field mapping, soil/rock mechanics and hydraulics. BGC's services include spillway scour analysis, dam overtopping assessment, stilling basin/plunge pool scour and design, scour protection design, hydraulic modelling, site investigation,

high-resolution remote sensing monitoring, and physical hydraulic model design. BGC also provides scour subject matter expertise for risk assessments/risk-informed decision making as well as for review board / independent consultant roles.

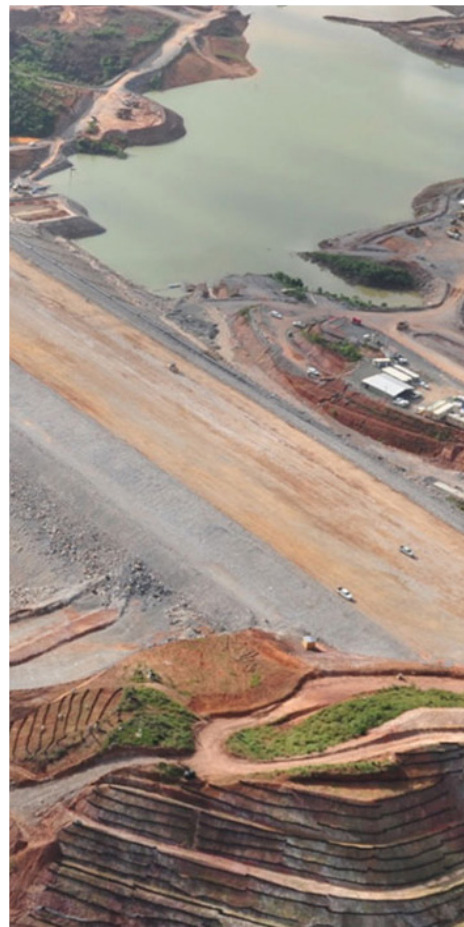
PERMITTING SUPPORT

BGC supports the permitting process for mining sites in jurisdictions with different environmental laws spanning the Americas. We support our clients in developing permitting strategies for proposed mines, expansion of existing mines, and mine facilities upgrades. We provide technical details required to support permitting and we support our clients in engagement with regulatory bodies and stakeholders.

INDEPENDENT REVIEW AND EXPERT LEGAL OPINION

BGC provides subject matter expertise in the areas of hydrology, hydraulics, geomorphology, numerical modelling, water management planning, hydrotechnical engineering and scour assessment for independent review board roles. Our subject matter experts participate in review boards for tailings storage facilities and water retaining structures for mine operations and mining projects across the world.

BGC Principals are retained by legal counsel to provide expert opinions within their area of subject matter expertise including flooding, erosion and sedimentation, debris flows and geohazards, hydraulic structures, and others.





Selected Experience

BGC offers surface water consulting services to mining companies, as well as sub-consulting services to prime consultants. Our key mining clients have included:

Barrick Gold Corporation
Hudbay Minerals Inc.
Kumtor Gold Company
Newcrest Red Chris Mine Limited
New Gold Inc.
Newmont Corporation
Pan American Silver

CLIMATE AND HYDROLOGY BASELINE ASSESSMENTS INCLUDING CLIMATE CHANGE

HYDRO-METEOROLOGICAL DATA SYNTHESIS AND ANALYSIS

Pueblo Viejo Dominicana Corporation | Dominican Republic | 2017 - 2018

BGC has worked on the Pueblo Viejo mine since 2003. In 2018, BGC used available local and regional data to update the local climatic and hydrological conditions at the mine site. The study included the compilation and review of the available data, and the

development of updated estimates for temperature, solar radiation, wind speed, relative humidity, evaporation, precipitation, and stream flows for application in mine design and operations. Our work incorporated quantifying the effects of climate change and translating this understanding to water resources projects.

CLIMATE CHANGE ASSESSMENT AND DESIGN PARAMETERS UPDATE

Confidential Mining Client | Canada | 2021 - 2022

BGC worked with a mining client to develop updated hydroclimatic design parameters for their tailings impoundment area. As part of the work, several global climate models were analyzed, and the impacts to the projected extreme rainfall and flooding events were assessed. Scaling factors were estimated using the ratios of the rainfall depth quantiles of the immediate and near future periods to the rainfall depth quantiles of the current climate period. Projections for short durations and long durations probable maximum precipitation and probable maximum flood were produced. These results were incorporated into our designs for end of operations and post-closure.



WATER BALANCE MODELLING

PORCUPINE GOLD MINE PROJECT

Newmont Corporation | Northern Ontario, Canada | 2011 – ongoing

BGC developed a GoldSim water balance model (WBM) for the Porcupine Gold Mine (PGM) No. 6 Tailing Management Area (TMA) located next to Timmins, Ontario. The WBM was initially developed by BGC to assess the tailings pond levels and volumes on an ongoing basis, but it is also used to assist PGM with internal cyanide code compliance requirements; informing dewatering and water treatment of an open pit; and most recently for a proposed mine expansion.

ANDERSON TAILINGS IMPOUNDMENT AREA (TIA) PREDICTIVE WATER BALANCE

Hudbay Minerals Inc. | Manitoba, Canada | 2020 - ongoing

BGC was commissioned by Hudbay to develop a predictive GoldSim water balance model (WBM) to support operations with tailings deposition modelling and operation decision making. The WBM incorporates the interactions with the TIA, underground workings, and downstream receiving environment. The model also serves as a capacity check for planned facility raises and informs associated flood routing assessments.

KUMTOR GOLD MINE PIT DEWATERING REVIEW

Kumtor Gold Company | Kyrgyz Republic | 2020 – 2021

The Kumtor Gold Mine is an open pit operation located in the south of the Kyrgyz Republic in the central Tien Shan Mountain region. The mine is located at an elevation of over 4,000 m and is surrounded by glaciers. Seasonal melting from the glaciers and snowpack provides the main source of water to the pit, both as direct surface water runoff and as a groundwater source to pit inflows. The water is managed through a series of constructed water management features (i.e., ditches, horizontal drains, dewatering wells, sumps, pumping stations, and pipelines). In 2020, BGC were retained by Kumtor Gold Company to carry out a data review and risk assessment of pit dewatering efforts at the mine. BGC also developed a GoldSim-HSPF (Hydrologic Simulation Program Fortran) model to estimate runoff into the open pit for the period 2001 to 2019, with runoff (rainfall + snowmelt + glacier melt) calculated on an hourly basis at 100 m elevation bands.





WATER MANAGEMENT PLAN (WMP) AND SITE-WIDE WATER BALANCE MODEL (WBM)

BRUCEJACK GOLD MINE WATER BALANCE MODEL

Pretium Resources Inc. | Northern British Columbia, Canada
2013 – 2019

BGC was retained by Pretium (which was acquired by Newcrest Mining Limited in 2022) to develop a feasibility-level water balance model (WMP) and site-wide WBM for the Brucejack Mine, a gold-silver deposit located at high altitude in northwest British Columbia. Due to high annual precipitation (>2000 mm) and minimal evaporative losses (<200 mm), water management is a critical component of the project. Using streamflow data collected over a period of several years, the WBM was calibrated to site conditions and the potential hydrologic and water quality impacts of the proposed mine were then evaluated.

Results from the water balance and water quality modelling were used to inform the development of a water management plan for the site. These studies then formed a component of the Environmental Assessment (EA) and Environmental Impact Statement (EIS) applications for the project, as well as an application for Mines Act and Environmental Management Act (MA/EMA) permits. The EA/EIS Applications were approved by regulators early in 2015, followed several months later by the provincial MA/EMA permits.



WATER MANAGEMENT PLANNING AND DESIGN FOR TAILINGS DAM UPGRADES

Confidential Mining Client | Manitoba, Canada | 2021 - 2023

BGC was retained to develop concepts and designs for upgrading a series of existing tailings dams to improve stability. This included the development of a water management plan to manage water within and around the dam upgrades, making use of existing infrastructure as much as possible. reviewed information available about existing and proposed conditions, identified critical surface water and groundwater flowpaths and erosion mechanisms to be considered in the development of the water management plan. Alternative options were developed at a conceptual level for discussion with the client. The selected option was then advanced through feasibility and detailed design for construction. BGC provided construction supervision for the dam upgrades and the associated water management structures.



HYDROLOGIC AND HYDRAULIC MODELLING

VELADERO HEAP LEACH FACILITY – SNOWMELT MODELLING

Minera Argentina Gold S.R.L. (MAGSA) | Veladero Mine Site, Argentina | 2016 - 2017

BGC was retained by MAGSA to develop a snowmelt prediction model in support of operational aspects related to the water management of their Heap Leach Facility (HLF) at the Veladero mine site. The Veladero HLF snowmelt modelling exercise was approached using two different models: an energy-based model based on the SNOW module within the Hydrologic Simulation Program Fortran (HSPF) package and the temperature index, Snowmelt Runoff Model (GoldSim-SRM).

The model results included the snowmelt water balance components and HLF drain-down water balance components. After being calibrated using 2015 and 2016 data, the HSPF model provided good estimates of the total snowmelt water balance, including snowfall, snowmelt, snowpack water equivalent, fraction of snow cover and sublimation. In contrast, the GoldSim-SRM's temperature index model provided a much poorer fit to the snowpack evolution on the HLF, principally as snowmelt is dominated by short-wave radiation rather than temperature at high elevations.

While a majority of the HSPF hydrologic model routines are publicly available in the GoldSim modelling platform, the SNOW module is not. Barrick therefore requested that BGC also develop the HSPF SNOW module within the GoldSim platform, as a follow-up study.

PASCUA – SNOWMELT AND HYDROLOGICAL MODELLING

Barrick Gold Corporation | Proposed Pascua Mine Site, Chile 2016 - 2022

BGC was retained by Barrick to develop a snowmelt and hydrological model for various locations in the Rio del Estrecho at the proposed Pascua mine site. The HSPF-Goldsim snowmelt module was used to simulate daily snowmelt and glacier melt volumes, while a modified version of the Australian Water Balance Model (AWBM) was used to route the melt volumes to the downstream river network. The AWBM is available as a module in the GoldSim modelling platform.

Model calibration was conducted for the period 2001-2009 using available streamflow data from five streamflow gauges,

followed by model validation using streamflow data for the period 2010-2017. Model results showed a reasonable fit to the most downstream gauges, which are interpreted to have the most accurate dataset. The timing of snowmelt was also calibrated using available satellite data (i.e., MODIS). Data pertaining to the spatial distribution of snow was available on a near daily basis and were of good quality for the central and northern regions of Chile. Evolution of the modelled snowpack showed a reasonable agreement with the MODIS snow cover data.

BGC's GoldSim-HSPF model was updated in 2022 with new data and evaluated four climate change scenarios based on climate change projections. These scenarios were developed to study the effects of increasing air temperatures and decreasing precipitation on glacier melt and the hydrological regime.

RAIN-ON-GRID MODELLING FOR A MINE SITE

Confidential Mining Client | Canada | 2022 - 2023

BGC developed a combined hydrologic-hydraulic model using the Rain-on-Grid (RoG) approach in HEC-RAS 2D to support design of water management structures on site. This approach is also known as direct rainfall modelling. The catchment area is divided into cells, rainfall losses are calculated for each cell, and runoff routed according to topography. Model outputs include flowrate and runoff volume, flow velocity, flow depth, and water elevation.

The RoG approach was adopted to better capture the complexity of the catchment areas, e.g., different land cover types, multiple and converging flowpaths, and storage in local depressions. The RoG model covered an area of more than 12 km² and included natural features such as creeks and lakes, as well as engineered structures such as dams, culverts, and ditches.

The model was used to confirm the structures met the design intent, whether that be in terms of providing flow containment or sufficient erosion protection based on flow velocities. In addition, flowrates were extracted from the model as input for empirical calculations. The modelled water elevations were also used as input to dam stability models as the tailwater condition.

HYDROTECHNICAL DESIGN TO CONSTRUCTION FOR MINES AND INFRASTRUCTURE

FARO MINE PROJECT

Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) | Yukon, Canada | 2016 - 2020

BGC provided a detailed design of a 2-km long engineered channel to route non-contact water through the closed Faro mine site for large flood events while also maintaining suitability for fish passage and habitat. Hydrotechnical design elements include a 5% stepped channel for energy dissipation at the channel outlet, a low flow pilot channel to limit icing in winter months, a floodplain-spanning berm at the inlet to convey flows into the diversion, and hydraulic features for fisheries including boulder clusters, sediment augmentation, and stepped pools.

MINE SITE HYDROTECHNICAL DESIGN FOR WATER MANAGEMENT STRUCTURES

Confidential Mining Client | Northern British Columbia, Canada | 2016 - ongoing

BGC provided design of water management structures to support operational water management at the mine site located in northern BC. Detailed designs were developed for non-contact water diversion channels, including a 5-km long diversion ditch, contact water and seepage collection channels, and sedimentation ponds and sumps. BGC estimated peak instantaneous design flows, sized the channels, rock armour revetments, energy dissipation structures, and provided construction supervision and performance monitoring.

PAMOUR GOLD MINE PROJECT

Newmont Corporation | Northern Ontario, Canada | 2021 – 2023

BGC provided feasibility-level and detailed design of water management structures at two locations where surface runoff and near-surface seepage containing elevated metals from previous mining activities were discharging directly to the environment. Because of these discharges, the two areas were targeted by Newmont and regulators for the collection of contact water. The design involved close collaboration of BGC geotechnical and hydrotechnical staff, as the only areas to collect the contact water were characterized by thick sequences of peat overlain by a very soft glaciolacustrine unit. The final design included a vinyl sheet cutoff wall that was embedded several meters into the

glaciolacustrine unit and with sufficient height to contain the design event. A horizontal directional drill (HDD) to convey the collected contact water to an adjacent open pit for subsequent treatment was included in the design of one of the collection areas.

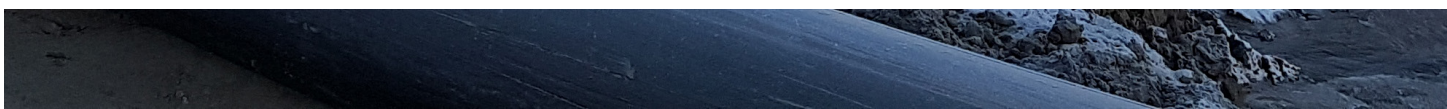
OUTBURST FLOOD HAZARD ASSESSMENT AT PETROV LAKE

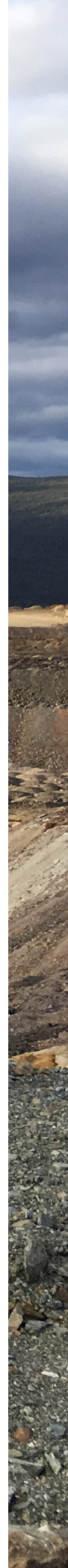
Kumtor Gold Company (KGC) | Kyrgyzstan | 2020 - 2021

Petrov Lake is a frozen-moraine dammed proglacial lake located immediately downstream of Petrov Glacier in the Ak-Shyrak mountain range of Kyrgyzstan. It is also located upstream of infrastructure, notably the tailings dam, for the Kumtor Mine. Previous studies have identified the potential for the moraine dam to fail and for a glacial lake outburst flood (GLOF) to occur. To mitigate a potential GLOF, KGC lowered the level of Petrov Lake and widened the moraine dam at its narrowest section. BGC was retained to develop an updated geohazard assessment for a potential Petrov Lake outburst flood, considering the lowered lake levels.

A failure modes analysis for moraine dam outburst floods was updated to include new monitoring data and updated geothermal modelling results. Broadly, eight identified failure modes were assessed mostly at a conceptual level due to a lack of quantitative observational data relevant to the failure mode. Based on the geothermal modelling results and the observed thickness of massive ground ice within the moraine dam, substantial settlement of the moraine dam crest to below lowered lake levels is likely inevitable due to permafrost degradation in response to climate warming.

BGC estimated a peak flow from a variety of empirical equations based on natural landslide dam failures. These estimates were compared with the breach hydrographs output from a probabilistic breach model at different lake elevations. Lowering the water level, as proposed, reduced the peak discharge by approximately 50%. The outbreak floods associated with three of the breach scenarios were routed downstream using a 2D numerical hydrodynamic model.





DAM BREACH, PARTIAL SATURATION AND INUNDATION STUDY

New Gold Inc. | British Columbia, Canada | 2021 - 2022

BGC has completed multiple dam breach inundation studies at the New Afton Copper Gold Mine. The site layout leads to the potential for cascading dam failures, which requires effectively coordinating with the client and downstream dams' EORs. The 2021-2022 study incorporated planned mitigations and tailings stabilization into the breach and runout modelling. The tailings stabilization would lead to dam failure scenarios with non-liquefiable tailings and no supernatant pond. DAN3D was used to assess the runout for the non-liquefiable tailings and FLO-2D was used to assess the runout for scenarios where liquefiable tailings and supernatant ponds were applicable.

GEOHAZARD ASSESSMENTS

MINE SITE GEOHAZARD ASSESSMENT

Confidential Mining Client | Peru | 2021 - 2022

BGC conducted an in-depth geohazard assessment for a mine project near the Peruvian coast close to Arequipa. This project included an analysis of climate change impacts in terms of the increase in total and extreme rainfall at the site. This was integrated in a complex overarching mine risk assessment whereby flood and debris flow risks were adjusted through anticipated climate change effects.

FEASIBILITY-LEVEL DESIGN REPORT FOR DEBRIS-FLOW MANAGEMENT

Pan American Silver | Argentina | 2022 - 2023

BGC provided feasibility level designs of various water management infrastructure and geohazard mitigation measures associated with the proposed mine site. Two tributaries will directly discharge towards mine facilities and are susceptible to potentially destructive debris flows which can move large quantities of water and sediment during periods of high intensity or prolonged rain.

The feasibility-level design was based on reducing debris-flow

impacts to site as much as practicable, given BGC's current understanding of debris-flow hazards and the proposed mine layout. The proposed debris-flow management design on site included mechanically stabilized earth walls tied into a rock-cut or riprap. The barrier was designed to retain debris, manage dynamic impact loading from debris flows, and pass streamflow. Additionally, BGC completed geohazard mapping across different areas of the project.

KSM PROJECT GEOHAZARD AND RISK ASSESSMENT

Seabridge Gold Inc. | British Columbia | 2009 - ongoing

BGC provided terrain stability mapping, terrain stability field assessment (TSFA) and a site-wide geohazard and risk assessment of landslides and snow avalanches for the Kerr-Sulphurets-Mitchell (KSM) project in Northern British Columbia. This work formed part of a larger scope involving design of the proposed open pits.

KSM project area contains a high spatial density of large rockslides as well as rock fall, debris flows, debris floods, shallow failures in surficial material, and flooding. BGC identified 280 geohazard scenarios with the potential to impact project facilities. BGC estimated order-of-magnitude likelihoods of occurrence for each geohazard and their likelihood of leading to a loss, at a pre-feasibility level of detail. Consequences were estimated for each geohazard scenario with respect to human safety, economic loss, environmental loss, and reputation loss to the company. The likelihood and consequence ratings for each facility were combined into a risk matrix.

The site-wide geohazard risk assessment and hazard mapping formed the hazard basis for mine layout planning and supported Seabridges' successful Environmental Application. It was used to identify conceptual mitigation options for project facilities assessed as subject to levels of geohazard risk, and as the basis to develop a large landslide management plan. Some large landslides were also characterized in more detail and are subject to ongoing monitoring.



SPILLWAY SCOUR ASSESSMENTS

ERODIBILITY FOR EMERGENCY SPILLWAY DESIGN

Pueblo Viejo Dominicana Corporation | Pueblo Viejo Mine, Dominican Republic | 2018 - 2019

BGC evaluated the erodibility of geological materials that may be encountered during excavation of an emergency spillway channel for the Tailings Storage Facility. This analysis was performed deterministically and using a probabilistic framework to account for variability in the different engineering geological units. Geologic data from hundreds of boreholes were synthesized to characterize nine material types for their erodibility potential which varied with weathering grade, degree of damage and degree of alteration. This analysis was used to select a design emergency spillway layout and channel slope to limit scour as well as evaluate the need for armoring.

TAILINGS IMPOUNDMENT AREA SPILLWAY SCOUR ASSESSMENT

Confidential Mining Client | Manitoba, Canada | 2021 - 2023

BGC assessed the erodibility of the bedrock portion of a spillway channel that services a Tailings storage facility (TSF). The spillway was designed to convey the peak flow during the probable maximum flood (PMF) and is founded through a bedrock outcrop between two embankment dams.

The assessment was comprised of two components: determining the Erodibility Index based on rock characteristics; calculating the stream power associated with the peak PMF spillway discharge. The results were plotted against case history data, from which a threshold for scour to occur can be established, to determine the scour potential along the spillway channel. The outcome of this assessment indicated additional reinforcement or armoring of the bedrock was not required to withstand erosive forces during the PMF.

PERMITTING SUPPORT

DONLIN GOLD PROJECT

Donlin Gold LLC | Alaska | 2006 - ongoing

BGC participated in the development of closure and post-closure water management plans, a site-wide water balance model, pit lake models, and waste rock facility and tailings storage facility closure design for the Donlin Gold Project located in Alaska. BGC collaborated with the multi-stakeholder venture during development of the closure plan and represented the project proponent during environmental review and permitting processes. BGC contributed to the Reclamation and Closure Plan and associated Financial Assurance, submitted to the Alaska Department of Natural Resources, and incorporated them into the EIS review.

CLOSURE PLAN FOR HISTORICAL MINE WORKINGS

Barrick Gold, Pueblo Viejo Dominicana Corporation Dominican Republic | 2006 - ongoing

BGC developed the remediation and closure plans for several facilities and landforms that are legacies of the historical mining operations that predate the current operations. The pre-existing facilities include acid-generating pit slopes and waste dumps, tailings facilities partially founded on limestone, rivers and creeks that were impacted by acid rock drainage and metals-bearing sediments, stored hazardous waste, and cyanide-impacted groundwater. The project required a multi-disciplinary approach and integrated both in-house and external expertise in climate, hydrology, hydrogeology, geochemistry, geotechnical engineering, hydrotechnical engineering, cover design, mine planning, stakeholder interests, environmental management, and performance monitoring. BGC prepared the designs and closure plans in Spanish and English and presented the designs and plans to Dominican Republic government representatives and their international review board.

BGC also provides ongoing support for permit application requirements for the dam crest raise of their existing tailings storage facility.

INDEPENDENT REVIEW

BAN HOUAYXAI (BHX) AND PHU KHAM (PKM) TAILINGS STORAGE FACILITIES (TSF) INTERIM AND CLOSURE SPILLWAY DESIGN REVIEW

PanAust Limited | Laos | 2021 - ongoing

BGC provides on-going independent review for PanAust's BHX and PKM tailings facilities as a Subject Matter Expert (SME) on spillways and erodibility. BGC serves as a specialist member of PanAust's Tailings Independent Review Panel (TIRP), which provides periodic review of the facilities and designs from the EOR. In this role, BGC has performed review of a proposed closure bedrock chute spillway on the BHX site, providing interpretation of the scour analysis results and guidance on additional scour analyses to better understand long-term spillway performance. Additionally, BGC has performed review for a proposed interim riprap-lined spillway chute at PKM providing guidance on riprap sizing, spillway layout and energy dissipation.

NEVES-COVO MINE HYDROLOGY, WATER MANAGEMENT AND HYDROTECHNICAL DESIGN REVIEW

Lundin Mining Corporation | Portugal | 2022 - ongoing

BGC serves as a member of the Independent Tailings Review Board (ITRB) providing review of surface hydrology, water management, water balance, and hydrotechnical design associated with the tailings storage facility and water management dams at the Neves-Corvo copper and zinc mine in the Alentejo Region, Portugal. The ITRB is supporting Lundin Mining's implementation of the global standard on tailings management (GISTM) at the mine.





Key Team Members

HAMISH WEATHERLY, M.Sc., P.Geo.

Hamish is a Principal Hydrologist with over 25 years of international consulting experience related to hydrology, fluvial geomorphology, and river engineering. Hamish has worked on the development of water management plans and water balance models for proposed, in construction and existing mines, as well as closure activities. His project work includes diverse climatic environments such as Alaska, Canada, Chile, Argentina, Russia, and the Dominican Republic where he works to integrate his understanding of hydrology, geomorphology and hydraulics for application to water resource projects.

ROB MILLAR, Ph.D., P.Eng., P.Geo.

Rob is a Principal Hydrotechnical Engineer with over 35 years of consulting and applied academic experience in hydrologic design, river engineering, mine water management, dam safety, and erosion and sedimentation. He has a wide range of industry and academic experience in Canada, the United States, Australia, South America, Romania and Turkey working in water management and infrastructure design, flooding, sedimentation, and environmental impacts related to metalliferous and coal mining, forestry, and hydropower industries. He has co-authored more than 70 journal articles, conference papers and book chapters related to hydraulics and river engineering.

PAOLO CHIARAMELLO, B.Sc., P.Eng.

Paolo is a Senior Hydrotechnical Engineer with 19 years of consulting experience in water management and environmental permitting for civil and mining projects in North America, South America and Europe. He has acted as water discipline lead for several international and multidisciplinary projects providing technical coordination of all water aspects of the projects. He also led and provided senior technical review for numerous studies including climate and hydrology baseline, hydrotechnical design for water management structures, water balance modelling, closure and reclamation planning and dam breach and inundation studies.

MIKE GEORGE, Ph.D., P.E., P.Eng.

Mike is a Senior Hydrotechnical/Geological Engineer with 20 years of experience specializing in water resources, dam, spillway, and river engineering with focus on erodibility, scour remediation, rock mechanics, hydraulics, high-resolution remote sensing monitoring, and reliability methods. He has worked as a consulting engineer and researcher in the United States and abroad and has developed methodologies for evaluation of rock mass erodibility, delivered training to FERC, USACE, USSD and ASDSO on scour, and authored over 25 papers on the subject including sections for the recently updated FERC Engineering Guidelines for Arch Dams (2018). Mike also serves as co-chair to the European Working Group on Overflowing & Overtopping Erosion for ICOLD as well as a subject matter expert for risk assessment and independent review board/panel member for multiple dams and spillways.



JULIO PORTOCARRERO, M.Eng., P.Eng.

Julio is a Senior Hydrotechnical Engineer with nearly 15 years of experience on water resources and environmental projects for mining operations across North America, South America and Europe. Julio has led numerous studies including hydrology and climate assessment, river hydraulic modelling, hydrotechnical design from conceptual to detailed engineering, water balance modelling studies, dam breach and inundation studies, closure and reclamation planning and development of water management and sediment control plans for mining operations.

REBECCA LEE, P.Eng., P.Geo.

Rebecca is a Senior Water Resources Engineer with a broad background in the processes shaping earth's surface and atmosphere, as well as civil engineering fundamentals. She has spent more than 15 years leading and contributing to hydrology and climate assessments, geohazard risk assessment, 1D and 2D hydraulic modelling, flood mitigation design and design of water management structures from conceptual stage to construction, integrated flood risk management planning, dam and landslide dam breach assessments, erosion characterization and mitigation, and independent engineering review. She has worked for mining clients in Northern Canada and Alaska, British Columbia, Alberta, Manitoba, Ontario, Labrador, Dominican Republic and Kyrgyzstan. She has supported mines in various stages of permitting, operations and closure.

MICAH RICHEY, B.Sc., P.E.

Micah is a Senior Water Resources Engineer with over 15 years of experience in water resources, erosion control, water management and mine and landfill closure planning. Micah's project work spans several resource sectors including mining, pipelines, coal ash residual and solid waste landfills. He has contributed to conceptual mine drainage and water management plans and developed detailed operational plans for mine and landfill closures.



DALEY CLOHAN, M.A.Sc., PMP, P.Eng.

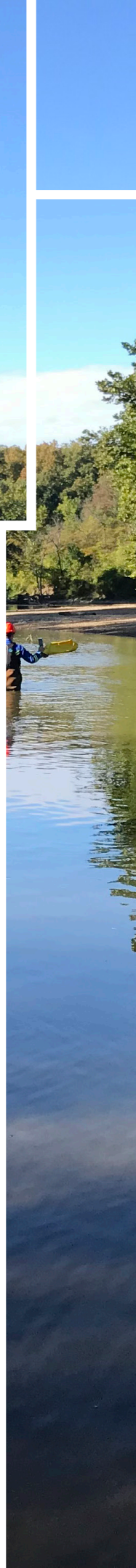
Daley is a Senior Hydrotechnical Engineer with over 17 years of experience in river engineering, tailings dam breach assessment, landslide generated wave assessments, and complex multi-disciplinary projects that focus on implementing innovative and scalable numerical solutions. Daley leads BGC's computational fluid dynamics (CFD) work.

HARMEN VAN HOVE, M.Eng., P.Eng.

Harmen is a Senior Hydrotechnical Engineer with 10 years of consulting experience in the fields of water and geohazard management. He has participated in all levels of site investigation, hazard assessment, and engineering design for water management projects associated with mining transportation infrastructure, and pipelines. His experience stretches across North America where he has led multiple teams in emergency flood management and response. He has been extensively involved with large-scale hydrological and hydrodynamic modelling projects and is experienced with incorporating climate change into designs.

AARON BRISBIN, M.Eng., P.Eng.

Aaron is a Senior Hydrotechnical Engineer with over 10 years of engineering consulting experience. He has experience with climate analysis, hydrology, hydraulics, frequency analysis, mine water management planning and water balance modelling. He has worked on water management for mines at various stages of development and provided them with infrastructure designs from the conceptual level through to detailed design. He has also built and maintained site-wide water balance models at multiple mines for operational support, environmental compliance assessments and closure options analysis.



CINDY WANG, P.Eng.

Cindy is a Hydrotechnical Engineer with 10 years of consulting experience in tailings, water, and dam safety management in Southeast Asia, North America, and South America. She has acted as hydrotechnical discipline lead for Canadian mining projects, providing technical input, and project coordination for multiple scopes. She has undertaken climate assessments, hydrologic and hydraulic modelling, tailings deposition and dam raise planning, as well as dam safety and performance evaluations. Her field experience includes dam surveillance, construction monitoring, and site investigation.

HILLARY TOPPS, P.Eng.

Hillary is a Water Resources Engineer with over 5 years of experience in mine water management, primarily focused on hydrometeorology studies, water balance modelling, fish habitat remediation, and dam breach inundation studies. Her project experience has largely been in metal, coal and diamond mines in western Canada and the territories.

GEMMA BULLARD, Ph.D., P.Eng.

Gemma is a Hydrotechnical Engineer with experience in water resources and environmental projects for mining operations across Canada and into the Caribbean. Gemma completed her PhD specializing in landslide-generated waves and has completed these assessments for mining operations to support risk-informed decisions. Gemma has led numerous dam breach and inundation studies ranging from screening-level to detailed assessments, including estimations of Population at Risk (PAR) and Potential Lives Lost (PLL).

MARC OLIVIER TROTTIER, M.A.Sc., P.Eng., ing.

Marc has a background in Civil Engineering with a master's degree focusing on water resources optimization. His research was primarily on evaluating the advantage of using stochastic inflow models to optimize hydropower systems. Mr. Trottier has 10 years of academic and industry experience. He has worked on projects involving hydrologic and hydraulic modelling including 1, 2, and 3D models to support structures design, scour analysis, river engineering, mine water management, dam breach, spillway and floodplain mapping.





VANCOUVER

Suite 500, 980 Howe Street, Vancouver, British Columbia, Canada V6Z 0C8

Tel: +1 604-684-5900

Email: info@bgcengineering.ca

CANADA VICTORIA

Tel: +1 778-401-4640

KELOWNA

Tel: +1 778-765-9455

KAMLOOPS

Tel: +1 250-374-8600

CALGARY

Tel: +1 403-250-5185

EDMONTON

Tel: +1 780-466-0538

TORONTO

Tel: +1 416-644-1216

KINGSTON

Tel: +1 647-495-6754

OTTAWA

Tel: +1 343-633-3932

HALIFAX

Tel: +1 902-474-5925

FREDERICTON

Tel: +1 506-460-8660

USA GOLDEN

Tel: +1 720-598-5982

NASHVILLE

Tel: +1 615-931-5974

CHILE SANTIAGO

Tel: +56 2-374-0090

DOMINICAN REPUBLIC SANTO DOMINGO

Tel: +1 809-378-9402

AUSTRALIA BRISBANE

Tel: +61 434-612-142

