

IN RE LINC ENERGY OPERATIONS, Inc.) DOCKET NO. 13-4804

EXPERT WITNESS DISCLOSURE

Pursuant to the Order of Schedule entered herein on October 28, 2013, and Rule 26(a)(2), Wyo. R. Civ. P., Linc Energy Operations, Inc., discloses the following expert witness:

1. Thomas J. Osborne
President and Principal Hydrologist
HydroSolutions Inc
1500 Poly Drive, Suite 103
Billings, MT 59012

Mr. Osborne is a professional hydrologist, who was retained and performed services as a consultant to Linc Energy Operations, Inc. in conducting groundwater hydrology investigations and in the preparation and submission of the application for research and development license at issue in this matter. Mr. Osborne's professional resume is attached hereto. Mr. Osborne's work on the project included the gathering of factual information related to hydrology and hydrogeology that is relevant to the application. Linc Energy Operations will call Mr. Osborne to present that factual information as well as technical information related to his area of expertise to the Environmental Quality Council. The facts related to the issues in this case are set forth in detail in the "Aquifer Reclassification Justification Statement of Basis" (SOB), also referred to as Appendix D-12 of the R&D License Application, and other sections of the application referenced therein.

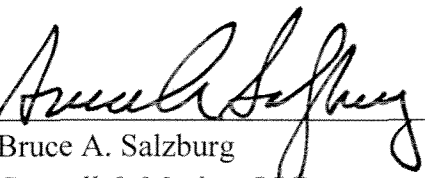
In addition, Mr. Osborne may be asked to offer his opinions regarding whether the demonstration project meets the requirements for an aquifer exemption under the applicable Federal regulations. Specifically, if asked, Mr. Osborne would opine that the project meets the requirements of 40 CFR § 146.4, in that the portion of the Wyodak aquifer at issue in this case does not currently serve as a source of drinking water, and it cannot now and will not in the future serve as a source of drinking water because it can be demonstrated to contain minerals or hydrocarbons that considering their quantity and location are expected to be commercially producible. Mr. Osborne may also opine that the aquifer is situated at a depth which makes recovery of water for drinking water purposes economically impractical. The facts supporting these opinions are set forth in detail in Appendix D-12 of the Application, and referenced sections of the application.

In expressing his opinions, Mr. Osborne may further rely on his education, training and experience in the field, as well as reliable public information and learned treatises.

Mr. Osborne charges a professional services fee of \$151 per hour, plus reasonable and necessary expenses incurred.

Dated this 1st day of November, 2013.

Linc Energy Operations, Inc.

By: 
Bruce A. Salzburg
Crowell & Moring, LLP
205 Storey Blvd., Ste. 120
Cheyenne, WY 82009

CERTIFICATE OF SERVICE

I hereby certify that a copy of the above and foregoing Expert Witness Disclosure was served by electronic mail on the 1st day of November, 2013, on the following:

Jeremiah Williamson
Asst. Attorney General
jeremiah.williamson@wyo.gov

Nancy Nuttbrock
Land Quality Administrator
nancy.nuttbrock@wyo.gov

Shannon Anderson
Powder River Basin Resource Council
sanderson@powderriverbasin.org

Todd Parfitt
Director, DEQ
todd.parfitt@wyo.gov

Thomas J. Osborne

Principal Hydrologist

Email: TomO@hydrosi.com

Tel:406.655.9555 ext 101

Professional Profile



Mr. Osborne is President of HydroSolutions Inc, a hydrologic and environmental consulting firm. He is responsible for technical services, business management, project development, technical quality and client relations. Mr. Osborne conducts hydrological, water quality and environmental investigations, performs strategic regulatory consulting and permitting, and provides expert services in support of litigation.

Academic Credentials

38 Semester Credits	Engineering and Mathematics, Montana College of Mineral Science and Technology- Butte, Montana	1986
M.S.	Water Resources Management, University of Wisconsin - Madison	1974
B.S.	Forestry, Natural Resource Management, University of Wisconsin - Stevens Point	1970

Professional Affiliations

Association of Ground Water Scientists and Engineers, NGWA	1983
American Geophysical Union, Hydrology Division Member	1977
Appointee to Montana Department of Environmental Quality UST Risk Based Corrective Action Stakeholders Committee	1996-1999
Appointee to Non-Degradation of Water Quality Task Force, Montana Department of Environmental Quality	1997
Hydrology Advisor and Associate Supervisor, Yellowstone County Conservation District Board	1991-2003
Board Member and Chairperson, Beartooth Resource Conservation and Development Area	1995-2002
First President, Montana Environmental Technology and Services Network	1993-1994
President, Montana Chapter of Northwest Environmental Business Council, based in Portland, OR.	1999
Appointed by Montana DNRC to Technical Advisory Committee (TAC) for Powder River Basin Controlled Ground Water Area	2007-2013

Appointed by Montana DNRC to Yellowstone River Basin Advisory Council 2013

Honored as "Water Legend" by the American Water Resources Association Montana Chapter, for "Outstanding contributions to water resources and research in the State of Montana" 2013

Certifications

No. 1662	Professional Hydrologist, American Institute of Hydrology	
No. 112-111	Licensed Professional Hydrologist, State of Wisconsin	
No. 260	Certified Ground Water Professional, Association of Groundwater Scientists and Engineers	
No. 8102 EIT	Engineer-In-Training, Montana Certificate	
ASTM Risk Based Corrective Action Module II Training Program		
40-Hour Hazardous Waste Operations Training Certificate		1990
Monitoring Well Constructors License	State of Montana	1989
Radiological Safety Training and Radio Isotope Use Certificate		1986
River Mechanics-Modeling of Rivers	Colorado State University	1977

Teaching Experience. Taught college level courses in hydrogeology, including:

- Groundwater Science and Management Overview (Rocky Mountain College, 1995)
- Basic Design of Groundwater Monitoring and Production Wells (Rocky Mountain College, 1996)
- Natural Groundwater Chemistry and Impacts of Contamination (Rocky Mountain College, 1996)
- Field Hydrogeology (Montana Tech, 1986-88)
- Groundwater Modeling- USGS finite difference numerical model (The University of Montana at Montana Tech, Department of Geological Engineering, 1985)

Military Service

U.S. Army, 1970-72. Duty stations in Hawaii, and Vietnam with the 101st Airborne, and 2nd of the 327th Infantry. Combat duties included: radio-telephone operator, artillery fire direction control, and artillery forward observer. Awarded Bronze Star and Campaign medals. Honourably discharged Specialist 4th Class.

Selected Current and Previous Projects

EXPERT HYDROLOGY SERVICES IN SUPPORT OF LITIGATION AND ADMINISTRATIVE HEARINGS

- ❖ *Garvey Schubert Barer, Washington, DC, and Murphy Oil Corporation, El Dorado, AR* - Expert hydrologist from 1997-2013 in large brine contamination of groundwater case related to

leaking UIC wells and oil-field facilities. Involved assessment of many historic and recent oil-field brine sources, fate and migration, and remediation. Provided expert testimony to U.S. EPA and Tenth Circuit Court of Appeals in Denver regarding sources, extent, magnitude and conditions of groundwater contamination. Provided expert consultation in response to EPA Emergency Administrative Orders and settlement negotiations between oil companies and EPA Region 8. Participated intensively with U.S. EPA, DOJ and the responsible oil companies in negotiations of a Consent Decree which was signed in April 2012.

- ❖ *Hageman Law P.C., Cheyenne, WY; U.S. District Court for Wyoming* - Expert hydrologist for defendant landowner in Section 404 Clean Water Act lawsuit brought by U.S. Dept of Justice and EPA over alleged unpermitted stream channel and wetlands alterations near Worland, WY. Participated in extensive settlement negotiations and submitted expert settlement plan for Consent Decree which was reviewed and found generally acceptable by EPA, DOJ and government hydrology experts. Deposed by opposing counsel and prepared expert disclosure report for pending trial in October 2013. Trial is pending.
- ❖ *Bechtold Law Firm, PLLC, Missoula, MT; Project site in Yellowstone County, Montana.* Expert hydrologist in forensic investigation of a dry residential well potentially impacted by aggregate mine. Conducted hydrologic evaluation and produced expert report that served as basis for insurance claim settlement of a new water well for the client.
- ❖ *Dietrich and Associates, P.C.; Yellowstone County, Montana.* Expert hydrology and water rights services for industrial client with large water use from the Yellowstone River. Provided preliminary plant water balance analysis and water rights assessment in relation to potential objections to Water Court decree.
- ❖ *Water Rights Solutions, Inc. Helena, Montana; Project site in Ravalli County, Montana.* Provided expert peer review of another consultant's water rights services, standard of practice and billing in connection with lawsuit over quality of services and payment. Case settled out of court.
- ❖ *Robbins, Kaplan, Miller & Ciresi LLP; Western North Dakota.* Retained as expert hydrologist in lawsuit of riparian land and mineral owners against the State of North Dakota. Provided expert consultation regarding hydrologic factors on the Missouri River.
- ❖ *Confidential Client, Houston, TX; Project site in Wyoming* - Selected as Expert Hydrogeologist following competitive interviews by attorneys for international oil and gas production company in western United States. Conducted review of factual information and testimony, assisted in developing case strategy and data needs until out-of-court settlement reached.
- ❖ Retained by consortium of coal bed natural gas companies in Wyoming and Montana to provide comments on groundwater and water quality aspects of Montana BLM's Supplemental Environmental Impact Statement. Oral and written technical comments were submitted.
- ❖ *Gough Shanahan Johnson & Waterman, P.C., Helena, MT* - Expert hydrologist to law firm representing oil and gas company in intervention in civil action arising out of State of Montana agencies' approval of the Statewide Environmental Impact Statement and Plan of Development for Coal Bed Methane.
- ❖ *Fidelity Exploration & Production Company, Denver, CO* - Provided expert testimony to Montana Board of Environmental Review and Water Pollution Control Advisory Council regarding the hydrogeology of Fort Union formation and potential for injection of produced water from coal bed natural gas operations.
- ❖ *Gough Shanahan Johnson & Waterman, P.C., Helena, MT* - Expert hydrologist for

intervener energy company in a Montana civil action alleging violation of Montana Constitution "right to clean and healthful environment" provision, invoked relative to withdrawal of groundwater from coal beds as part of natural gas production operations. Have provided expert affidavits on groundwater hydrology and expert review of groundwater modeling, and hydrogeologic aspects of coal bed water production and shallow aquifers.

- ❖ *Gough Shanahan Johnson & Waterman, P.C., Helena, MT* - Water Rights Hydrology Expert in judicial appeals of water rights rulings by Montana DNRC Hearings Examiners. Cases involve expert review of regional MODFLOW groundwater flow model for simulating coal bed methane extraction, potential water quality issues of wastewater disposal, and potential groundwater to surface water hydrologic connection.
- ❖ *Confidential Client, Houston, TX* - Expert Hydrology services to major oil and gas company regarding hydrologic restoration of stream valley. Conducted field assessments of oil and gas water management facilities and natural stream hydrology. Negotiated work plans with landowners and the company.
- ❖ *Faure Holden Attorneys at Law, P.C. Great Falls, MT* - Expert witness for Plaintiff landowner- regarding accretion-avulsion case on lower Yellowstone River. Completed historical evaluation of river migration and produced multi-layered GIS analysis displaying the river and property ownership. Case was dropped prior to court.
- ❖ *Nance Petroleum Corporation, Billings, MT* - Expert hydrologist providing testimony to Wyoming Oil & Gas Commission in regulatory contested hearing regarding produced coal bed methane water infiltration rates, water balance, water quality, and stream hydrology associated with pit permit applications. Commission ruled in our client's favor on all accounts.
- ❖ *Anaconda, Montana* - Expert hydrogeologist to Poore Roth & Robinson, P.C. and their multi-national industrial client in groundwater damages and permitting case. Managed major field hydrogeologic investigation of large sub-drain system near Anaconda, Montana, conducted potential property damage evaluation, provided consultation in depositions and expert reports. Was owner's representative in rehabilitation design program and environmental permitting during court directed settlement.
- ❖ *Bridger, Montana* - Conducted evaluation of artesian well, large spring, stream and irrigation systems in a water rights case, near Bridger, Montana. Provided expert report.
- ❖ *Bozeman, Montana* - Provided expert opinion to attorney for defendant company over potential impacts and damages from alleged dumping of wastewater. Conducted major field evaluation, developed a comprehensive wastewater management plan and negotiated with Montana DEQ, which resulted in settlement of the civil case and authorization for implementation of the treatment/disposal plan.
- ❖ *Crowley, Haughey, Hanson, Toole & Dietrich, P.L.L.P., Billings, MT* - Lead hazardous waste and hydrogeology expert for large Montana law firm and Plaintiff in lawsuit regarding contamination from industrial chemicals consisting of hydrocarbon and metallic wastes released from above ground and underground tanks, or otherwise disposed and spilled in an eastern Montana city. Conducted field investigation, provided expert report, and courtroom testimony in federal district court in Billings. Lawsuit settled in Plaintiff's favor with monetary damage award.
- ❖ *Billings, Montana* - Conducted household hydrology investigation of alleged over- irrigation for defendant insurance company, regarding causes of soil failure and distress to a neighboring residential dwelling. Documented cause by an entirely different water source that exonerated the client.
- ❖ *Dorsey & Whitney, P.C., Billings, MT* - Provided expert services to national law firm and

defendant utility company in case alleging subsurface damage to a spring from construction activities. Conducted field inspection, hydrogeologic analysis and provided expert report. Case resolved in out-of- court settlement.

- ❖ *Bozeman, MT* - Provided expert hydrogeological review and opinions to attorney for defendant client in case of large-scale groundwater contamination from solvent chemicals allegedly caused by releases from a sanitary sewer connection to a dry cleaning facility in western Montana.
- ❖ *Poore Roth & Robinson, P.C., Butte, MT* - Served as principal expert to a law firm defending an environmental consulting company in alleged environmental negligence and damages lawsuit involving potential impacts of a subsurface gasoline release on the construction of a hotel on an adjoining property. Provided expert written testimony, consulting and review related to contaminant transport, remediation, hydrogeologic conditions, Phase I environmental site assessments, and standards of environmental consulting practice. Case resolved in out-of-court settlement.
- ❖ Expert hydrologist for national insurance carrier regarding the magnitude and recurrence interval of a large storm, water runoff volumes, and the extent of unique residential property damages allegedly exacerbated by a street construction project.
- ❖ *Horse Creek Water Users Association, Absarokee, MT* - Conducted hydrogeologic evaluation and provided expert testimony to Montana DNRC Hearing on behalf of citizen-landowner group regarding potential impacts to springs and streamflow in Horse Creek basin from large residential development near Absarokee, Montana. This resulted in establishment of a Temporary Groundwater Control Area.
- ❖ *City of Billings, MT* - Expert hydrogeologist for defendant municipality in case of alleged basement flooding from leaky fire hydrant. Reviewed Plaintiff's expert report, conducted on-site investigation, discovered new soils data, performed analysis of water movement rates through unsaturated and saturated soils, analyzed meteorological data, authored expert report. Case dropped by Plaintiff after review of the expert report.
- ❖ Expert hydrologist in residential property damage case due to flooded basement. Collected and analyzed causes and probable effects of storm runoff events, groundwater fluctuations and irrigation facilities. Provided expert testimony in deposition and in report.
- ❖ *Crowley, Haughey, Hanson, Toole & Dietrich, P.L.L.P., Billings, MT* - Expert hydrogeologist for defendant utility-energy company in case of potential structural damages to 23 residential and commercial properties due to alleged leakage of water from a reservoir. Provided expert overview of hydrogeologic setting, groundwater movement, sources of water, and critique of many other technical reports. Prepared expert report summarizing expert findings and opinions of a team of structural, geotechnical and hydrology experts. Case settled prior to court date.
- ❖ *Hendrickson Law Firm, P.C.* - Expert hydrogeologist in contested water rights claim involving groundwater pumping for irrigation from the Fort Union, Tullock and Fox Hills aquifers in the Bull Mountains, Musselshell County, Montana. Testified at DNRC hearing in Roundup, Montana.
- ❖ *City Attorney, Lewistown, MT* - Expert hydrologist to City of Lewistown, Montana who objected to water right permit application for a high capacity water well from Madison Group artesian aquifer. Research hydrology and geology, critique application and submit expert testimony for DNRC hearing. Provided recommendations which led to out-of- court agreement of the parties.
- ❖ *Saye Law, Billings, MT* - Expert hydrologist for Plaintiffs in irrigation-related property damage case. Conducted assessment of the basis for claim of over-irrigation and background

hydrologic conditions in large irrigation project in south-central Montana. Provided testimony in expert report.

- ❖ *Carbon Canal Irrigation District, Bridger, MT* - Expert hydrologist for Defendant irrigation canal company sued for alleged damage to dwelling and crops from excessive leakage and lack of maintenance. Provided expert hydrology report. Case settled out of court.
- ❖ *Homeowners Association, Bozeman, MT* - Provided expert hydrogeologic analysis and testimony to Montana DNRC regarding effects of residential well development on water availability in Sipes Creek basin, Bozeman, Montana. DNRC granted a Temporary Groundwater Control Area.
- ❖ *Gough Shanahan Johnson & Waterman, P.C., Helena, MT* - Expert hydrologist appearance before Water Rights Hearing Examiner with Montana Department of Natural Resources and Conservation, Helena, Montana, on behalf of natural gas company applicant seeking precedent-setting Water Marketing application. Testified on potential water quality effects of use of produced water for industrial and agricultural purposes.
- ❖ *Luxan & Murfitt, PLLP, Helena, MT* - Water Rights Hydrology Expert for Plaintiff in Montana Water Court. Provided interpretation of historic water diversion and irrigation using aerial photographs and other information. Deposed by opposing counsel.
- ❖ *Espland Law Office, Columbus, MT* - Expert Hydrology services to Plaintiff riparian landowner in suit alleging loss of springs and subsurface flow along stream in Yellowstone River basin.
- ❖ *Chapin and Dixon, LLP, Casper, WY* - Expert Hydrology services to Wyoming defendant landowner over alleged misrepresentation of well yield related to property sale.
- ❖ *Gray & Johnson, PLLP, Billings, MT* - Expert witness for Plaintiff natural gas company in Montana District Court regarding time frames and environmental permitting standards for produced water management.
- ❖ *Leanne Schraudner, Attorney, Bozeman, MT* - Expert hydrology services in water rights dispute over historic and consumptive use. Provided expert interpretation of aerial imagery and expert report.
- ❖ *Doney, Crowley, Bloomquist, Payne & Uda, P.C., Helena, MT* - Provided expert hydrology services to assess groundwater contamination associated with a wastewater treatment facility near Belgrade, MT. Expert report included technical analysis of the problem and potential mitigations.
- ❖ *Faure Holden Attorneys at Law, P.C. Great Falls, MT* - Expert witness for Plaintiff landowner-farmer regarding alleged property damages from irrigation-induced flooding; Montana District Court. Gave deposition to opposing counsel.
- ❖ *Patten Peterman, Bekkedahl & Green, PLLC, Billings, MT* - Provided expert report in case of household flooding from storm runoff water.
- ❖ *Crist, Krough & Nord, LLC* - Expert witness for defendant oil company regarding alleged damage to soils from produced water disposal. Provided expert report and testified as an expert in Montana District Court in Shelby, MT.

OVERVIEW OF HYDROLOGIC AND WATER QUALITY WORK EXPERIENCE

- ❖ *Hope 2 One Life, Inc., Billings, MT* - Board Member and Hydrologist with non-profit organization focused on developing drinking water supplies for a refugee farm, schools and villages in Uganda, East Central Africa, 2008-present. Obtained grants from National Ground Water Research and Education Foundation, developed and supervised water well drilling projects and solar water pumping technologies. Introduced drip irrigation technology to refugee farm in northern Uganda for growing vegetables in dry season.
- ❖ *Nance Petroleum Company, Billings, MT* - Conducted accretion-avulsion evaluation of Powder River in Campbell County, Wyoming in case involving mineral ownership and drilling rights on property subject to changes due to river migration. Utilized aerial imagery, cottonwood age distribution and hydrologic evaluation.
- ❖ *Barrick Gold Corporation, Golden Sunlight Mine, Whitehall, MT* - Requested by Montana DEQ to conduct independent analysis of potential groundwater and water quality impacts of proposed open pit gold mine at Barrick's Golden Sunlight Mine, Whitehall, MT. Completed hydrogeologic analysis and report.
- ❖ *HydroSolutions Inc, Sheridan, WY* - Lead author of professional paper on Wyoming Department of Environmental Quality's Impoundment Groundwater Monitoring Database, along with WDEQ co-authors. Evaluated groundwater quality associated with background samples at hundreds of CBNG impoundments in Powder River Basin. Evaluated available compliance data. Peer-reviewed paper published by American Society of Mining and Reclamation.
- ❖ *Montana Engineering and Administration, Billings, MT* - Provided hydrogeology services for the Towns of Jordan and Worden-Ballantine regarding assessment of current municipal water supply, and targets for new municipal wells. Prepared a Source Water Protection Plan, which was reviewed by the DNRC who stated, "it was one of the best reports they have seen".
- ❖ *Linc Energy Inc, Casper, Wyoming* - Lead hydrologic consultant to Australian-based company developing in-situ coal gasification project in Wyoming, at depths of 1,100-ft. Provide technical analysis in hydrogeology, water chemistry and impact assessment in support of state R&D license and operating permit. Includes hydrogeology studies in support of Class III UIC permit and aquifer exemption requests to Wyoming DEQ and EPA.
- ❖ *Montana Board of Oil & Gas Conservation, Billings, MT* - Lead hydrologist and program manager for the Tongue River Information Project, sponsored by Montana Board of Oil and Gas Conservation. Project collects field data on crop production, soil salinity and water quality on irrigated fields along the Tongue River from Wyoming throughout Montana and evaluates for potential effects of coal bed natural gas discharges. The project also produces a hydrology and water quality evaluation of the Tongue River basin.
- ❖ *Fidelity Exploration & Production Company, Denver, CO* - Supervisory Hydrologist for coal bed natural gas producing studies of injection feasibility. Developed hydrogeologic evaluations and injection permit application to Wyoming DEQ.
- ❖ *Nance Petroleum Company, Billings, MT* - Supervisory Hydrologist for hydrogeologic evaluation of coal bed natural gas produced water impoundment sites in Montana. Developed hydrogeologic evaluation and permit application to Montana Board of Oil and Gas Conservation and Montana DEQ. Permit application approved by agencies following technical review.
- ❖ *Fidelity Exploration & Production Company, Denver, CO* - Conducted feasibility studies for injection of coalbed natural gas produced water through Class V UIC wells into non-aquifer coal and sand units of the Fort Union formation in southeastern Montana. Also reviewed Class V UIC applications to MBOGC for potential interference with gas production of another company, and negotiated mitigation measures eventually adopted in the permit.
- ❖ *Fidelity Exploration & Production Company, Denver, CO* - Prepared and submitted Class IID UIC permit application to Montana BOGC on behalf of natural gas company to inject CBNG produced water and neutralized brine into Shannon formation at depths of 5600 to 5700-ft.

- ❖ *Beneterra, Inc, Sheridan, WY* - Lead Groundwater Modeler for Class V UIC permit application to Wyoming DEQ, modelling the injection of CBNG produced water using subsurface drip irrigation system in Powder River Basin of Wyoming. Authored hydrogeology and modelling report which was submitted to WDEQ, resulting in the approval of SDI system, the first such system requiring modelling analysis.
- ❖ *Nance Petroleum Company, Billings, MT* - Groundwater Modeler for numerical groundwater and surface water modeling of alluvial aquifer-river system to develop impoundment designs which were non-discharging to the river. Modeling work was documented in technical report provided to Wyoming DEQ, and subsequently approved.
- ❖ *Garcia and Associates, Bozeman, MT* - Lead Hydrologist for Gallatin River Outstanding Resource Water Environmental Impact Statement. Part of project team retained by State of Montana DEQ through competitive selection to perform high profile EIS, involving evaluation of water quality impacts and protection alternatives for Gallatin River basin, western Montana. Final EIS published by Montana DEQ, January 2007.
- ❖ *Montana Department of Environmental Quality, Helena, MT* - Awarded contract by State of Montana DEQ to evaluate Alternatives to proposed rulemaking to Hard Rock Mine permitting and operating requirements eliminating perpetual water treatment at hard rock mine sites. Provided document and analysis used in Economic Impact Analysis.
- ❖ *Garcia and Associates, Bozeman, MT* - Hydrologist for Redwater River Planning Area TMDL project for Montana DEQ. Evaluated the hydrology and water quality of several large watersheds in eastern Montana to characterize existing and natural conditions, and potential water quality impairments. Conducted quantitative assessments of streamflow and water quality relationships for sediment, salinity and metals. Assisted in development of TMDL targets. Authored significant portions of the Draft TMDL report submitted to DEQ.
- ❖ *Montana Department of Environmental Quality, Helena, MT and U.S. Bureau of Land Management* - Principal hydrology consultant for Golden Sunlight Mine Pit Reclamation SEIS for Montana DEQ and BLM, through Spectrum Engineering, Inc. Conducted extensive review of historical water quality and mine operations information, evaluated hydrology and water quality of pit, rock dumps and tailing impoundments for Existing Environment. Made predictions of potential water quality impacts of five alternatives and prepared significant portions of the Draft SEIS. Responded to MAA information requests and produce documents under an accelerated time frame.
- ❖ *Fidelity Exploration & Production Company, Denver, CO* - Lead Hydrologic Consultant to CBM gas producer in northern Powder River Basin, Wyoming. Performed water management planning, baseline inventory, along with water pit locating, permit preparation to Wyoming Oil and Gas Conservation Commission.
- ❖ *St. Mary Exploration & Production Company, Billings, MT* - Lead Hydrologic Consultant to CBM gas exploration project in Powder River Basin of Wyoming and Montana. Designed and implemented Water Monitoring Plan, including baseline inventory over 120 sq. miles. Evaluated hydrogeology of Ft. Union formation and identified specific springs and wells with specific aquifers. Supervised extensive test drilling and monitoring well program, preparation of geologic logs, maps and cross sections. Preparation of NEPA Environmental Assessment covering surface water and groundwater resources and potential effects of CBM production.
- ❖ *Montana Department of Environmental Quality, Helena, MT and U.S. Bureau of Land Management* - Performed technical analysis and preparation of hydrology portion of Supplement Environmental Impact Statement for reclamation alternative selection at Zortman Landusky mine complex. Synthesized and analyzed over 20 years of hydrologic and geologic data. Developed water quality classification system for acid rock drainage and natural mineralized groundwater and surface water.

- ❖ *Montana Department of Environmental Quality, Helena, MT and U.S. Bureau of Land Management* - Developed Operations Plan and Assessment for a 400-acre Land Application and Disposal site to treat and manage a complex mix of contaminants including cyanide, selenium, nitrate, metals, sodium and salinity. Plan reviewed and approved by USEPA, USBLM and Montana DEQ.
- ❖ *Montana Department of Environmental Quality, Helena, MT and U.S. Bureau of Land Management* - Lead Hydrologist on \$63 million Zortman-Landusky abandoned gold mine reclamation project in north-central Montana, under subcontract from Spectrum Engineering to State of Montana. Responsible for surface water and groundwater mass balance, water quality goals and monitoring, and fate and migration of hazardous compounds in land application sites.
- ❖ *Yellowstone Valley Electric Cooperative, Huntley, MT* - Conducted geomorphologic study and report on river channel changes related to floods on the Yellowstone River, including impacts of dikes and natural factors. Expert assistance during settlement negotiations with MDEQ.
- ❖ *Private Landowner, Roscoe, MT* - Conducted evaluation of forest fire and logging effects on hydrology and erosion in steep terrain along the Rocky Mountain front.
- ❖ *Montana Fish, Wildlife and Parks, Lewistown, Montana* - Provided hydrogeology services to Robert Peccia & Associates and Montana Fish Wildlife and Parks for assessment of Big Springs, near Lewistown, Montana. Work included evaluation of Madison aquifer, aquifer testing and well design for 10,000 gpm collector well. Project was successfully installed and operated.

EARLIER JOB HISTORY & EXPERIENCE

- ❖ *University of Wisconsin, Stevens Point, WI* - Director and Hydrogeologist for the Central Wisconsin Ground Water Center, University of Wisconsin - Stevens Point (1986-89). Hired as the first Director and managed a new groundwater center sponsored by the University of Wisconsin - Extension and Wisconsin Geological and Natural History Survey. Conducted research and lead public education and outreach on groundwater quality throughout central and northern Wisconsin.
- ❖ *University of Wisconsin, Stevens Point, WI* - Implemented the first wellhead protection pilot studies in the State of Wisconsin under the Safe Drinking Water Act amendments. Funded by US EPA Region V.
- ❖ *University of Wisconsin, Stevens Point, WI* - Conducted field demonstration project on impacts of agricultural chemicals and management practices on groundwater quality.
- ❖ *University of Wisconsin, Stevens Point, WI* - Helped lead development of an integrated water quality database and geographic information system for groundwater protection and management.
- ❖ *Montana Bureau of Mines and Geology, Butte, MT - Research Assistant Professor and Hydrogeologist (1981-1986)*. Developed and lead multi-year study of the geology, groundwater flow and hydrochemistry of abandoned underground coal mine district around Sand Coulee, Montana. Implemented and evaluated feasibility of using large-scale vegetative controls on groundwater recharge to mines. Provided expert witness testimony on mine tailings impacts.
- ❖ *Montana Bureau of Mines and Geology, Butte, MT* - Quantified hydrologic and irrigation water budget for a 50,000- acre irrigation district, including assessments of canal seepage and on-farm losses. Conducted extensive groundwater and surface water monitoring and modeling.
- ❖ *Montana Bureau of Mines and Geology, Butte, Montana* - Hydrogeologist and Research Assistant Professor at the Montana Bureau of Mines and Geology (1981-86). Principal investigator for field research projects throughout Montana, including hydrogeologic investigations and remediation of impacts of acid mine drainage, mine tailings, irrigation and drainage, and saline soils.

- ❖ *Montana Bureau of Mines and Geology, Belt, Montana* - Supervised installation and aquifer test of high capacity municipal well serving Town of Belt, Montana. Well was completed in Madison Limestone aquifer.
- ❖ *Montana Energy and Research and Development Institute, Butte, MT* - Geohydrologist (1980-81). Responsible for the implementation and analyses of surface water and groundwater field studies at four sites in Montana being evaluated for siting of coal-fired power plants.
- ❖ *Northern Cheyenne Research Project, Lame Deer, MT* - Hydrologist (1976-1980). Conducted Environmental Protection Agency- sponsored water and geology investigations for the Northern Cheyenne Indian Tribe. Assisted, and later supervised, the implementation of a field research project to identify the hydrologic systems on the 447,000-acre Northern Cheyenne Reservation, consisting of a four-year program of surface water and groundwater exploration, monitoring and analyses. Assisted in the development of hydrologic systems models and a predictive method to quantify potential impacts to water quality from coal strip mining.

Professional Publications and Presentations

Andrews, C.B., M. Hanson, S. Hicks, S. Mara, T. Osborne, B. Petrie, and T. Van Zandt, 1975. Oil Shale Development in Northwestern Colorado: Water and Related Land Impacts: EIS Report 48, University of Wisconsin-Madison, 254 pp. (Masters Thesis project)

Osborne, T.J., 1977. The Northern Cheyenne 208 Water Quality Management Report: Yellowstone-Tongue Area Planning Organiz., Broadus, MT., 173 pp.

Osborne, T.J., 1979. The Hydrologic and Salt Balance of the Tongue River along the Northern Cheyenne Reservation, Montana (abs.): Geologic Society of America, Abstracts with Programs, V.11, No. 6, p 249.

Osborne, T.J., 1979. The Effect of Clinker on Water Quality of Two Small Perennial Streams on the Northern Cheyenne Reservation (abs.): Geologic Society of America, Abstracts with Programs, V.11, No. 6, p 298.

Woessner, W.W., C.B. Andrews, and T.J. Osborne, 1979. The Impact of Coal Strip-Mining on the Hydrogeologic System of the Northern Great Plains: Case Study of the Potential Impacts on the Northern Cheyenne Reservation: In, W. Back and D.A. Stephenson (ed.) Contemporary Hydrogeology-- The George Burke Maxey Memorial Volume. Journ. of Hydrology, 43:445-467.

Woessner, W.W., T.J. Osborne, E.L. Heffern, J. Whiteman, W. Spotted Elk, and D. Morales-Brink, 1980. Hydrologic Impacts from Potential Coal Strip-Mining, Northern Cheyenne Reservation: U.S. EPA. No 600-781-004A, Cincinnati, OH., Proj. No. R803566, 448 pp.

Andrews, C.B., T.J. Osborne, and J. Whiteman, 1980. Hydrologic Data from the Northern Cheyenne Reservation: U.S. EPA. No. 600-781-004B, Cincinnati, OH., Proj. No. R806082, 569 pp.

Osborne, T.J., and C.B. Andrews, 1980. Sediment Characteristics of the Tongue River Basin: 1980 Watershed Management Symposium, Boise, ID., 73 pp. Summary published by American Society of Civil Engineers, New York, NY.

Donovan, J.J., M.R. Miller, T.J. Osborne, A. Middlestadt, and F.A. Schmidt, 1981. Evaluation of Saline Seep Drainage Systems, North-central Montana: Montana Bureau of Mines and Geology Open File Report No. 87, Montana College of Mineral Science and Technology, Butte, MT. 215 pp.

Osborne, T.J., Irrigation Water Runoff: Processes and Management on the Greenfield Bench Irrigation District: Presentation and Abstract, Montana Academy of Sciences Annual Meeting, Bozeman, MT.

Osborne, T.J., 1983. Evaluation of the Groundwater Contribution to Muddy Creek from the Greenfield Bench Irrigation District: Abstract and Presentation, Rocky Mountain Groundwater Conference

Boise, ID.

Osborne, T.J., R.A. Noble, J.L. Sonderegger, and J.J. Donovan, 1983. Acid Mine Drainage Contamination of the Madison Aquifer Near Great Falls, Montana (abs.): Geological Society of America, Abstracts with Programs, V.15, No. 5, p 312.

Osborne, T.J., J.J. Donovan, and J.L. Sonderegger, 1983. Interaction Between Groundwater and Surface Water Regimes and Mining-Induced Acid Mine Drainage in the Stockett-Sand Coulee Coal Field: Montana Bureau of Mines and Geology Open File Report No. 109. Montana College of Mineral Science and Technology, Butte, MT., 54 pp.

Osborne, T.J., R.A. Noble, M.H. Zaluski, F.A. Schmidt, 1983. Evaluation of the Groundwater Contribution to Muddy Creek from the Greenfield Irrigation District: Montana Bureau of Mines and Geology Open File Report No. 113. Montana College of Mineral Science and Technology, Butte, MT., 131 pp.

Zaluski, M.H., and T.J. Osborne, 1984. Water Table Response to Change in Storage on the Greenfield Bench Irrigation District: Montana Bureau of Mines and Geology Special Publication 91, Abstracts, 13th Annual Rocky Mountain Groundwater Conference

Osborne, T.J., 1984. A Survey of Hydrogeologic Effects of Earthquakes: Montana Bureau of Mines and Geology Special Publication 91, Abstracts, 13th Annual Rocky Mountain Groundwater Conference.

Osborne, T.J., and M.H. Zaluski, 1985. The Sage Creek Alluvial Aquifer Test, October, 1984: Montana Bureau of Mines and Geology Open File Report No. 157. Montana College of Mineral Science and Technology, Butte, MT., 42 pp.

Osborne, T.J., T.E. Duiame, and H.R. Moore, 1986. Metal and Arsenic Distribution in Soils and Soil Water of Contaminated Agricultural Land Adjacent to Silver Bow Creek, Deer Lodge and Silver Bow Counties, Montana: Montana Bureau of Mines and Geology Open File Report No. 166. Montana College of Mineral Science and Technology, Butte, MT.

Osborne, T.J., and H.R. Moore, 1986. Design of Hydrologic System Controls for Mitigation of Acid Drainage (abs.): Geological Society of America. Abstracts with Programs.

Osborne, T.J., 1987. How Good are Slug Tests for Determination of Hydraulic Conductivity? Abstracts, American Water Resources Assoc., Wisconsin Section. 11th Annual Meeting, p.28.

Osborne, T.J., C.M. Mechenich, and B.H. Shaw, 1987. New Wisconsin Ground Water Center Tackles Non-Point Source Contamination. National Water Well Assoc., Proceedings of the FOCUS Conference on Midwestern Groundwater Issues. Indianapolis, IN., pp 37-58.

Osborne, T.J., 1988. Assessing Ground Water Quality Variability, The Case of Nitrate in Portage County, Wisconsin. Abstracts, American WaterResources Association, Wisconsin Section, 12th Annual Meeting, p. 20.

Osborne, T.J., Analysis of Wellhead Protection Areas for Municipal Water Supply Wells Serving the Village of Whiting, Wisconsin. Presentation to the Conference on the Premiere Ground Water Protection Strategy for the Nineties., U.S. EPA and National Water Well Association, New Orleans, LA.

Travis, M. and T.J. Osborne, 1989. Ground Water Levels and Nitrate Leaching from Irrigated Potato Fields During the 1988 Growing Season. Abstracts, American Water Resources Association, 13th Annual Mtg., p. 13.

Osborne, T.J., 1989. Ground Water Contamination from Agri-Chemicals: Understanding Our Responsibilities. Invited paper to the Longwood Graduate Seminar in Public Horticulture, The Univ. Of Delaware, Newark, DE.

Osborne, T.J., and J.L. Sorensen. 1990. Wellhead Protection in Wisconsin; Case Studies of the Town of Weston and City of Wisconsin Rapids. Ground Water Management, Vol No. 1, Proceedings of the 1990 Cluster of Conferences, Kansas City, MO, National Water Well Association, p 479-495.

- Osborne, T.J., D. Curwen and B.H. Shaw. 1990. Quantifying Groundwater Quality and Productivity Effects of Agricultural Best Management Practices on Irrigated Sands. Ground Water Management, Vol No. 1, Proceedings of the 1990 Cluster of Conferences, Kansas City, MO, National Water Well Association, p 129-143.
- Osborne, T.J. and J.L. Sorensen. 1990. Pilot Wellhead Protection Studies in the State of Wisconsin, U.S.A. First USA/USSR Joint Conference on Environmental Hydrology and Hydrogeology, Leningrad, USSR, June, 1990. American Institute of Hydrology, Leningrad Mining Institute and USSR Academy of Sciences.
- Osborne, T.J., 1990, Designing Wellhead Protection Investigations: Case Studies of Two Wisconsin Communities. Presentation and Abstract to Northern Rocky Mountain Water Congress. Butte, MT.
- Padilla, C.E., and T.J. Osborne, 1996, "Hydrogeology and Structure of the Bluewater Springs Area South Central Montana". Presentation and Abstract to American Association of Petroleum Geologists, Rocky Mountain Section Meeting, Billings, MT.
- Osborne, T.J., 1998, Invited presentation to The Cambridge Institute Montana Environmental Compliance Seminar, Billings, Montana. "Phase I and II Environmental Site Assessments".
- Osborne, T.J., 2001, Invited presentation to the University of Montana Geology Department Seminar Series: Zortman Landusky Mines, Overview, Hydrogeology and Reclamation.
- Shaw, S.C., J.Adams, and T.J. Osborne, 2002. Geochemical Evolution and Consequent Water Management Changes for Solutions From A Spent Ore Heap Leach Pad, Landusky Mine, Montana. Presentation and Extended Abstract to US EPA Hardrock Mining 2002 Conference, Denver, CO.
- Osborne, T.J., and K. Gallagher, 2002. Dewatering of a Pit Lake And Groundwater Management Using A Flowing Well: Case Study of The Landusky Mine Shear Zone, Montana, Presentation and Extended Abstract to US EPA Hardrock Mining 2002 Conference, Denver, CO.
- Osborne, T.J., 2003. The Water Balance and Chemical Mass Loads at the Zortman and Landusky Mines, Montana. Paper & abstract presented at 2003 National Meeting of the American Society of Mining and Reclamation, Billings, MT. 28 pgs.
- Osborne, T.J., 2003. Land Application of Mine Effluent Workshop, lead presenter and organizer for 2003 Mine Design, Reclamation and Closure Conference sponsored by the Mine Waste Technology Program, Montana Tech of the University of Montana, Polson, Montana.
- Osborne, T.J., 2004. Managing Produced CBNG Waters In the Powder River Basin Via Subsurface Methods. Presentation and abstract presented to Soil and Water Conservation Society Annual Meeting, Billings, Montana.
- Adams, J.A., and T.J. Osborne, 2004. Re-injection of CBNG-Produced Water: Thinking Small. First Annual Coalbed Natural Gas Research, Monitoring and Applications Conference, University of Wyoming, Laramie, WY. (abstract and presentation)
- Osborne, T.T. and J.A. Adams, 2005. Coalbed Natural Gas and Water Management in the Powder River Basin, Southwest Hydrology, Vol. 4 No. 6. (Invited paper) 6 pgs.
- Osborne, T.J. and J.A. Adams, 2005. Opportunities and Limitations of CBNG Produced Water Management Alternatives in the Powder River Basin, International Petroleum Environmental Conference, Houston, TX. Proceedings of 12th Annual Conference, (Invited paper and presentation) 14 pgs.
- Adams, J.A., T.J. Osborne, and W.A. Jepson, 2006. Groundwater flow in fractured rocks at the Landusky Mine Site, Phillips County, Montana. Abstract and presentation: American Water Resources Association, Montana 23rd Annual Meeting, Polson, MT.
- Osborne, T.J., U. Williams, M. Smith, D. Fischer, and K. Frederick, 2007. Groundwater Monitoring at Coal Bed Natural Gas Produced Water Impoundments: The Wyoming DEQ Database. Paper presented at 2007 National Meeting of the American Society of Mining and Reclamation, Gillette, Wyoming, June 2-7. Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.
- Osborne, T.J., N. Fehringer, W. Schafer, K. Harvey, 2007. Tongue River Information Program- Overview of Tongue River Hydrology and the Agronomic Monitoring and Protection Program. Presentation and abstract in: American Water Resources Association Montana Section, 24th Annual Meeting, October 12, 2007, Lewistown, Montana.
- Osborne, T.J. 2008. The Tongue River Information Program Overview. Invited speaker to the Water Forum, sponsored by the Urban Institute, Montana State University Billings, Billings, MT.

Osborne, T.J., 2008. A 25-year Perspective on Sustainability Issues: The Challenges We Face With Answering Water Quality and Water Quantity Concerns in Our Developing Landscape. Invited Plenary Session speaker at 25th Annual Meeting of the American Water Resources Association, Montana Section, Big Sky, MT.

Osborne, T.J., 2009. Geochemistry and Geohydrology of the Landusky Mine Site: Ten Years after Bankruptcy. Invited Plenary Session speaker. Mine Design, Operations and Closure Conference; sponsored by Montana Tech of the University of Montana, Fairmont Hot Springs Resort, Fairmont, Montana.

Osborne, T.J., 2009. Invited as kickoff speaker at Water Forum, sponsored by the Urban Institute of Montana State University, Billings, Montana.

Osborne, T.J., 2009. Probing the Plumbing of the Landusky Mine Site. Presentation to the 26th Annual Meeting of the American Water Resources Association, Montana Chapter, Missoula, MT. October 2009.

Osborne, T.J., W.M Schafer, and N.E. Fehringer, 2010. The Agriculture- Energy-Environment Nexus in the West. Journal of Soil and Water Conservation, Vol. 65. No. 3, Pgs 72A-76A.

Osborne, T.J., 2010. Invited speaker at Air and Waste Management Association PNWIS Annual Conference, Missoula, MT. "The Energy-Agriculture-Environmental Nexus in the West".

Osborne, T.J. 2010. Drinking Water Resource Development in Uganda- A Case Study. Presentation to the Annual Meeting of the American Water Resources Association, Montana Chapter, Helena, MT. October 2010.

Osborne, T.J. 2011. Underground Coal Gasification Research and Development in the Powder River Basin. Presentation to the Annual Meeting of the American Water Resources Association, Montana Chapter, Helena, MT. October 2011.

Osborne, T.J. and N. Hart, 2012. Solar-Powered Groundwater Development Project in Uganda. Presentation to the Annual Meeting of the American Water Resources Association, Montana Chapter, Anaconda, MT. October 2012.