PROFILE

Mr. O'Brien has 30 years of hydrogeology experience in the mining, environmental, water use, construction, and waste-containment fields. Mr. O'Brien has demonstrated expertise in dewatering, pit-wall depressurization, environmental permitting, water-resources management, and the design of engineered infrastructure. His ability to synthesize data to develop a sound understanding of dynamic hydrologic systems guides characterization, technical analyses, and 3D hydrogeologic modeling.

Mr. O'Brien brings value to projects by providing a wholistic approach to Program design, implementation, and management. He applies a strong understanding of the technical methods and instrumentation for monitoring groundwater flow systems to the design of characterization studies that address the key project uncertainties. The ability to communicate and coordinate with engineers, tradesmen, and technical specialists, within client organizations and third-party contractors, facilitates successful implementation of complex projects. Skill in developing and managing budgets, schedules, staff, contractors, technical work, and deliverables simplifies project management for clients. Technically sound and defensible hydrogeologic analyses, models, and reports address issues that allow client organizations to make informed decisions and implement solutions to project obstacles.

Mr. O'Brien has extensive experience in the Basin and Range province, mountainous terrains, semi-arid and desert basins, fluvial deposits, and fractured rock. Strong technical writing skills have been developed by authoring hundreds of descriptive technical reports that are supported by informative illustrations and 3D models. Oral presentations and expert testimony are delivered for clients, stakeholders, regulators, and the public.

REGISTRATIONS AND CERTIFICATIONS

Registered Professional Geologist – Arizona, Wyoming

MSHA Surface Miner Safety Training

PROFESSIONAL AFFILIATIONS

Society of Mining, Metallurgy, and Exploration (SME)

American Exploration and Mining Association (AEMA)

International Mine Water Association (IMWA)

International Association of Hydrogeologists (IAH)

National Groundwater Association (NGWA)

American Society of Civil Engineers (ASCE)

Colorado Mining Association (CMA)

EDUCATION

Master of Engineering, Geological Engineering, Colorado School of Mines, 1997

Bachelor of Science, Geology, University of Wyoming, 1986

PRACTICE AREAS

Mine hydrogeology and dewatering

Construction dewatering

Environmental impacts and permitting

Water supply and management

Hydrologic mitigation & engineering controls

Groundwater and surface-water interactions

SELECTED PROJECT EXPERIENCE

GROUNDWATER FLOW AND CHEMICAL TRANSPORT MODELING

***Open-pit Mine* – Groundwater Flow Modeling, Rosemont Project, Hudbay Minerals / Augusta Resources, Tucson, Arizona (2010 - present).** Project Lead for a regional groundwater flow model to support an Environmental Impact Statement, Aquifer Protection Permit, and Biological Assessment. The initial groundwater flow model was completed in 10 weeks to meet aggressive project deadlines. Pre-mining conditions, open-pit dewatering during the active mining period, and pit-lake formation following closure were simulated. Engineering effects to streams, springs, riparian vegetation, and biological resources were estimated and used in the permitting process.

The flow model has been subsequently updated to represent new Mine Plan of Operations. The mining schedule for facility construction, plant site design changes, and open-pit advancement were simulated. A refined grid in the open-pit area was implemented to allow the regional-scale model to meet environmental permit requirements specified in monitoring and mitigation plans.

***Open-pit Mine* – Dewatering and Water Supply, Rosemont Project, Hudbay Minerals, Tucson, Arizona (2014 - 2016).** Optimum pit-slope angles increase the mineable ore reserves and project profitability. However, the open-pit area at this project was characterized as having high pore pressures, which results in decreased pit-slope angles that reduced the mineable ore. The overall low-permeability rocks would make it difficult to cost-effectively reduce these pore pressures. Addressing this problem required updating the project flow model with the latest geologic units and structures to evaluate the feasibility of effectively decreasing pore pressures. Preferential groundwater flow intervals were identified by analyzing core samples, rock quality, geologic structures, hydraulic testing, piezometers, water quality, water age, water levels, and exploration hole drilling conditions. These hydrogeologic characteristics were incorporated into the groundwater flow model for dewatering-scenario testing, predicting pore pressures that assisted pit-slope designs that maximize mineable ore volumes. In additions, analyses and modeling results supported identification of optimum areas for on-site water supply wells.

***Open-pit Mine* – Hydrogeologic Model, Mission Mine Complex, ASARCO, Sahuarita, Arizona (2017 - present).** Development of a 3D hydrogeologic model that incorporates geologic structures, pit shells, geotechnical properties, and detailed lithology. Pore-pressure analyses developed to aid in geotechnical pit slope designs. Modeling used to design dewatering program and alternatives. Monitoring system design identifies groundwater sources and effectiveness of depressurization. Water-management improvements to reduce stormwater runoff infiltration.

***Mine Tailings* – Tailings and Groundwater Model, Solitude Tailings, Globe, Arizona (2017).** Numerical modeling to simulate tailings seepage and peak infiltration during periodic ponding on tailings impoundment. Modeling identified physical processes likely responsible for the transient

response of underlying alluvial groundwater system. Concerns regarding the impact of storm runoff on the tailings impoundment were addressed.

***Open-pit Mine* – Pit Backfill Modeling, Rosemont Project, Augusta Resources, Tucson, Arizona (2010 - 2014).** As part of the project alternatives analysis during the EIS process pit backfill was evaluated as a method for reducing groundwater drawdown and losses due to pit-lake evaporation. Several pit-backfill scenarios were simulated with varying backfill levels and addition of supplemental water to more quickly return to pre-mining groundwater levels. These simulations showed that costly pit backfilling would not result in meaningful reductions in drawdown at distant sensitive areas.

***Open-pit Mine* – Contaminant Transport Modeling, Rosemont Project, Hudbay Minerals, Tucson, Arizona (2014 - 2017).** A Discharge Impact Area analysis was conducted as part of an Aquifer Protection Permit. This analysis predicts the area that would exceed background water-quality concentrations due to discharge from permitted mine facilities. Constituents of concern were identified by evaluating Synthetic Precipitation Leaching Procedure (SPLP), Meteoric Water Mobility Procedure (MWMP), and pore-water test results on waste rock and tailings samples. Water quality and infiltration rates for the waste-rock facility, tailings facility, and process water ponds were estimated and simulated in the project flow model. Constituent specific transport properties were applied to account for known processes that would retard chemical transport in the groundwater system. Constituents exceeding background concentrations at point of compliance wells were identified and the location where concentrations would return to background levels was estimated.

***Mine Mill and Ore Storage Area* – Groundwater Flow and Transport Modeling, Dawn Millsite, Dawn Mining Company, Ford, Washington (2009 - present).** Unsaturated and saturated groundwater flow and chemical transport modeling was completed for the ore stockpile area and tailings disposal area at this legacy uranium mill site. Infiltration rates, travel times, flow paths, and natural attenuation processes were estimated. These simulations resolved regulatory concerns and were used to support site closure and transfer to the Department of Energy

***Waste Isolation* – Groundwater Flow Modeling, Death Valley Regional Flow System, Department of Energy, Las Vegas, Nevada.** Worked within a technical team consisting of U.S. Geological Survey scientists, academic researchers, and private consultants constructing a regional groundwater flow model to evaluate flow paths and travel times from a proposed high-level nuclear waste facility. The modeling integrated Nevada's Basin and Range hydrogeology, faulting, fracturing, hydraulic-property variations, evapotranspiration, and spring characteristics. Technical contributions included conceptualization, design, construction, calibration, and sensitivity analyses for flow modeling. Responsibilities included directing and coordinating the multi-disciplinary technical team and resolving differences in scientific interpretation and approach to ensure that projects were technically sound, consistent across disciplines, and were completed on schedule.

***Mine Tailings* – Groundwater Flow and Transport, Monterey Mine No. 2, ExxonMobil, Albers, Illinois.** Developed groundwater flow and transport models to support the legacy facility's permit conditions. Simulated current and historic water-quality data, slurry-wall containment, and water-management practices. Modeling and a site-wide water balance led to understanding the interactions between groundwater, surface water, and site management practices. Modeling improved predictive performance and reliability by simulating natural hydrologic boundaries and transient conditions.

ENGINEERING EFFECTS

***Construction Dewatering* – Sylvan Lake Dam, Colorado Parks and Wildlife, Eagle, Colorado (2018).** The earthen dam and spillway upgrades required lowering the lake level, building a coffer dam, and dewatering the construction areas. Existing geotechnical borings and monitoring wells were

used to develop a 3D hydrogeologic model and a 3D groundwater flow model of the site. Various scenarios were simulated to optimize dewatering well spacing, depth, and location. These simulations considered lake levels, coffer dam configuration, and identified hydrogeologic uncertainties that could impact the project. The optimized dewatering design was installed by the construction contractor, which saved over $100,000 in fees that were quoted by a dewatering contractor.

***Open-pit Mine* – Environmental Impact Statement Analyses, Rosemont Project, Augusta Resources, Tucson, Arizona (2010 - 2017).** Groundwater system changes due to this proposed open-pit copper mine were simulated, analyzed, and documented during the EIS process. Changes to streamflow, springs, riparian vegetation, and biological resources were estimated for the mining phase and post-closure period. Extensive sensitivity analyses were completed to bound the range of potential groundwater system changes.

Supporting analyses were prepared to address specific concerns at sensitive areas. The nature and occurrence of groundwater and surface-water interactions were defined and potential changes were evaluated. Scientific interpretations and comments from project reviewers were addressed to improve prediction reliability and to the meet regulatory needs.

***Construction Dewatering* – First Creek Interceptor Pipeline, City of Aurora, Aurora, Colorado (2017).** The alignment of this underground pipeline crossed highways, railways, and streams. Dewatering costs were highly dependent on the subsurface conditions and potential inflows. Representative dewatering contractor bids were needed to avoid costly change orders that could make the project financial unfeasible. The subsurface geology and hydrologic conditions were simulated to estimate dewatering well spacing, depths, construction details, inflows, and timing. These results constrained the specifications and resulted in comparable contractor bids.

***Mine Mill and Ore Storage Area* – Groundwater Remediation, Dawn Millsite, Dawn Mining Company, Ford, Washington (2009 - present).** The project groundwater flow and transport model was used to evaluate the effectiveness and feasibility of groundwater remediation measures for an ore stockpile area. Remediation alternatives included an engineered soil cover, source removal, pump and treat system, permeable reactive barrier, groundwater collection trench, and slurry-wall technologies. Optimization and integration of the alternatives was completed to estimate the time required to achieve site closure and the associated costs. Uranium mass transport to a stream and resulting concentrations at high and low streamflow conditions was estimated for each remediation alternative.

***Mine Tailings* – Groundwater Remediation, Monterey Mine No. 2, ExxonMobil, Albers, Illinois.** Developed 3D groundwater flow and transport models to identify remediation measures that maintain contaminants within the facility's permit conditions. Existing water management measures were modified to improve their effectiveness and to reduce operational costs. A previously installed slurry-wall was re-incorporated into the remediation measures by identifying the operational conditions necessary to contain contaminants. Recovery well locations and pumping rates were optimized to reduce the volume of water requiring treatment, which reduced operating and maintenance costs.

CHARACTERIZATION

***Open-pit Mine* – Hydrogeologic Characterization, Mission Mine Complex, ASARCO, Sahuarita, Arizona (2017 - present).** Design, installation, and monitoring to characterize the groundwater flow system at this large, well-established, 60+ year old open pit mine. Monitoring implemented to assist in pit-slope stability analyses and to evaluate effectiveness of implemented dewatering measures. Horizontal and vertical grouted piezometers have been designed and installed to depths up to 1,100 feet. Monitoring wells and drains are instrumented to measure in-pit groundwater levels and flows. Dewatering wells were designed, tested, and instrumented to estimate hydraulic properties of faults

and fracture zones that control groundwater flow and pore pressures. Developed specifications, selected contractors, and coordinated submersible pump, control panel, discharge piping installation, flowmeter, and pressure transducer installation. All characterization and on-going monitoring data are used to develop and calibrate the project's groundwater flow model.

***Open-pit Mine* – Hydrogeologic Characterization, Rosemont Project, Augusta Resources and Hudbay Minerals, Tucson, Arizona (2010 - present).** Site and regional characterization included new data collection and synthesis of existing data. Geologic features such as faults, fractures, dikes, skarn alteration, hydrothermal alterations, and lithologic variations that control groundwater flow where characterized. The rate and distribution of groundwater recharge in topographically steep, fractured bedrock and lower elevation basin fill deposits was studied to obtain a water balance that guided subsequent conceptual and computer modeling. Groundwater discharge at springs and seeps was investigated to identify features that would and would not be impacted by mining activities. Ephemeral, perched- water springs and perennial, regional groundwater fed springs were identified by investigating flow rates, flow persistence, presence of riparian vegetation, water quality, and chemical isotopes. Streamflow was characterized to identify ephemeral reaches fed by stormwater runoff that would not be impacted by the project and perennial reaches fed by regional groundwater that could potentially be altered. Groundwater and surface-water interactions were investigated by installing monitoring stations to measure streamflow discharge, precipitation, soil moisture profiles, isotope ratios, water quality, and groundwater levels in stream channel alluvium and surrounding bedrock.

***Water Development* – South Platte River Watershed Study, Wyoming Water Development Commission, Laramie County, Wyoming (2016 – present).** This project developed a thorough and comprehensive evaluation of alluvial and bedrock aquifers, groundwater resources, and groundwater use. Geologic structures and aquifer characteristics were analyzed to determine their role in groundwater availability and potential for additional development. Unexplored groundwater development areas were identified based on favorable hydrogeologic and operational conditions. Developed an improved understanding of surface water and groundwater interactions based on analyses of streamflow, climate conditions, and aquifer responses. Water-balance estimates including aquifer recharge due to areal precipitation, infiltrating streamflow, and agricultural irrigation return flow were developed.

***Mine Mill* - Groundwater Flow and Water-quality Characterization, Dawn Mill Site, Dawn Mining Company, Ford, Washington (2009 - present).** Developed focused characterization and testing programs to support design and implementation of corrective action closure alternatives at this legacy uranium mill site. Programs were designed to identify critical hydrogeologic conditions that control vertical and spatial distribution of contaminants in the unsaturated and saturated zones.

***Open-pit Mine* – Groundwater Flow Characterization, Midnite Mine, Wellpinit, Washington.** Developed a groundwater investigation plan to support mine remediation and implementation of the EPA's Record of Decision. Data collected supported analyses for determining groundwater inflow to two open pits, capture of alluvial groundwater, spring and stream flows, pit-lake levels, water-balance modeling, and volumes of water requiring treatment under existing conditions, during construction, and after site remediation.

***In-situ Mining* – Groundwater Feasibility, Hairhan Depression In-situ Recovery (ISR) Uranium Project, Denison Mines, Mongolia.** Lead for hydrogeology components of this ISR mining project. Responsible for management, coordination, and completion of drilling, well construction, water-quality sampling, aquifer testing, and ISR pilot-test design. Mongolian crews were trained on USA drilling, well completion, and well development techniques to ensure high-quality and reliable well installations. Close interaction with the client on procurement and logistical support led to successful

completion of planned field activities under challenging conditions. Specialized and routine equipment had to be purchased outside of Mongolia and transported to the remote Gobi Desert location. Seven hydrogeologic monitoring wells, 18 baseline water-quality monitoring wells, and 2 pilot-test areas were installed.

***Open-pit Mine* – Mine Feasibility Study, Zonia Copper Mine, Copper Mesa Mining Company, Yavapai County, Arizona.** Lead for hydrogeologic investigations supporting mine feasibility study, aquifer protection permit application, and mine water supply. Completed hydrologic characterization and monitoring program plans.

***Underground Mine* – Groundwater Discharge Permit, Energy Queen Mine Uranium Project, Energy Fuels Resources, San Juan County, Utah.** Completion and submittal of groundwater characterization data for a discharge permit to the Utah Division of Water Quality. Permit was accepted by the State without comment.

***Artificial Recharge* – Well-field Design, Sand Hollow Reservoir Artificial Recharge Recovery System, Washington County Water Conservancy District, Washington County, Utah.** Completed hydrogeologic investigation of reservoir site and designed a well field to capture artificially-recharged water. The well-field utilized natural fracture flow to increase well production and efficiency, while minimizing water loss from the reservoir.

***Mine Mill* – Hydrogeologic Characterization, Shootaring Canyon Uranium Mill Project, Uranium One, Garfield County, Utah.** Design and planning of hydrogeologic studies and monitoring to obtain groundwater discharge permits.

***Waste Isolation* – Aquifer Testing and Monitoring Network, Yucca Mountain Project, Site-Scale Saturated Zone, Department of Energy, Las Vegas, Nevada**. Accountable for the design, instrumentation, completion, and analyses of monitoring wells, multiple aquifer tests and monitoring networks. Aquifer properties were used in three-dimensional numerical modeling at the site and regional scales. Groundwater system responses to earthquakes were measured by customized monitoring systems that could detect earthquakes across the globe. Responses to major earthquakes in nearby California were recorded and the data were used to address concerns over the impacts of seismic activity on this potential underground, high-level nuclear waste site.

CONCEPTUALIZATION

***Open-pit Mine* – Regional Conceptual Model, Rosemont Project, Augusta Resources, Tucson, Arizona (2010 - 2014).** As part of an Environmental Impact Statement study, developed a conceptual hydrogeologic model for a 150-square-mile region surrounding this proposed open-pit copper mine. This conceptual model was based on analysis of chemical isotopes in groundwater and precipitation, climate conditions, groundwater recharge, spring occurrence and discharge, vegetation, aquatic resources, groundwater levels, geology (including the role of fractures, faults, and geologic structures on groundwater flow), geomorphology, streamflow occurrence, and groundwater and surface-water interactions. Resources that were and *were not* likely to be impacted by the project were identified and supported by data and analyses. Subsequent numerical computer models that predicted groundwater system changes were based on this regional conceptual model.

***Open-pit Mine* – Conceptual Site Model, Rosemont Project, Hudbay Minerals, Tucson, Arizona (2014 - present).** The immediate open-pit area for this project was characterized as highly fractured bedrock having overall low-permeability and high pore pressures, which could result in shallow pit-slope angles that negatively impact the recoverable ore resources. Hydraulic tests, groundwater levels, water chemistry, water age, lithologic variations, fractures, mineral alteration, rock quality, and

geologic structures were analyzed to identify preferential groundwater flow paths that could be used to depressurize the pit slopes, increase pit-slope angles, and expand the mineable ore body.

***Mine Tailings* – Conceptual Hydrogeologic Model, Solitude Tailings, Globe, Arizona (2017).** Developed a conceptual model to describe the occurrence and movement of infiltration through and around the tailings impoundment during dry periods and stormwater runoff events resulting in ponded water. Conceptual model formed basis for numerical model that simulated constant tailings seepage and peak infiltration during ponding.

***Open-pit Mine* – Conceptual Site Model, Mission Mine Complex, ASARCO, Green Valley, Arizona (2017 - present).** Evaluating geologic, geotechnical, and hydrologic data to develop a conceptual model describing the hydrogeologic conditions influencing pit slope conditions. Initial effort in developing pit-slope depressurization program.

***Mine Mill and Ore Storage Area* – Conceptual Flow and Transport Model, Dawn Mill Site, Dawn Mining Company, Ford, Washington (2009 - 2016).** Developed a conceptual model to describe the occurrence and movement of uranium from an ore stockpile area and tailings disposal areas. The analyses identified the occurrence and importance of clay layers within an alluvial outwash deposit, the role of a previously poorly characterized confining unit, and the hydraulic isolation of a deeper regional aquifer from the contaminated project area.

***Residential Development* – Hydrogeologic Conceptual Model, Vista Ridge Subdivision, Erie, Colorado.** Development of the hydrogeologic basis and conceptual model for litigation related to home damage due to infiltrating water and swelling soils. Analyses included sources of water, groundwater occurrence and flow, current and future impacts due to infiltrating water, and remediation strategies to mitigate future impacts. Conceptual model and related data were the basis for 2-D and 3-D infiltration modeling to estimate depth of wetting that was used to calculate potential soil heave and effectiveness of remediation designs.

***Open-pit Mine* – Monitoring and mitigation plans, Rosemont Project, Augusta Resources, Tucson, Arizona (2010 - 2014).** Monitoring and mitigation plans were completed to satisfy EIS requirements. Waste-rock monitoring included lysimeter installation to measure the rate and water quality of infiltrating water during the active mining phase. Water-quality and groundwater-level monitoring, including technical procedures, were developed to ensure permit compliance. A groundwater flow model update plan included monitoring for data used in model updates and recalibration over the mine life. Monitoring included pumping from water supply wells and all pit dewatering activities (wells, drains, sumps, galleries). Model re-calibration will incorporate new geologic data, climate data, and groundwater system responses to pit dewatering. An interagency technical team will assess whether measured conditions and model simulations are within the bounds disclosed during the EIS process and whether a take of endangered species has occurred.

COMMUNICATION

***Open-pit Mine* – Rosemont Project, Augusta Resources and Hudbay Minerals, Tucson, Arizona (2010 - present).** Serving as the groundwater lead on this large mining project involves working closely with the Rosemont staff and other project consultants to prepare and present technical methods and findings. As the technical groundwater representative represented the project to the EIS team, state and federal regulators, stakeholders, and the public. Assisted attorneys and provided expert testimony in formal administrative legal hearings related to Aquifer Protection Permit protests. Primary author on over 40 technical documents and reports submitted to the client, Arizona regulators, and Federal regulators. Presentation of analysis findings, model simulation results, and explanations of natural processes were prepared to advance understanding of the project and potential engineering effects.

Water Development **– Clark, Lincoln, and White Pine Counties Groundwater Development Project, Southern Nevada Water Authority, Las Vegas, Nevada.** Provided technical evaluation and strategic recommendations for scientific studies supporting this water-supply project. Reviewed and evaluated scientific studies involving geochemistry, evapotranspiration, groundwater recharge, subsurface geology, water rights, stream base flow, groundwater discharge, and groundwater flow modeling. Implementation of recommendations assisted in having the study findings accepted in legal proceedings.

Water Development **– Clark, Lincoln, and White Pine Counties Groundwater Development Project, U.S. Bureau of Land Management (BLM), Reno, Nevada.** Provided technical evaluation for scientific studies supporting development of the project Environmental Impact Statement. Reviewed and evaluated scientific studies involving geochemistry, evapotranspiration, groundwater recharge, subsurface geology, water rights, groundwater discharge, and groundwater flow modeling. Review comments were addressed by proponent and included in the draft EIS documents.

In-situ Mining **– Groundwater Regulatory Compliance Audit, Crow Butte, Uranium ISR Mine, Cameco, Crawford, Nebraska.** Technical lead for groundwater aspects of regulatory compliance audit for In-Situ Recovery operations. Compliance with U.S. NRC and State of Nebraska regulations (Department of Environmental Quality, Department of Health and Human Services, and Department of Natural Resources) were evaluated. The audit included site specific permits and regulations related to deep-injection wells (Class I), ISR mining wells (Class III), septic system (Class V), water supply, and industrial groundwater. This internal audit identified strengths and deficiencies to assist operators in preparation for external audits and to maintain environmental compliance.

Waste Isolation **– Nuclear Waste Repository Project Office (NWRPO) Independent Scientific Investigations Program, Nye County, Nevada.** Performed a groundwater modeling program technical evaluation and provided recommendations for future modeling approaches and supporting studies. Technical gaps that impacted the County's concerns for environmental, health, and safety risks of radioactive waste isolation were identified and addressed. Even though there had been numerous studies at the Department of Energy's Yucca Mountain Project there were key, unresolved technical issues that could impact the health and safety of the County's citizens. An interdisciplinary study was designed and implemented to identify the project uncertainties and incongruous study findings that could potentially impact repository performance and result in health and safety issues. Responsible for coordination and integration of consulting scientists and academic researchers; and completion of a report that clarified health and safety issues and provided recommendations for resolving concerns.

Waste Disposal **– Well-field Evaluation, Potasio Rio Colorado (PRC), Potash Solution Mine, Vale, Argentina.** Hydrogeology lead for final feasibility review of deep-well, brine-waste injection and water supply well field. Review of geologic modeling, geophysical logs, injection testing, and groundwater flow and transport modeling to assess long-term (40 years) feasibility of deep-well injection (at rates up to 600 cubic meters per hour). Adequacy of site characterization and analysis was investigated to determine level of risk related to critical conditions necessary for long-term project success. Recommendations for lowering risk and best practices related to U.S. EPA Underground Injection Control (UIC) program and industry standards were developed to assist in advancing project development.

Underground Mine **– Hydrogeologic Characterization, Velvet Mine Uranium Project, Uranium One, San Juan County, Utah.** Senior review of hydrogeologic characterization data, flow-system conceptualization, and potential impacts of proposed mining activities.

***Open-pit Mine* – Black Mesa Coal Mine Life-of-Mine Permit Evaluation, Coconino County, Arizona.** Evaluated the technical adequacy of the Life-of-Mine Permit submitted by Peabody Western Coal Company that requested groundwater pumping to supply water for a coal-slurry pipeline and coal-washing facility. Evaluated permit package documentation including hydrogeologic conceptual models, groundwater flow models, supporting data, and assumptions.

PROFESSIONAL EMPLOYMENT HISTORY

- Principal Hydrogeologist, Founder, NEIRBO Hydrogeology, Fort Collins, Colorado (2012-present)
- Senior Hydrogeologist, Engineering Analytics, Inc., Fort Collins, Colorado (2010-2012)
- Senior Hydrogeologist, Tetra Tech, Inc., Fort Collins, Colorado (2008-2010)
- Principal Hydrogeologist, Founder, GeoFlow, Inc., Fort Collins, Colorado (2006-2008)
- Principal Hydrogeologist, Founder, Earth Knowledge, Inc., Tucson, Arizona, (2003-2006)
- Hydrologist, U.S. Geological Survey, Tucson, Arizona (1998-2003)
- Hydrologist, U.S. Geological Survey, Denver, Colorado (1989-1998)

PUBLICATIONS

In addition to numerous reports and technical memorandums prepared for private clients, Grady authored the following publications prior to entering consulting:

Belcher, W.R., ed. 2004. "Death Valley Regional Ground-Water Flow System, Nevada and California—Hydrogeologic Framework and Transient Ground-Water Flow Model." U.S. Geological Survey Scientific Investigations Report 2004-5205, 408 p.

Chapter A – Introduction; by Belcher, W.R., D'Agnese, F.A., and **O'Brien, G.M.**

Chapter D – Hydrology; by Faunt, C.C., D'Agnese, F.A., and **O'Brien, G.M.**

Chapter F – Transient Numerical Model; by Faunt, C.C., Blainey, J.B., Hill, M.C., D'Agnese, F.A., and **O'Brien, G.M.**

D'Agnese, F.A. and **O'Brien, G.M.** 2003. "Impact of Geoinformatics on the Emerging Geoscience Knowledge Integration Paradigm." In: Rosenbaum, M.S. and Turner, A.K. (eds.) Characterisation of the Shallow Subsurface: Implications for Urban Infrastructure and Environmental Assessment. Springer-Verlag, Düsseldorf. 000-000. (INVITED).

D'Agnese, F.A., **O'Brien, G.M.,** Faunt, C.C., Belcher, W.R., and San Juan, C.A. 2002. "A Three-Dimensional Numerical Ground-Water Flow Model of Predevelopment Conditions in the Death Valley Regional Ground-Water Flow System, Nevada and California." U.S. Geological Survey Water Resources Investigations Report 02-4102.

O'Brien, G.M., D'Agnese, F.A., and Nasser, K.H. 2002. "An Infrastructure and Protocols to enable Geoscience Knowledge Integration." Geological Society of America Abstracts with Programs, vol. 34, no. 6, p. 224.

O'Brien, G.M., D'Agnese, F.A., Turner, A.K., and Nasser, K.H. 2002. "Role of Geoinformatics in the Geoscience-Business Process." Proceedings of the International Association of Mathematical Geology, Annual Meeting 2002, Berlin Germany.

D'Agnese, F.A. and **O'Brien, G.M.** 2002. "Impact of Geoinformatics on the Integration of Geoscience Knowledge." Geological Society of America Abstracts with Programs, vol. 34, no. 6, October 2002, p. 224. (INVITED).

Lagueux, F., Nasser, K.H., **O'Brien, G.M**., and D'Agnese, F.A. 2002. "An Enterprise System to enable Geoscience Knowledge Integration." Geological Society of America Abstracts with Programs, vol. 34, no. 6, October, p. 225.

Hill, M.C., Ely, D.M., Tiedeman, C.R., **O'Brien G.M.,** D'Agnese, F.A., and Faunt, C.C. 2000. "Preliminary Evaluation of the Importance of Existing Hydraulic-Head Observation Locations to Advective Transport Predictions, Death Valley Regional Flow System, California and Nevada." U.S. Geological Survey Water-Resources Investigations Report 00-4282, 62 p.

O'Brien, G.M., D'Agnese, F.A., Faunt, C.C., and Belcher, W.R. 2000. "Effective Model Calibration for the Geologically Complex Death Valley Regional Ground-Water Flow System, Nevada and California." (abs.) EOS, Transactions, American Geophysical Union, 2000 Fall Meeting, San Francisco, California, Vol. 81, No. 48, November 28, p.426.

O'Brien, G.M., D'Agnese, F.A., Faunt, C.C., and Belcher, W.R. 2000. "Hydrogeologic Data, Parameter Estimation, and the Death Valley Regional Ground-Water Flow Model." (abs.) Geological Society of America Abstracts with Programs, Vol. 32, No.7, 2000 Annual Meeting, Reno, Nevada, p. 338.

O'Brien, G.M. 1998. "Analysis of Aquifer Tests conducted in Borehole USW G-2, 1996, Yucca Mountain, Nevada." U.S. Geological Survey Water-Resources Investigation Report 98-4063, 22 p.

D'Agnese, F.A., **O'Brien, G.M.,** Faunt, C.C., and San Juan, C.A. 1998. "Simulated Effects of Climate Change on the Death Valley Regional Ground-Water Flow System, Nevada and California." U.S. Geological Survey Water-Resources Investigation Report 98-4041.

O'Brien, G.M. 1997. "Analysis of Aquifer Tests conducted in Boreholes USW WT-10, UE-25 WT#12, and USW SD-7, 1995-96, Yucca Mountain, Nevada." U.S. Geological Survey Water-Resources Investigation Report 96-4293, 36 p.

Graves, R.P, Tucci, P., and **O'Brien, G.M.,** 1996, "Analysis of Water-Level Data in the Yucca Mountain Area, Nevada, 1985-95." U.S. Geological Survey Water Resources Investigation Report 96-4256.

O'Brien, G.M., Tucci, P., and Burkhardt, D.J. 1994. "Water Levels in the Yucca Mountain Area, Nevada, 1992." U.S. Geological Survey Open File Report 94-311.

Tucci, P., **O'Brien, G.M.,** and Burkhardt, D.J. 1994. "Water Levels in the Yucca Mountain Area, Nevada, 1990-91." U.S. Geological Survey Open File Report 94-111.

O'Brien, G.M. 1993. "Earthquake-Induced Water-Level Fluctuations at Yucca Mountain, Nevada, June, 1992." U.S. Geological Survey Open File Report 93-73.

O'Brien, G.M. 1992. Earthquake-Induced Water-Level Fluctuations at Yucca Mountain, Nevada, April, 1992." U.S. Geological Survey Open File Report 92-137.

O'Brien, G.M. 1991. Water Levels in Periodically Measured Wells in the Yucca Mountain Area, Nevada, 1989." U.S. Geological Survey Open File Report 91-178.