SPECIALIZATION

Scott Effner, Principal Hydrogeologist/Geochemist for Whetstone Associates, specializes in ground water hydrology, aqueous geochemistry, and water resource studies for mining, industrial, and oil and gas projects. Over the last 15 years, Mr. Effner has served as project manager or senior investigator on over 100 projects in which ground water hydrology, hydrologic testing, geochemical modeling, water quality monitoring, or numerical modeling of ground water flow were the focus of work. Mr. Effner has extensive experience performing hydrologic and geochemical studies for permitting and construction and is knowledgeable about water resource issues related to the preparation of NEPA documents. Mr. Effner's main areas of expertise are in hydrogeologic characterization and testing, design of water control systems, numerical modeling of aqueous geochemistry and ground water flow, design of water quality monitoring networks, and preparation of geochemical characterization studies.

EDUCATION

M.S., Geology, University of Idaho, Moscow, Idaho 1992
B.A., Geology, Western State College, Gunnison, Colorado 1988
Colorado School of Mines Short Course, "Modeling Ground Water Flow and Contaminant Transport" 1994
CGWA Workshop "Ground Water Flow in Low Permeability Environments" 1995

PROFESSIONAL AFFILIATIONS AND CERTIFICATION

Professional Geologist, Wyoming, Registration # PG-3434
International Association of Geochemistry and Cosmochemistry, 1994 - present
International Mine Water Association, 1993 - present
National Ground Water Association, 1998 to present
MSHA 40-Hour Training for Surface and Underground Miners
OSHA 40-hour Hazardous Waste Operations Training

WORK HISTORY

Whetstone Associates, Principal Hydrogeologist/Geochemist, 1999 – present

TRC Hydro-Geo Consultants, Lakewood, CO, Senior Geochemist/Hydrogeologist, 1993 – 1999

Empresa Minera Can-Mex, Hermosillo, Mexico, Contract Geologist 1992 to 1993

Tenneco Minerals Company Lakewood, CO, Contract Geologist 1989 to 1991

REPRESENTATIVE PROJECT EXPERIENCE

- *Greystone Consultants – Rasmussen Ridge Mine EIS, Idaho – Project Manager* – Responsible for the development of the water resources and geochemistry sections of the North Rasmussen Ridge Mine Environmental Impact Statement (EIS). Project duties included the review and development of recommendations for baseline characterization studies, analysis of hydrologic and geochemical data, evaluation of hydrologic and geochemical impacts to water resources, numerical modeling (MODFLOW/MT3D) of contaminant fate an transport, senior review of geochemical modeling, and preparation of text for the EIS. A successful Record of Decision (ROD) was issued in September, 2003. The EIS received the highest rating from the EPA that has been given to any mining project in the region, due largely to strength of the analysis presented in the water resources section.
- *Greystone Consultants – Rasmussen Ridge Mine EIS, Idaho – Project Manager* – Preparation of Water Resources Technical Report in support of EIS. Project duties included the development of a comprehensive water resources document that compiled all available data and analysis for ground water and surface water in the project area, and presentation of conceptual hydrologic models to agencies and environmental groups.

- *Dudley and Associates, Seminole Road CBM Project, Hanna Basin Wyoming – Senior Hydrogeologist* – Prepared numerical ground water flow model for the Seminoe Road Coal Bed Methane Project Environmental Impact Statement. The model was used to evaluate potential drawdown impacts in the Hanna Basin caused by pumping from over 1,200 wells which will be installed at full production. The model was also used to evaluate impacts caused by injection of produced water into the Dad sandstone of the Lewis Formation.

- *Agrium, LLC, Rasmussen Ridge Mine, Idaho – Project Manager* – Prepared Surface Water and Ground Water Monitoring Plan and Quality Assurance Project Plan for Annual Water Quality Sampling Program. These documents were required by Idaho Department of Environmental Quality (IDEQ) to support the ROD for the North Rasmussen Ridge Mine EIS. Project work included negotiation of sampling sites and monitored parameters with agencies, and preparation of standard operating procedures for the North Rasmussen Ridge Mine.

- *Nicolet Minerals Company, Crandon Project, Wisconsin – Project Manager* – Hydrologic characterization and permeability testing of bedrock to support numerical modeling of ground water for the Crandon Mine Environmental Impact Statement (EIS). Project duties included the development and implementation of a permeability testing program for bedrock at the proposed mine site, data analysis, and preparation of technical documentation.

- *Nicolet Minerals Company, Crandon Project, Wisconsin – Project Manager* - Grouting Feasibility Investigation and Pilot Testing Program. Project duties included the design and implementation of a pilot testing program to investigate the feasibility of using cement based grouts to control inflow to the proposed underground mine. Preliminary grout formulations, standard operating procedures and cost estimates were prepared for the in-mine grouting program along with recommendations for mine dewatering and underground water handling. The results of the feasibility study and the conceptual grouting program were presented at public meetings and to agencies.

- *Nicolet Minerals Company, Crandon Project, Wisconsin – Project Manager* – Developed an analysis to relate weathering intensity, fracture frequency and aperture dimensions to hydraulic conductivity and groutability to project the reductions in permeability that can be achieved by a large scale grouting program

- *ENSR, Three Oaks Mine EIS, Texas – Project Manager* - Review and sensitivity analysis of "Brazos Region G" and "Three Oaks" numerical ground water flow models for the Three Oaks Mine Environmental Impact Statement (EIS).

- *CESEL Ingenieros, Cerro de Pasco, Peru – Project Manager* – Review and preparation of closure alternatives for Quiulacocha tailings facility and Excelsior waste rock dump, senior review of geochemical and hydrologic characterization programs, design of water quality monitoring program, numerical modeling (UNSAT-H) of seepage for cap/cover design.

- *FMC, Dry Valley Mine, Idaho – Project Manager* – Geochemical modeling and evaluation of chemical loading and transport in ground and surface water from proposed waste rock dumps for the Dry Valley Mine South Extension Project Environmental Impact Statement (EIS) Review and evaluation of geochemical testing data provided by EIS baseline contractor.

- *Minera Alumbrera, Alumbrera Project, Argentina– Project Manager* – Construction of a seepage capture well field for the Minera Alumbrera tailings facility. Project duties included the design, installation, and testing of a well field to capture bedrock seepage. Work performed for the project included on-site management of a two million dollar drilling program to locate, construct, and test nine large diameter (12-inch) extraction wells to depths of 200 meters.

- *Hecla Mining Company, Rosebud Mine, Nevada – Senior Hydrogeologist* – Hydrologic Characterization Study for the Rosebud Mine Environmental Assessment (EA). Project work included hydrogeologic characterization of the project area and evaluation of the potential impacts to ground water quality from underground mining. A geochemical model (PHREEQE) was developed to evaluate changes in mine water chemistry.

- *Akzo-Nobel Salt, Hampton Corners Mine, New York– Project Manager* - Hydrologic characterization for shaft sinking. Project work included the design and implementation of a drilling and packer permeability testing program for the shaft site and calculation of the anticipated ground water inflow during sinking.

- *Fluor Daniel, Alumbrera Project, Argentina – Senior Hydrogeologist* – Hydrogeologic investigation and evaluation of bedrock for tailings dam foundation. Project work included the design and installation of monitor wells, implementation of a packer permeability testing program, and evaluation of the hydrologic characteristics of bedrock.
- *Cyprus Minerals Company, Cerro Verde Mine, Peru – Senior Hydrogeologist* - Hydrogeologic characterization of a site for the construction of a copper heap leach facility. Project work included geologic evaluation and mapping, installation and testing of monitoring wells, packer permeability testing, and infiltration testing of unconsolidated sediments. Seepage estimates from the facility were prepared along with recommendations for facility monitoring.
- *Echo Bay Minerals Company, Key West Mill Site, Washington – Senior Hydrogeologist* – Hydrologic study and impact evaluation for the Key Mill near Republic Washington. The study incorporated analysis of the physical and chemical impacts to ground and surface water from milling operations and tailings disposal at the site.
- *Hecla Mining Company, Rosebud Mine, Nevada – Senior Hydrogeologist*,- Water supply study. Project work included the design and implementation of a ground water exploration program, installation and testing of production wells in fractured bedrock.
- *McIntosh Redpath Engineering, Monarch Mine, Venezuela– Project Manager* - Hydrogeologic characterization for shaft sinking. Project work consisted of underground drilling and packer permeability testing, calculation of inflow to the shaft during sinking and preparation of recommendations for water control and handling.
- *Getchel Gold Corporation, Turquoise Ridge Mine, Nevada – Senior Hydrogeologist* - Hydrologic characterization and water control study for the Turquoise Ridge Mine. Performed and evaluated pumping tests, and developed a numerical ground water flow model (MODFLOW) to predict inflow to the shafts during construction.
- *Coeur Alaska, Kensington Mine, Alaska – Senior Hydrogeologist* – Hydrologic characterization study. Reviewed existing studies and data to characterize hydrologic conditions for the Kensington underground mine. Mine dewatering and water handling recommendations were made, and a geochemical evaluation (PHREEQC/MINTEQA2) was performed to evaluate the potential long term water quality in the mine.
- *Meridian Gold, Bear Track Mine, Idaho – Senior Hydrogeologist* – Hydrologic characterization and dewatering study. Project work included the design, installation and testing of dewatering wells for the south pit, and spreadsheet modeling of ground water flow.
- *Meridian Gold, Beartrack Mine, Idaho – Senior Hydrogeologist* – Pit Filling Study. Performed analytical calculation of flooding for South Pit at the cessation of dewatering.
- *Southern Perú Copper Corporation, Perú – Project Manager* – Environmental audit. Reviewed and audited surface and ground water monitoring network for Toquapala and Cuajone mines, related tailings facilities and smelter and port facilities. Presented short courses for design of ground water monitoring networks, ground water modeling (MODFLOW/MT3D), and geochemical modeling (PHREEQC/MINTEQA2).
- *Sociedad Contractual Minera El Abra, Chile – Senior Hydrogeologist* – Third party review and hydrogeologic/geochemical characterization study for 180 mt. ROM Dump Leach facility. Project work included the review of previous hydrologic studies and the development of an integrated hydrogeologic model for the site. Leaching and attenuation studies for substrate materials were also performed using synthetic PLS. The main focus of the study was for permitting of the facility and to determine potential impacts to down stream users.
- *FMC, Dry Valley Mine, Idaho – Project Manager* – Surface Water and Ground Water Monitoring Plan and Quality Assurance Project Plan. Project work included negotiation of sampling sites and monitored parameters with agencies, preparation of SOP's, and development of text for the South Extension Mitigation Plan. Particular emphasis was placed on the selenium and sediment issues in Dry Valley Creek which is listed as a 303(d) impaired stream.

- *Arch Coal, Carbon Basin, Wyoming – Project Manager* – Geochemical characterization study. Prepared geochemical evaluation for D-5 permit application and developed stratigraphic correlation for acid producing potential and constituents of concern. Project work included development of 20 geologic cross-sections, interpretation of geophysical logs, preparation of geologic and geochemical sections for permit application, and statistical analysis of geochemical data.
- *Dudley and Associates, Seminole Road CBM Pilot Project, Hanna Basin Wyoming – Senior Geochemist* - Geochemical modeling (PHREEQC/MINTEQA2) to support design of water treatment facility for discharge from coal bed methane wells.
- *Fluor Daniel, Batu Hijau Project, Indonesia, - Senior Hydrogeologist* – Numerical modeling of ground water flow. Developed a finite difference ground water model (MODFLOW) to simulate a pumping well field in a shoestring alluvial aquifer. Model results were used to design a water supply well field for the mine and to predict the effects of pumping on surface water resources. The potential for sea water incursion into the aquifer was also evaluated. Model results were in good agreement with the installed well field.
- *Fluor Daniel, Alumbrera Project, Argentina – Senior Hydrogeologist* – Construction of water supply well field. Developed a ground water supply well field for the construction and operation of a large copper porphyry mine in northern Argentina. Project work included evaluation of ground water potential, field exploration for ground water, the installation and testing of 7 large diameter (16-inch) production wells, and numerical modeling (MODFLOW) of the water supply well field. Currently, the well field is producing at its design capacity of 750 l/sec, and observed drawdowns are in good agreement with modeled pumping.
- *Sociedad Mineria El Brocal, El Brocal Mine, Peru - Senior Hydrogeologist* – Numerical modeling of pit dewatering. Developed a finite-difference ground water flow model (MODFLOW) to predict inflow to the planned open pit. The effectiveness of using surface extraction wells to dewater the mine was evaluated along with the potential impacts to surface water resources.
- *American Electric Power, Windsor Mine, W. Virginia – Senior Hydrogeologist* – Prepared Probable Hydrologic Consequences (PHC) document for C-Panel expansion. Project work included the design and installation of a water quality/quantity monitoring network for the C-Panel area, determination of PHC's, and preparation of permitting document.
- *American Electric Power, 44 Hollow Mine, W. Virginia – Senior Hydrogeologist* – Prepared Probable Hydrologic Consequences (PHC) document for the proposed underground fine refuse disposal in the 6 East Panel, 44 Hollow Mine. Project work included the development of site hydrogeology, evaluation of mine flooding and seepage, and preparation of PHC document.
- *Cyprus Foidal Creek Coal Mine, Colorado– Senior Hydrogeologist* – Prepared study of longwall mining operation on surface and ground water resources, including permit to mine under an alluvial valley floor.
- *Cyprus Twentymile Coal Company, Colorado – Senior Hydrogeologist* – Prepared salt loading evaluation of mine spoils on local drainages tributary to the Yampa River.
- *Coeur Alaska, Kensington Mine, Alaska – Senior Geochemist* – Developed geochemical characterization program for cemented paste backfill containing flotation and cyanide tailings which incorporated column testing, acid-base accounting, NMWMT testing.
- *Minera Hecla, La Choya Mine, Mexico – Senior Geochemist* - Designed and supervised sampling program for waste rock and spent ore to characterize material for site closure. Analytical laboratories in Hermosillo Mexico were evaluated for their ability to perform meteoric water mobility tests, acid-base accounting, and rinse down detoxification column tests. A review of the existing geochemical data was performed to determine adequacy for mine closure.
- *LAC Minerals U.S.A., Ortiz Mine, New Mexico – Senior Geochemist* - Developed a predictive geochemical model (PHREEQE) for the Ortiz Pit Lake. Equilibrium methods were used to identify and constrain geochemical controls of the pit lake water composition. The model incorporated humidity cell, acid-base accounting, XRD, microprobe and limnologic data to estimate the long-term water quality. Chemical profiles were developed from samples collected at various depths to investigate the potential for stratification of the lake.

- *LAC Minerals U.S.A., Coliseum Mine, California – Senior Geochemist* - Developed a predictive geochemical model (PHREEQE) for closure of the Coliseum Pit Lake. The model used equilibrium methods to identify and constrain geochemical controls of pit lake water quality, and incorporated humidity cell, acid-base accounting, and whole rock geochemical data. Chemical profiles were developed to investigate the potential for stratification of the lake.
- *Echo Bay Minerals Company, Key West Mine, Washington – Senior Geochemist* - Developed a predictive geochemical model (PHREEQE) for the Key West Pit Lake. Equilibrium methods were used to identify and constrain geochemical controls of pit lake water quality. The study incorporated humidity cell, acid-base accounting, and whole rock geochemical data.
- *Echo Bay Minerals Company, Key West Mine, Washington – Senior Geochemist* – Revision and recalibration of the of the physical filling and geochemical pit lake models (PHREEQC/MINTEQA2) to incorporate an additional 6 years of monitoring data.
- *Astaris, Dry Valley Mine, Idaho – Project Manager* – Prepared Annual Surface and Ground Water Monitoring Reports for 1998 - 2002.
- *Envirocare Clive Facility, Utah – Senior Geochemist* – Developed soil partition coefficients (K_ds) for organic constituents and radionuclides for the 11e.(2) and Western Low Activity Radioactive Waste (LARW) disposal cells.
- *Canyon Resources, Briggs Project, Nevada – Senior Hydrogeologist* – Developed Standard Operating Procedures Manual for ground water and surface water sampling the mine. Performed statistical analysis of water quality data to determine the Constituents of Concern (COC's) to which the mine is regulated.
- *Lac Minerals U.S.A., Ortiz Mine, New Mexico – Senior Hydrogeologist* - Designed and installed a grout curtain below an acid rock drainage (ARD) interceptor system to reduce seepage in fractured bedrock. Laboratory testing and geochemical modeling (PHREEQE) were performed to evaluate grout resistance to chemical attack.
- *Echo Bay Minerals, Lamefoot Mine, Washington – Senior Geochemist* - Statistical analysis and characterization of ground water quality.
- *TRC, Barrick Goldstrike Mine, Nevada – Project Manager* – Geochemical modeling (PHREEQC/MINTEQA2) of sorption and mineral precipitation/ dissolution reactions for the Betze-Screamer Pit Lake. Particular emphasis was placed on modeling the sorption behavior of arsenic to precipitating ferrihydrite using the program PHREEQC and a modified MINTEQA2 thermodynamic database.
- *Tenneco Minerals, Goldstrike Mine, Utah – Senior Geochemist* - Characterized the spatial distribution of trace metals in relation to structural features and ore-grade gold mineralization in the Humbolt Pit. The study included the design and implementation of the sampling program and a statistical analysis of trace metal correlation with gold.
- *Barrick Goldstrike Mines, Betze-Screamer Pit, Nevada – Project Manager* - Performed senior review of geochemical pit lake model for Betze-Screamer Pit.
- *Minera Yanacocha, La Quinua Pit, Perú – Project Manager* – Performed mixing and pH calculations for pit dewatering discharge and receiving surface waters.
- *Minera Alumbrera, Alumbrera Mine, Argentina – Senior Geochemist* – Prepared standard operating procedure manual for ground water and surface water monitoring program.
- *Coeur, Rochester Mine, Nevada – Senior Hydrogeologist* – Installation and hydrologic testing of a 14-inch water supply well to a depth of 1,000 feet.
- *Coeur, Rochester Mine, Nevada – Senior Hydrogeologist* – Numerical modeling of ground water flow an contaminant transport for the Stage I heap Leach Facility.
- *Astaris, Dry Valley Mine, Idaho – Project Manager* – Design and installation of deep (>900 ft.) monitoring wells.

- *Kinross, Kettle River Operations, Washington – Senior Hydrologist* – Prepared numerical ground water flow and contaminant transport model (MODFLOW/MT3DMS) to evaluate mitigation strategies for ground water contamination at the Key Mill Tailings Facility. The model incorporated multiple contaminant sources, and was calibrated to 14 years of water quality and water level data.

PUBLICATIONS

Effner, S., Straskraba, V., Vandersluis, G., 1995. Pressure Grouting of Fractured Bedrock to Control Acid Mine Drainage. Proceedings of the 1995 Annual Meeting of The American Institute of Hydrology and the International Mine Water Association, Water Resources at Risk.

Straskraba, V. and Effner, S., 1998. Water Control in Underground Mines - Grouting or Drainage?, Proceedings of the 1998 Annual Meeting of The American Institute of Hydrology and the International Mine Water Association, Water Resources at Risk.

Vandersluis, G., Straskraba, V., and Effner, S., 1995. Hydrogeological and Geochemical Aspects of Lakes Forming in Open Pit Mines, Proceedings of the 1995 Annual Meeting of The American Institute of Hydrology and the International Mine Water Association, Water Resources at Risk.