

Tom (Thomas) Kaldenbach

Bend Geoscience, Owner/Principal

P. O. Box 5247; Bend, OR 97708

Tel. (541) 719-8401 Email: tom@bendgeoscience.com

Tom Kaldenbach has worked as a professional geologist in the public and private sectors for more than 30 years. Tom is responsible for managing Bend Geoscience, conducting environmental site assessments, environmental permitting, and natural resource evaluations. Prior to establishing Bend Geoscience in 2015, he was a supervisor in the mine environmental regulatory program of the State of Colorado's Division of Reclamation, Mining and Safety. Prior to his 18-year career with the State of Colorado, he worked as a geologist in the oil and gas industry in exploration, property management, and consulting to private industry and the U. S. Forest Service.

With the State of Colorado, Tom conducted more than 400 investigations of mine sites through the State's inspection and enforcement process. He reviewed and processed more than 100 permit applications and revisions for sites. Mine permits are comprehensive environmental permits with associated state, federal, and local agency approvals, including: storm water and industrial waste water discharge (NPDES) permits, Army Corps of Engineers dredge and fill 404 permits, historical and cultural resources (SHPO) clearances, wetland mitigation measures, U. S. Fish and Wildlife Section 7 Consultations, air emissions permits, NEPA clearances (EAs or EISs), and local land-use approvals.

EDUCATION

M.S. Geology, 1984, Colorado State University, Fort Collins

Course concentration: Fluvial sedimentology

Thesis: "Geology of the Bannock Peak Area, Deep Creek Mountains, Idaho"

B.A. Geology, 1980, University of Colorado, Boulder

PROFESSIONAL GEOLOGIST LICENSES

California (No.9352)

Texas (No. 11747)

Idaho (PGL-1518)

Washington (No. 3077)

Oregon (No. 2466)

California Qualified Storm Water Pollution Prevention Plan Developer (Certificate no. G09352)

Principal – Bend Geoscience 2015 to Present

Projects:

- Phase I Environmental Site Assessments of commercial properties in: Crook, Deschutes, Jackson, Jefferson, Klamath, and Malheur Counties Oregon.
- Preliminary Groundwater Assessment, Jefferson County, Oregon – Evaluated potential groundwater impacts of an onsite sewage wastewater treatment system for a proposed recreational vehicle park. Project included analytical (mass-balance) modelling of effluent

migration. Report was part of an application for a water pollution control facility permit approved that was approved by DEQ.

- Mine permit consulting to a southwest Oregon mine operator regarding permit requirements of the Oregon Department of Geology and Minerals Industries.
- Hazardous waste determination at a mine site in southwest Oregon. Evaluated acid-producing potential of mine waste based on Synthetic Precipitation Leaching Procedure.

EMPLOYMENT AT COLORADO DIVISION OF RECLAMATION, MINING AND SAFETY (CDRMS)

Senior Environmental Protection Specialist IV, Supervisor of Colorado East Team of Minerals Regulatory Program, 2011 – 2015

Responsibilities:

- Supervised the Colorado East Minerals Team, comprised of a seven-member multi-disciplinary team of geologists, engineers, and environmental scientists who handle environmental regulation of approximately 900 mining permits in 38 counties of central and eastern Colorado. Regulated mine sites included aggregate mines, quarries, and metals mines.
- Guided enforcement strategies for environmental compliance at mine sites and made final decisions for the East Team on application of state environmental laws to mines.
- Reviewed work of Minerals East Team to ensure it was high quality and met regulatory deadlines (included mine permit applications and revisions, inspection reports, enforcement documents, and monthly presentations to Colorado Mined Land Reclamation Board).
- Conducted performance reviews of employees. Interviewed and recommended the hiring and termination of employees. Recommended disciplinary actions and promotions.
- Served as lead regulatory groundwater specialist for mines in central and eastern Colorado. Reviewed groundwater and surface water monitoring plans, evaluated mine water treatment systems, evaluated drawdown impacts of mine excavations, reviewed mines' numerical models, used conceptual and analytical methods for predicting groundwater shadowing and mounding effects of pit slurry walls and for predicting off-site contamination, and reviewed mine hydrologic data provided in applications for release of reclamation bond and mine permit termination.
- Responded to public inquiries, comments, and objections regarding mine operations and reclamation.
- Served as lead regulatory specialist on a high public profile underground metals mine with significant water quality/treatment issues.
- Interviewed technical consultants, wrote scopes of work and task orders, and managed consultants' contracts.
- Assisted the Minerals Program Supervisor on policy development.
- Reviewed and implemented MOUs with other state, federal, and local government agencies.
- Provided monthly briefings on regulatory developments at mining industry association meetings.
- Represented CDRMS in periodic meetings of multi-agency groundwater protection workgroup.
- Made monthly presentations and coached team members in formal contested enforcement hearings before the Colorado Mined Land Reclamation Board.
- Coordinated enforcement actions and litigation with legal counsel.
- Presided over civil penalty assessment conferences with mine operators.

Environmental Protection Specialist II, CDRMS Coal Regulatory Program, 1997 – 2011

Responsibilities:

- Reviewed coal mine permit applications for compliance with state and federal environmental regulations, with emphasis on hydrologic impacts and subsidence impacts.
- Prepared technical findings documents for mine permit renewals, permit revisions, and reclamation financial surety releases.
- Evaluated reclamation success of mines in permit reviews, financial surety releases, and field inspections (structure demolition, backfilling, grading, topsoil replacement, revegetation, and hydrologic balance).
- Coordinated team members' technical reviews and findings document preparation for mines and ensured mandatory review and decision deadlines were met.
- Prepared mine reclamation cost estimates for establishing required financial sureties from permittees totalling more than \$100 million of reclamation work on approximately 20 sites.
- Prepared notices of violations and civil penalty assessments.
- Coordinated mine permitting with lead agencies for: local land-use approvals, NPDES permits, air emissions permits, state dam safety and water rights, SHPO (State Historic Preservation Officer) clearances, the State wildlife agency, Section 7 U. S. Fish and Wildlife consultations, wetland delineations, USACOE 404 dredge and fill clearances, and NEPA (EA/EIS) clearances.
- Made presentations to the Colorado Mining Land Reclamation Board in contested enforcement hearings.
- Acted as liaison among mine operators, citizens, and government agencies.
- Responded to public inquiries, comments, and objections regarding mine operations and reclamation.
- Assisted the Coal Program Supervisor on policy development and review.
- Reviewed and implemented MOUs with other state, federal, and local government agencies.
- Served as hydrology, hydrogeology, and subsidence specialist on an interdisciplinary team.
 - Reviewed adequacy of engineering designs of erosion and sediment control plans and structures, and inspected installation, maintenance, and function of structures. Verified post-construction compliance of structures with as-built designs.
 - Reviewed mine hydrology annual reports for compliance with sampling and reporting requirements, and compliance with standards and discharge limitations.
 - Reviewed and guided development of mine ground and surface water environmental monitoring plans for adequacy of geographic and stratigraphic coverage, sampling frequency, sampling methods and QA/QC, and parameters sampled.
 - Sampled NPDES outfalls for storm water, industrial waste water, and process water discharges. Sampled groundwater monitoring wells. Measured field parameters, submitted samples to lab, interpreted analytical results, determined compliance with standards and discharge permits, and pursued enforcement actions. Also sampled instream flows.
 - Inspected NPDES discharge outfall structures.
 - Reviewed monthly and quarterly NPDES Discharge Monitoring Reports. Coordinated with state Clean Water Act lead agency on enforcement actions.
 - Verified compliance of erosion and sediment control Best Management Practices in permit reviews and field inspections.
 - Assessed local and regional hydrologic impacts from mining. Authored regional "Cumulative Hydrologic Impact" documents for three major watersheds.
 - Evaluated quantitative revegetation sampling plans for statistical adequacy and adequate field methodology (optical point counter).

- Provided comments on proposed guidelines, regulations, and water quality standards.
- Modeled surface and groundwater flow and quality, using conceptual, analytical, and numerical methods (extensive use of SEDCAD TR-55 emulator, limited use of Modflow).
- Inspected compliance of storage and containment of hazardous substances, waste, explosives, and petroleum products. Sampled contaminated soils and pursued enforcement actions.
- Mapped with GPS and displayed data in ARCGIS.
- Verified structure and boundary locations/elevations with a transit.
- Interpreted well pump tests, slug tests, and geophysical logs.
- Monitored mine blasts with a seismograph.
- Reviewed mine subsidence material damage predictions and control plans.
- Reviewed subsidence monitoring reports and seismic reports.
- Evaluated subsidence angle-of-draw, magnitude, and tilt.
- Evaluated subsidence impacts to structures, water resources, and slope stability.

Selected Technical Investigations Performed for the Colorado Division of Reclamation, Mining and Safety

Coal Mine Groundwater Investigations

- **Contaminated water well investigation (large surface mine).** Tested for a geochemical match between a surface mine's spoil backfill leachate and a bedrock water sample from a neighbor's contaminated water supply well, using *Aquachem* software. Analysis helped resolve mine/neighbor dispute.
- **Monitoring well siting, completion, pump testing, and plugging, (various mines).** Reviewed well draw-down, slug, recovery, and interference tests, and determined aquifer properties from those tests for use in coal leachate plume prediction. Used gamma ray-bulk density logs from mine operators for identifying permeable flow units in bedrock aquifers to be completed in monitoring wells.
- **Dewatered artesian spring investigation (large surface mine).** Constructed a hydrogeologic cross-section for determining if a spring was either hydraulically connected to a nearby mine pit or was isolated from the pit by aquiclude layers. Analysis helped resolve mine/neighbor dispute.
- **Identification of mine spring source, natural source versus spoil leachate (large surface mine).** Constructed a hydrogeologic cross-section to identify the source of freshwater springs on a mine as being natural ground water, rather than coal spoil backfill leachate as had been reported for many years in the mine's annual hydrology reports (which had allowed an overly-optimistic prediction for the mine's long-term spoil leachate quality). The mine was required to revise the Probable Hydrologic Consequences section of the permit to reflect a less optimistic prediction of leachate quality.
- **Drawdown in a regional confined aquifer (proposed surface mine).** Used *Modflow* module in *Groundwater Vistas* software simulate drawdown that may result from excavation of a large surface pit in a regional aquifer+.
- **Contaminant transport in bedrock aquifers (large surface mine).** Created predictive models of development of a spoil leachate plume in a confined aquifer down-gradient

from a surface mine pit that is backfilled with coal combustion waste. Modeling was done in *Plume2D* and *Groundwater Vistas* softwares. Used *ArcGIS* for overlaying geologic data on a mine workings map in a predictive model of the areal extent of leachate seepage from a coal seam subcrop into stream alluvium and to surface water.

- **Prediction of spoil spring discharge rate and timing (various mines).** Prepared spreadsheet predictive water-balance model of inflows into reclaimed pit and discharges from pit to ground water and surface water, for purpose of estimating probable spoil spring discharge rate and timing of spoil spring formation. Permittee revised their spoil spring predictions based on the spreadsheet model.
- **Prediction of backfill leachate quality (various surface mines).** Used mine overburden chemistry data in a USGS geochemical model of spoil backfill leachate quality for making predictions of the duration of degraded leachate in several Colorado coal mines. Presented this methodology and its applicability to mines in other western states at a USDOJ-Office of Surface Mining conference.
- **Prediction of surface water discharge from mine portals (large underground mines).** Constructed hydrogeologic cross-sections and used analytical groundwater models for making predictions of the potential for mine water discharge from mine portals.
- **Guided permittees in designing monitoring plans (various sites).** Included well locations, baseline data collection, well completion, sampling frequency and analytes, reporting, establishment of ground water points of compliance, and compliance verification.

Metals Mine Groundwater Investigations

- **Mine water migration (underground metals mine).** Determined minimum mine pool pumpdown that would prevent mine water migration to nearby stream.
- **Mine water migration (underground metals mine).** Collected mine water samples and developed technical case in enforcement action that led to settlement of litigation that was before the Colorado Court of Appeals.
- **Mine water quality (underground metals mine).** Performed spreadsheet calculation of sulfate concentration in underground mine pool water that will result from disposing reverse osmosis residuals into mine pool.
- **Monitoring plan (underground and surface metals mines).** Guided operator in selecting well locations, planning baseline data collection, well completion methods and screened intervals, sampling frequency and analytes, reporting, establishment of ground water points of compliance, and verifying compliance.

Aggregate Mine Groundwater Investigations

- **Domestic well drawdown by neighboring mine.** Constructed cross-section showing hydrologic connection between pit and well. Required operator to use more appropriate method of calculating radius of influence of pit drawdown.

Coal Mine Surface Water Investigations

- **Water quality trend analysis at final bond release (surface mine).** Prepared projections of TDS trends in stream water by determining linear regression relationships of conductivity versus TDS, and stream flow versus conductivity. Mine operator was required to revise the bond release application to reflect the regression prediction.
- **Sediment yield estimation at Phase II bond release (various mines).** Reviewed and made estimates of premining and postmining sediment yield rates of reclaimed lands using *SEDCAD* application (a TR-55 emulator). Surveyed sediment volumes in ponds and then used *RUSLE* and assumed sediment-delivery ratios to back-calculate sediment yield rates of disturbed lands.
- **Sediment control structures (various mines).** Verified adequacy of designs of ponds, ditches, and other sediment and drainage control structures, using *SEDCAD* software. Also, developed and used a spreadsheet employing “Rational” method for checking operators’ surface runoff predictions. Used Manning equation for testing the adequacy of operators’ ditch and culvert designs.
- **Software evaluation.** Served as national team leader of a U. S. Office of Surface Mining team that evaluated software applications for evaluating surface water flow and quality in large watersheds.
- **Predictive modeling of cumulative hydrologic impacts.** Created a spreadsheet model of stream salinity for a cumulative hydrologic assessment of the Yampa River watershed. The model consisted of linked spreadsheets that use historical monitoring data for calculating a series of chemical mass-balance equations under various flow scenarios (dry versus wet year, springtime high-flow versus autumn low-flow, underground mine pumping versus no pumping, etc). Imported model results into ArcGIS and generated watershed maps. Presented this methodology at a national meeting of the American Society for Mining and Reclamation.

ADDITIONAL PROFESSIONAL EXPERIENCE

Self-employed geologist, Denver, CO, 1992 – 1997

Managed working interests in 42 oil and gas wells in Colorado and neighboring states. Evaluated production potential and economics (IRR and NPV) of properties, conducted pre-purchase environmental assessments of production facilities. Negotiated acquisition and sale of properties. Made decisions on drilling and well workovers, integrated geological and engineering data, estimated oil and gas reserves, evaluated geologic and economic risk, interpreted geophysical logs and drillstem tests, constructed structure and isopach maps, performed financial and gas-balance accounting, analyzed lease division orders, executed joint operating agreements, hired and managed a part-time office assistant.

Self-employed consulting geologist, Denver, CO (under contract to U.S. Forest Service), 1991 – 1992

Prepared a technical proposal and submitted a successful competitive bid to the U. S. Forest Service to obtain the consulting contract. Hired and managed a geological consultant as a sub-contractor to assist in the project. The project required the evaluation and preparation of reports described the oil and gas potential of three National Forests in Utah (Ashley, Manti-LaSal, and Uinta). The reports were incorporated into the Forests' Environmental Impact Statements. Prepared maps for each Forest showed the regional distribution of petroleum potential and the reasonable foreseeable land disturbances from oil and gas operations. Conducted a comprehensive review of well completion data, drillstem test data, well production data, and seismic data. The reports included projections of the 15-year well drilling rates and the number of acres that would be disturbed by oil and gas operations on each Forest.

**Geologist, Hendricks and Associates, Inc., Denver, CO, 1985 – 1991
(petroleum exploration consulting firm)**

Mapped regional petroleum reservoir lithofacies using well cores and geophysical logs. Constructed core/log cross-sections, reservoir lithofacies maps, isopach maps, and structure contour maps. Completed work became parts of several proprietary regional studies of the Williston Basin (North Dakota) and Green River Basin(Wyoming) prepared for major and large independent oil companies that were clients of Hendricks and Associates. Coordinated and edited an interdisciplinary team's writing of a multi-volume text for one study. Ensured team's project deadlines were met. Was a primary presenter at several core workshops held for clients.

Geologist, Love Oil Company, Denver, CO, 1984 – 1985

Evaluated the petroleum potential of a 180,000-acre petroleum exploration prospect in the southeastern Idaho portion of the Overthrust Belt. Work involved two summers of field mapping, interpretation of Bouguer gravity data, and construction of volumetrically-balanced, restored structural cross-sections. Made presentation to management at project conclusion. This work was associated with my M.S. thesis mapping project. Part-time during school, full-time during breaks.

Geologic Field Assistant, U.S. Geological Survey, Denver, CO, 1980 – 1984

Prepared well cores for analysis, photographed and indexed cores, researched well data, determined porosity and permeability of core samples using porosimeter and permeameter. Part-time during school, full-time during school breaks.

PUBLICATIONS/PRESENTATIONS

"An Inferred Subsurface Ramp in the Paris Thrust South of Pocatello, Idaho and the Petroleum Potential of Related Structural Features" (Abstract), American Association of Petroleum Geologists Bulletin, August 1983 (master's thesis research topic).

"Oil and Gas Potential of Uinta National Forest", "Oil and Gas Potential of Manti-LaSal National Forest", "Oil and Gas Potential of Ashley National Forest" (three reports published in the Environmental Impact Statements of these National Forests in 1992).

"Predicting the Duration of Elevated Dissolved Solids in Coal Spoil Leachate, Colorado", paper presented at Annual Billings Reclamation Conference, 2002.

"Using Coal Combustion Waste as Backfill in Colorado", presentation to 2004 annual meeting of Conference of Government Mining Attorneys, Denver.

"Predictive Modeling of Stream Salinities, Yampa Coal Field, Northwestern Colorado", paper presented at American Society of Mining and Reclamation 2005 annual meeting, Breckenridge, Colorado.

MEMBERSHIPS

Geological Society of the Oregon Country
Northwest Association of Environmental Professionals

CONTINUING EDUCATION

Course completed in 2015 through ASTM International (American Society for Testing and Materials):
"Phase I and II Environmental Site Assessments for Commercial Real Estate"

Course completed through Wildland Hydrology (Trinidad, CO):
"Applied Fluvial Geomorphology"

Three courses completed through State of Colorado:
"The Nuts and Bolts of Supervising Colorado State Employees"
"Evaluation of Performance of Employees"
"Customer Service"

Thirteen courses completed through the U.S. Department of Interior, Office of Surface Mining:

"Applied Engineering Principles"	"Historical and Archeological Resources"
"CAD Applications for Permitting and Reclamation"	"SEDCAD for Mine Permitting and Reclamation"
"Galena Slope Stability Analysis"	"Underground Mining Technology"
"Using ArcGIS for Mining and Reclamation"	"Subsidence"
"Blasting and Inspection"	"Permitting Hydrology"
"Water Quality Analysis Using Aquachem"	"Quantitative Hydrogeology"
"Erosion and Sediment Control"	