GCS Geoscience

Engineering Geology
Geographic Information
Environmental Planning

554 South 7700 East Street
Huntsville, Utah 84317
d| 801 745 0262
m| 801 458 0207
gcsgeoscience@gmail.com
gschlen@q.com
gcsgeoscience.com

GCS Geoscience is a western U.S. geoenvironmental consulting service based in northern Utah. We are committed to providing solutions to the engineering geology, environmental planning, and geographic information technology markets. Our answers are not the right answers, but the best answers based on our analysis, observations and experience. We provide a wide range of geoenvironmental service to individuals, companies, and communities, and answer to your specific geoenvironmental challenges. The World is a changing place, and we are dedicated to doing the best for our present generation, and future generations.

Project Experience

The following is a representative selection of GCS Geoscience project experience:

Geological Hazards

Surface Fault Rapture Hazard and Slope Stability Evaluation, Proposed Residential Structure, Lot 19 Deer Ridge Development Draper, Utah – Senior Geologist 2014. Conducted field and desk top studies to evaluate the presence or absence of surface faulting and the potential of slope stability issues for a single family residential development lot. Trenching across the "footprint area" for the proposed structure revealed no indication of past fault movement, and slope stability analysis indicated stable conditions for the site under both static and dynamic loading conditions.

Surface Fault Rapture Hazard and Karst Evaluation, Proposed Piñon Ridge Uranium Mill Site, Montrose County, Colorado – Project Geologist 2008. As part of a general engineering geology evaluation for the uranium mill site, the potential for Quaternary faulting and karst development were identified on the 880-acre site. The potential hazards were related to the salt-dome collapse structure defining the Paradox Valley where the site was located. Seismic refraction lines identified bedrock displacement at depth, and field observations identified karst activity near the site. To evaluate whether the displacements at depth projected to the surface and displaced Quaternary deposits, nearly 3,000 feet of exploration trenches were excavated across the areas of the site scheduled for improvements. Stratigraphic units were delineated on the basis of soil units truncated by calcium carbonate horizons, and trench walls were logged at a scale of 1-inch to 5-feet. The results of the trenching indicated that Quaternary displacement did not appear to be present in the areas trenched. To evaluate karst,a GPS survey was conducted to document "circular feature" areas identified on aerial photography on and in the vicinity of the site. A total of 35 circular feature" areas were visited and documented, with none of these areas showing evidence karst activity.

Geological Hazards Evaluation and Plan; Lindon City Foothills Area, Utah County, Utah - Project Manager, 2007. Conducted investigation of the Foothills Area engineering geology, to identify the geological hazards that the Foothills area may be exposed to. The investigation found that the Foothills Area was exposed to several geological hazards, including strong earthquake ground motion hazards, surface fault rupture hazards, landslide and slope stability hazards, debris-flow hazards, flood hazards, and

potential problem soil and rock hazards. Areas identified as exposed to hazards were mapped using a GIS so that future land use planning decisions can be based on the hazard information. Strategies to reduce the exposure to the hazards, or mitigate the hazards are also provided to assist the city planners with future land use decision-making.

Slate Canyon Geological Hazards Evaluation; Provo, Utah - Project Manager 2006 Assisted land use planners in the development of a land use plan for a foothill neighborhood in Provo City. The planners were developing a comprehensive development plan for the neighborhood, however because this area was exposed to several natural geological hazards the incumbent was requested to assist by evaluating the geological conditions relevant to land use suitability and limitations for the Slate Canyon Area. Recommendations relative to exposure to active earthquake faults, debris flows, clear water flooding hazards and potentially liquefiable soils in the area were implemented into the final plan.

Engineering Geology Studies, Environmental Document In Support Of Proposed SR 6 Improvements; Spanish Fork to Green River, Utah - Project Geologist, 2005. In conjunction with geotechnical engineering and rock slope engineering studies, The Incumbent conducted technical engineering geology studies and detailed surficial geological mapping for support of environmental documentation being prepared for existing highway improvements for an approximately 127-mile segment of State Highway. Primary tasks included surficial geological mapping of highway alignment, seismic hazard characterization, natural hazards characterization, construction of geological issues on GIS for report presentation and delivery.

Geotechnical Engineering-Engineering Geology Studies, Lost Creek Canyon Pipeline Project; Summit County, Utah - Project Manager, 2004. Managed geotechnical engineering-engineering geology evaluation for a 5.1-mile 24-inch-outside diameter (OD) raw water pipeline project that will extended from a shallow aquifer water collection well system near Rockport Reservoir, to a water storage reservoir and a water treatment facility site at the Promontory development, in Summit County, Utah. The study included an evaluation of geologic hazards, slope stability, corrosion potential, seismic characterization and geotechnical material suitability for bedding and backfill for pipeline construction; geological evaluations for the Weber River and State Road 32 bore and jack crossings; geotechnical evaluation for a booster pump station facility and water treatment facility; and soils and permeability evaluation of two water storage reservoirs.

Stability Assessment, Cahba River Trunk Sewer Tunnel; Jefferson County, Alabama - Project Manager, 2002. A professional team was retained to assess as third-party experts for the geotechnical engineering and geologic hazards that could potentially impact the 12-foot diameter tunnel crossing beneath the Cahaba River near Birmingham Alabama. As an independent entity the team examined the project from two different time frames, namely the construction period and the operational period. Based on an inspection of the site, inspection of existing tunnels in the vicinity of the planned crossing, a review of the geotechnical samples, a review of geological and mining information and records, a review of the plans and specifications for the work, a review of the construction calculations and construction plans, discussions with the engineers and constructors involved with the projects, and a review of transcripts from public hearing and numerous documents pertaining to this crossing the team concurred with

the original finding that this tunnel crossing could be safely built and safely operated through its life cycle.

Surface Fault Rupture Hazard Evaluation, SR 201 Interchange Structures; Salt Lake City, Utah - Project Geologist, 2002. This investigation was conducted to evaluate the presence or absence of surface fault rupture hazards that could potentially affect highway interchange structures included for consideration in an environmental evaluation. The study included the excavation and logging of five exploration trenches at two proposed interchange locations to evaluate potential surface fault rupture hazards impacting the construction. Trenches were excavated to depths that exposed Pleistocene-age sediments, and were observed to determine the presence or absence of fault-related deformation in the Pleistocene-age sediments. The findings of the investigation concluded no indications of active fault deformation were observed in the trenches.

Geological and Geotechnical Responses to EIS Performance Standards for Proposed Natural Gas Mainline, Questar Regulated Services; Carbon, Emery, Sanpete and Utah Counties, Utah - Project Geologist/Project Manager, 2001. As directed by Environmental Impact (EIS) performance standards, geologic hazard and geotechnical evaluations for proposed a 75.6-mile, 24-inch natural gas pipeline from the Price Coal Bed Methane Project west of Price, Utah, to a termination point at Elberta, Utah. The evaluations included seismic hazards, slope stability hazards, surface fault rupture hazards, underground mine subsidence hazards, liquefaction potential hazards, flooding and stream scour, and collapsible soils hazards as directed by Bureau of Land Management and Forest Service Resource Managers.

Proposed Wasatch Boulevard Office Building Fault Rupture Hazard/Engineering Geology Evaluation, Salt Lake City, Utah - Project Manager, 1998. Was responsible for the evaluation of the office building site in close proximity to Wasatch fault. Four trenches were excavated comprising 450 feet of exposed soils for field interpretation and logging. Primary and secondary fault traces were and exposed, and recommendations for setbacks from the faulting were provided for the placement of the proposed 80,000 square foot building.

Engineering Geology/Slope Stability, Abandoned Mine Workings Evaluation, Deer Crest Development, Near Park City, Wasatch County Utah - Project Manager, 1998. Directed engineering geology, slope stability and abandoned mine workings evaluations for a proposed exclusive ski resort and residential, ski-in ski-out, development. Project team consisted of geologist, engineers and environmental professionals. The approximately 400-acre site is located on steep mountainous terrain with variable soil and geologic conditions. Site evaluation was developed from aerial interpretations, field reconnaissance and documentation, and soil and rock measurement from over 106 excavations. Appropriate recommendations regarding slope stability, snow avalanche, flooding, expansive soils and abandoned mine hazards were provided to safely steer site development.

Landslide Hazard Evaluation, Questar/Amoco Alignment, Weber Canyon, Morgan County, Utah - Project Manager, 1998. Failure of a supporting slope threatened integrity of shared natural gas and crude-product pipeline alignment located on steep slope above a popular fishery. Correlation of areal geologic and seismic refraction data was

utilized by the geologic and engineering staff to develop engineering repair strategies for the stabilization of failed slope.

Reconnaissance Landslide Investigation for 138 Kilovolt and 48 Kilovolt Power Transmission Towers, Shurtz Lake Landslide, PacifiCorp Engineering, Spanish Fork Canyon, Utah - Project Manager, 1996. Failure of the Shurtz Lake landslide threatened the integrity of 138 and 48 Kilovolt power transmission towers. Provided recommendations for mitigating active landslide damage and future potential damage to transmission tower structures constructed over an active landslide area.

Engineering Geology/Landslide Hazard and Monitoring Evaluations, Residential Development, Hoover Slide Zone, Provo Canyon Near Deer Creek Reservoir, Wasatch County, Utah - Staff Geologist-Project Manager, 1995-1999. Performed engineering geology analyses of existing and proposed residential developments on a landslide complex with active and inactive components. Monitoring activities included the evaluation of inclinometer readings recorded from 1993 to 1999.

NEPA/Environmental Permitting and Planning

Eagle Island Restoration Project, Boise River Ada County, Idaho, Senior Geologist 2010 – Present. Following a review and integration of one-foot aerial imagery, two–meter LiDAR, and existing geologic map layers at greater detail the surficial engineering geology mapping of the Eagle Island area was prepared at best scales using GIS analysis. Additionally historical 1939 aerial photography layers were integrated into the GIS database to demonstrate landscape change for the area. This data will be used by the Geotechnical Engineer, and USA Corps of Engineers Environmental Scientist for restoration decision-making.

Earth Resource Assessment, Mountain States Transmission Intertie Project - From 2007 to 2008. The Mountain States Transmission Intertie (MSTI) project is planned for the construction of a 500kv transmission line from west-central Montana to south-central Idaho to provide power grid relief in this part of the country. Although straight-line distance between the connecting substations is approximately 280 miles, nearly 990 miles of routing comprising 31 segment alternatives were evaluated to fulfill environmental planning requirements. Engineering geology issues evaluated in this characterization included surficial geology, mass movement potential, slope conditions, active faults, seismic zonation and liquifaction potential. To individually characterize these issues, each segment was mapped at “best-scales” using a GIS to integrate vector, raster and digital elevation information across the two state area. The GIS enabled the numeric quantification of the geological issues thereby allowing the environmental planners to compare and assess geologic and environmental impacts along the route segments.

Utah Division Of Oil Gas and Mining (DOGM) Large Mining Operation Permitting, Beck Street Quarry, City of North Salt Lake, Utah - Project Geologist, 2006. Prepared permitting for a Large Mining Operation regulated by the State of Utah DOGM for an aggregate rock Quarry that was to be used for materials for the construction of the Legacy Highway in northern Utah. The permit application required the development a mine operations and reclamation plans for mine development, operations and closure. Development and operations plans required the description of equipment used, routing

of haul trucks, blasting patterns and estimates to be used on the site. The reclamation plans required descriptions of topsoil management and sequestering, design and stability analysis of final mine cut highwall, and final re-contouring and revegetation of the site, and an estimate of surety to be bonded for the mine reclamation costs.

Proposed Park Well, Wilkinson Cottonwood Mutual Water Company Environmental Assessment, Mountain Green, Utah (Federal Revolving Fund Project #3F036) - Project Manager, 2005. Because federal funds were involved with this well development, an environmental assessment (EA) was required. The requirements of this EA were regulated and reviewed by the Utah State Division of Drinking Water, Department of Environmental Quality. This EA primarily involved desk-top studies and correspondences with "cross-cutter" agencies to inform of the proponent's proposed actions. Two public meetings were announced and held in Mountain Green at the commencement and conclusion EA studies.

Noise Analysis, Proposed PacifiCorp Lake Side Power Plant, Vineyard, Utah - Project Manager, 2004 and 2007. The purpose of the noise study is to evaluate whether the noise levels generated by the proposed Summit Vineyard Lakeside Power Plant (Lakeside Power Plant) comply with relevant noise limits established in the surrounding communities, and conform to the surrounding land use and zoning. To evaluate the potential noise impacts that the proposed plant would produce we assessed the land use of areas surrounding the proposed power plant location and compiled relevant noise limits established by state and/or local ordinances for the various land uses surrounding the proposed plant. Using GIS, the modeling of future maximum noise levels associated with the proposed power plant operation was performed using analytical calculations. The results of our modeling indicated the predicted noise levels generated by the proposed power plant would be in compliance with surrounding land uses. Follow up analysis following the commencement of plant operations in 2007 indicated that plant operations noise at full generation capacity did not exceed the 2004 modeled noise estimates.

South State Street CATX-Noise Analysis - Project Manager, 2004. Noise Analysis for State Street from 9000 South Street to 10600 South Street in Salt Lake County, Utah. Project requires taking existing noise measurements with 2B-3080 noise monitor, a detailed analysis using noise prediction model TNM 2.5, and determining the feasibility of noise mitigation using Federal Highway Administration guidelines. Noise assessment and mitigation modeling using the TNM 2.5,and ArcView GIS also performed to identify the appropriate mitigation options. The results of the studies and the impacts of each alternative are to be considered and documented for inclusion in the CATX Document.

Dugway Proving Ground, Michael Army Airfield Fixed Wing Runway Environmental Assessment - Project Manager, 2004. The environmental assessment for reconstruction and operational activities at the Michael Army Airfield, Dugway Proving Grounds was performed to evaluate potential environmental impacts of these activities. The EA describes and evaluates potential impacts to the following resources from the proposed construction and operation of the Airfield reconstruction project. The issues assessed include (1) vegetation, (2) wildlife, (3) threatened or endangered species, (4) water quality, (5) air quality, (6) soil impacts, (7) cultural resources, (8) land use, (9) hazardous and toxic materials, (10) socio-economic resources and (11) noise. The EA describes existing conditions of these resources, evaluates potential impacts to these resources and identifies mitigation activities for these impacts. A range of alternative actions

including the no action alternative was evaluated. Our team conducted a detailed site assessment of the potentially impacted areas of the installation and providing full documentation of compliance with the NEPA process and other applicable Federal and State environmental laws and regulations including but not limited to: The Clean Air Act, Clean Water Act, Endangered Species Act and the National Historic Preservation Act and Army Regulation AR-200-2.

I-215 Improvements, Environmental Assessment & Noise Analysis, Salt Lake County, Utah - Project Scientist, 2002. Noise Analysis for Interstate-215 from Intersate-80 to 300 East Street, Salt Lake County, Utah. Project required taking existing noise measurements with 2B-3080 noise monitor, a detailed analysis using noise prediction model TNM1.1, and determining the feasibility of noise mitigation using Federal Highway Administration guidelines. Also performed mitigation modeling using the TNM 1.1 model to identify the appropriate mitigation options. The results of the assessment and the impacts of each alternative were considered and documented for inclusion in the Environmental Assessment document. Detailed technical memorandums were also provided during the course of the project.

Geological and Geotechnical Support for FERC Environmental Resource Report, Proposed Natural Gas Mainline, Questar Regulated Services; Carbon, Emery, Sanpete and Utah Counties, Utah - Project Geologist 1999. Performed desk-top studies of geological and geotechnical conditions for a proposed a 75.6-mile, 24-inch natural gas pipeline from the Price Coal Bed Methane Project west of Price, Utah, to a termination point at Elberta, Utah. The studies included seismic hazards, slope stability hazards, surface fault rupture hazards, underground mine subsidence hazards, liquefaction potential hazards, flooding and stream scour, and collapsible soils hazards.

NEPA Environmental Assessment, Granite Flowline; Big Cottonwood Canyon, Utah - Project Manager, 1996. Supervised in-house and contract team consisting of geologist, hydrogeologist, geotechnical engineers, traffic engineers, landscape architects, soil scientists, environmental specialists, and plant and animal biologists. The NEPA assessment was conducted for PacifiCorp under review specifications by the Wasatch National Forest. The assessment of proposed and alternative actions assisted National Forest personnel in selecting a preferred alignment for the two-mile hydroelectric pipeline alignment.

Water Resources and Dams

Geological Hazards Evaluation for a Proposed 1.5 Million Water Tank, Draper, Utah – Senior Geologist 2012. Performed geological hazards evaluation for the Geotechnical Engineer. The tank site was investigated through desk-top GIS analysis, and a field program was conducted that included two geotechnical borings and a 210-foot long exploration trench across the proposed tank location. Geological hazards evaluated for the tank site, included surface fault rupture hazards, strong seismic ground motion hazards, liquefaction potential, landsliding and slope stability, debris hazards and stream scour hazards.

Geologic and Geoseismic Support, Austin-Wall Dam Level II Study, Fort Bridger, Uinta County Wyoming - Senior Geologist 2010-2011. Support included engineering geology mapping, geological hazards characterization, using photogeologic analyses of site

imagery, GIS analyses of elevation and terrain data, and reconnaissance to the site. Seismic hazard characterization was also conducted to evaluate the Maximum Credible Earthquake (MCE) and the Operating Basis Earthquake (OBE) for the dam site. Also supervised field drilling activities for the geotechnical engineer.

Seismic Hazard Assessment, Weber Basin Water Conservancy District. Davis, Weber and Box Elder Counties, Utah – Project Geologist, 2009. Performed a seismic hazard assessment for District System, primarily using GIS for assessment. Hazards assessed included, general geology, strong ground motion (both peak horizontal acceleration and modified Merchalli), exposure of the system to surface fault rupture hazards, liquefaction potential, landsliding, and debris flows hazards.

Geoseismic Evaluation, PacifiCorp Klamath River Hydroelectric Project - Project Manager, 2008. The Klamath Hydroelectric Projects consists of the J.C. Boyle Dam in Klamath County, Oregon, and the Copco No. 1 and Iron Gate Dams in Siskyou County, California. Because the dams are undergoing studies for Federal Energy Regulatory Commission (FERC) re-licensing, the FERC requested that seismic studies to be conducted that addresses the capability of regional earthquake faults, including the West Klamath Lake Fault Zone, the Cedar Mountain fault system and the Cascadia Subduction Zone. To characterize the seismicity of the of the dams, a regional seismic survey supported with GIS was performed consistent with the Federal Guidelines for Dam Safety, which include probabilistic earthquake parameters as well as calculating the Maximum Credible Earthquake (MCE) and the Operating Basis Earthquake (OBE) for the dam sites.

Geological Evaluation and Support for Geotechnical Planning and Economic Cost-Benefit Analyses for Control of Sediment in Irrigation Water from Twelvemile Creek; Sanpete County, Utah - Project Manager, 2008 through 2010. Water from the Twelvemile drainage has been used for irrigation by farmers and ranchers surrounding the communities of Mayfield and Gunnison, Utah since the mid 1800's. Historical landslide movement beginning in the 1980's in Twelvemile drainage has resulted in excessive suspended sediments that result in infrastructure damage and production losses on the order a half-million dollars annually. Incumbent provided engineering geology support and expertise for a multi-agency team tasked with developing a feasible strategy for mitigating the losses from sediment. This on-going project includes stakeholders from federal, state and county agencies.

Level II Study for the Upper Green River Storage Project for the Wyoming Water Development Commission - Project Geologist, 2007. As part of engineering and feasibility studies, provided supporting engineering geology assessments of four proposed dam sites in the Upper Green River Basin of Wyoming. Assessments included engineering geology mapping, geological hazards characterization, seismic hazard characterization, using photogeologic analyses of site imagery, GIS analyses of elevation and terrain data, and a limited reconnaissance to each of the four sites.

Geoseismic Evaluation PacifiCorp Grace Dam; Caribou County, Idaho - Project Manager, 2006. The Grace Dam consists of a 51-foot-high by 180-foot-long rock-filled timber crib dam, with a concrete core and a 120-foot-long central spillway section with 8-foot-high wooden flashboards; with a 250-foot-long earthen dam on the right abutment; a forebay with 250 acre-feet of usable storage capacity at a surface elevation of 5,555 feet a 52-foot-wide intake structure contained within a concrete stucco building, adjacent to

the embankment section of the dam, containing eighteen 5-foot by 10-foot screen sections. Because the dam is undergoing studies for Federal Energy Regulatory Commission (FERC) re-licensing, the FERC indicated that a seismic study should be conducted which addresses the capability of regional earthquake faults. To characterize the seismicity of the of the Grace Dam Site consistent with the Federal Guidelines for Dam Safety, which include probabilistic earthquake parameters as well as calculating the Maximum Credible Earthquake (MCE) and the Operating Basis Earthquake (OBE) for the site from the site.

Geoseismic Evaluation PacifiCorp Soda Dam; Caribou County, Idaho - Project Manager, 2006. The Soda Dam consists of: a 103-foot-high by 433-foot-long concrete gravity dam, with a 210-foot-long non-overflow gravity section, a 109-foot-long integral powerhouse section containing five headgates that supply water to the generating unit penstocks and to a 900-cubic feet per second capacity low-level discharge, and a 114-foot-long gated overflow spillway section containing three, 30-foot by 14-foot Taintor gates; a 55-foot-long by 19-foot-high earth fill dam; the Soda reservoir with a surface area of 1,100 acres, an active storage capacity of 16,300 acre-feet. Because the dam is undergoing studies for Federal Energy Regulatory Commission (FERC) re-licensing, the FERC indicated that a seismic study should be conducted which addresses the capability of regional earthquake faults. To characterize the seismicity of the of the Grace Dam Site consistent with the Federal Guidelines for Dam Safety, which include probabilistic earthquake parameters as well as calculating the Maximum Credible Earthquake (MCE) and the Operating Basis Earthquake (OBE) for the site from the site.

Geotechnical and Geophysical Field and Laboratory Services, PacifiCorp Ashton Dam; Ashton, Idaho - Project Manager, 2005. In support of the Civil Engineer (Black & Veatch) performed piezometer testing, ground penetrating radar (GPR) Survey, geotechnical drilling and sampling, and laboratory testing services to support the Civil Engineer to perform seepage investigation.

PacifiCorp Cove Pond Sediment Characterization Study; Caribou County, Idaho - Project Manager, 2005. The Cove Pond is an approximately 1200-foot long by 400-foot wide reservoir on the Bear River that is impounded by a 27-foot high dam that redirects water into a flume for hydroelectric generation. The dam has impounded water in the reservoir since 1912, and sediments from upstream areas have been captured behind the dam. Because significant agricultural, industrial, waste disposal and mining activities occur up-stream of the reservoir, the potential for the accumulation of hazardous levels of chemical constituents in the captured sediments is a concern. The Client was considering the decommissioning of the Cove Pond Dam as part Federal Energy Regulatory Commission (FERC) re-licensing requirements. The action would involve removing the dam, and the sediments behind the dam could potentially migrate down stream. Because of the concerns regarding the chemical constituents that may be contained within sediments behind the Dam, the Idaho Division of Environmental Quality (DEQ) and the U.S. Environmental Protection Agency (EPA) has requested that these sediments be analyzed for hazardous constituents that may have become concentrated behind the dam. To characterize the sediments, we sampled the pond sediments using, a barge mounted geo-probe sampler over the Cove Pond water surface. The sampled sediments were tested for constituents specified by the Idaho DEQ and EPA, and were found not have hazardous levels of chemical constituents requiring remedial actions.

Geotechnical and Geological Feasibility Evaluation, Proposed Spring Creek Reservoir; Uintah County, Utah - Project Geologist, 2003. Feasibility evaluation of the proposed dam site was conducted to evaluate the site relative to performance as a dam site, exposure to seismic and geological hazards, suitability of soil and rock materials on the site for use in dam construction, and recommendations as to dam structure. Surface and subsurface investigation included excavation of 20 test pits and three rock-core borings to as much as 290 feet. During the rock-core drilling, Packer testing was conducted to evaluate the hydraulic conductivity of the rock units underlying the dam and reservoir. Our findings were used by the County for the decision as to proceed with or abandon the site for proposed dam construction.

Dam Safety Evaluation, Jones Dam-UT00156; Wasatch County, Utah - Project Geologist, 2003. Conducted engineering geology and geotechnical evaluation of existing dam structure. Evaluation indicated that the dam did not meet the current Utah State safety standards, and recommendations were provided to bring the dam into compliance with minimum standards.

Dam Safety Evaluation, Three Creeks Three Creeks Dam-UT 0035; Sevier County, Utah - Project Geologist, 2001. Conducted engineering geology and geotechnical evaluation of existing dam structure. Evaluation indicated that the dam did not meet the current Utah State safety standards, and recommendations were provided to bring the dam into compliance with minimum standards.

Source Evaluations Mining

Hidden Splendor Resources, Horizon Mine, Plan Review, Carbon County, Utah - Senior Geologist, 2013. Conducted annual Mine Plan Review for ongoing mine permitting operations.

Michael Army Airfield Reconstruction Phase III, Aggregate Investigation, Dugway Proving Ground, Utah - Project Geologist, 2002 to 2005. The reconstruction of the Michael Army Airfield at Dugway Proving Ground, Utah required the development of new aggregate sources on the Proving Ground that could provide 1.25 million tons of aggregate for the reconstruction of two aircraft runways, 8,000 and 15,000 feet long. The 8,000- foot runway was to serve as an interim asphalt runway during the reconstruction of the 15,000-foot Portland concrete (PCC) main runway. During 2002 preliminary aggregate source evaluations for the 8,000-foot asphalt runway, which was constructed in 2003, the two aggregate source areas used were found to be lacking in suitable sand and gravel gradations, or to be comprised of lithologies unsuitable for the PCC materials that would eventually be needed for the main runway scheduled for construction in 2005. To locate adequate materials for the PCC runway requirements a geological and geomorphological GIS database was constructed by integrating existing geological mapping and geomorphological models relating to Pleistocene Lake Bonneville hydrography. The GIS helped to identify 10 candidate sand and gravel and rock aggregate sites on the Proving Ground that were later explored, sampled and tested for the runway PCC requirements. Despite the Proving Ground being nearly as large in area as Rhode Island, only a limited area was found to possess suitable lithologies for the PCC runway requirements. The GIS was also used to prioritize the selected sites for final selection of two sites on the basis of material suitability criteria, site access, proximity to the runway, and available water source locations.

Michael Army Airfield Reconstruction Phase II, Aggregate Investigation, Dugway Proving - Project Geologist, 2002. Aggregate Source Investigation for Proposed US Army 15,000-foot Fixed Wing Runway, Dugway Proving Grounds. Investigated numerous aggregate source locations at the proving grounds to identify source locations with adequate aggregate resource volumes for the construction of a 15,000-foot fixed wing runway. Eight sites were initially considered for resource development with two sites selected for resource volume and material quality exploration. Ultimately 1.2-million tons of suitable materials were identified to satisfy the 0.75-ton product requirement for the runway construction.

Geologic Materials Assessment Staker Paving Beck Street Quarry, Approximately 2100 North Beck Street, Salt Lake City, Utah - Project Manager,2000. Study was conducted to assess the nature and distribution of geologic-materials at the site. This assessment evaluated the distribution of competent Paleozoic rocks as opposed to the softer Tertiary and Quaternary rocks, for the development of a mining plan at the Beck Street Quarry.

Borrow Resource Evaluation, CPC White Hill Sand and Gravel Pit Phase II, North Salt Lake, Utah - Project Manager, 1999. Study was conducted to evaluate the remaining sand, gravel and coarse aggregate reserves of a previously un-mined property. The site geology was mapped in the field and the available sand, gravel and coarse aggregate volumes for mining at the site were estimated from test pit excavations and Odex System drilling.

Borrow Resource Evaluation, CPC White Hill Sand and Gravel Pit, City of North Salt Lake, Utah - Project Manager, 1998. Evaluated the remaining sand and gravel resources for existing sand gravel. Remaining resource volumes were estimated from borings, test pits and interpolations of geological structures. The evaluation revealed that most of the suitable materials on the approximately 70-acre site had been mined, and remaining resources were of marginal quality. Results of evaluation assisted owners in the decision to discontinue mining the site and convert site to future residential uses.

Gravel Mine Reserve Evaluation, Craythorne Gravel Mine, Davis County Utah - Project Manager, 1998. Study was conducted to evaluate the remaining sand and gravel reserves so that the future duration of mining operations could be estimated for conditional use zoning permits. The site geology was mapped in the field and the sand and gravel reserve volumes for the site were estimated using three-dimensional computer modeling to estimate reserve mine-out.

Reclamation Highwall Evaluation, Staker and Hughes Quarries, approximately 2100 North Beck Street, Salt Lake City, Utah - Project Manager, 1995. The study was conducted to evaluate the geological conditions affecting the long-term-future stability of adjacently owned coarse aggregate quarries. The geology of the sites and critical rock structure data were mapped in the field and static and dynamic slope stability analyses were modeled for differing slope angle/benching scenarios. Final slope configurations were recommended for closure and reclamation planning.