Bruce A. Lytle, P.E.

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(303) 350-4090

POSITION

President, Lytle Water Solutions^{LLC}

EDUCATION

B.S., Civil and Environmental Engineering, Clarkson College of Technology, Potsdam, New York, 1976.

M.S., Civil and Environmental Engineering, University of Colorado, Boulder, Colorado, 1978.

PROFESSIONAL REGISTRATION

Registered Professional Engineer in:

Colorado #18575
South Carolina #17012
Alaska #CE8647
New Mexico #13152
Nevada #CE12158
Wyoming #9159
Nebraska #E-12433
California #72732

PROFESSIONAL MEMBERSHIP

American Water Resources Association
National Ground Water Association
American Society of Civil Engineers
Special District Association of Colorado
American Council of Engineering Companies

PROFESSIONAL EXPERIENCE

- Managing/Founding Member of Lytle Water Solutions, LLC, Highlands Ranch, Colorado: May 2004 to Present.
- Halepaska and Associates, Inc., Englewood, Colorado: June 1985 to May 2004.
- In-Situ, Inc., Engineering and Environmental Science Division, Lakewood, Colorado: 1983 - 1985.
- Woodward-Clyde Consultants, Water Resources Division, Englewood, Colorado: October 1977 to August 1983.
- University of Colorado, Department of Engineering, Boulder, Colorado: September 1976 through August 1977.

PROFESSIONAL AWARDS

- American Council of Engineering Companies (ACEC) Engineering Merit Award - for water supply management with Rueter-Hess Reservoir, 2000.
- American Council of Engineering Companies (ACEC) Engineering Excellence Award - for Denver Basin Aquifer Recharge Demonstration Project, 1994.

PROJECT EXPERIENCE

Mr. Lytle has 40 years of diversified project experience in designing, implementing and managing surface and ground water-related projects throughout the United States. This experience includes:

- municipal well field development
- surface and ground water modeling
- alternatives evaluation for the development of water resources
- operational studies to determine water supply management with surface storage
- surface and ground water hydrology studies
- environmental contamination and remediation studies
- litigation support involving water quality and surface- and ground-water hydrology
- mining hydrology studies
- development of water supply systems and water management master plans
- evaluation of complex water supply projects related to physical and legal availability within the constraints of the water rights system

Mr. Lytle has assisted with the development of multiple municipal well fields that have included large-diameter alluvial wells and deep bedrock wells (up to 2,800 feet deep). Mr. Lytle has designed, observed the construction, and specified the parameters associated with the pumping of individual wells, as well as analyzing the spacing of wells in a well field to optimize yield and minimize well-to-well interference. Mr. Lytle also assessed numerous issues associated with well production declines over time related to mechanical fouling, bio-fouling, and loss of saturated thickness. Mr. Lytle has managed many well optimization studies to evaluate and implement well water management plans.

Well optimization studies frequently result in ground water modeling. Mr. Lytle's experience in ground water modeling has included simulating the effects of large-scale well pumping on adjacent users, simulating the potential suitability of an injection program for aquifer storage and recovery

(ASR), and simulating a large-scale rapid infiltration basin recharge and alluvial wells recovery system in a basin on the eastern plains of Colorado. Mr. Lytle managed a large ground water model in a basin in Southern California which has, as one objective, identifying the firm yield of a large well field.

Mr. Lytle also has extensive experience with the physical implementation of ASR projects in alluvial and bedrock aquifers. In fact, Mr. Lytle managed the first ASR study in the Denver Basin at Parker, Colorado. Subsequently, Mr. Lytle helped develop the scope of work, and was the technical project manager, for a 6-year research and development project investigating deep well injection, storage and recovery of surface water supplies. Mr. Lytle also developed, implemented, and assessed an ASR Pilot Study for the Cheyenne Board of Public Utilities in their Ogallala aquifer well fields by assessing the efficiency of both recharge through rapid infiltration basins (RIBs) and injection wells. Operations issues were evaluated related to variable stratigraphic sequencing that affected the efficiency of ASR, particularly related to RIB ASR. Mr. Lytle also evaluated the sustainable yield of a large ground water aquifer near Redlands, California, where State Project water was being recharged to the aquifer through RIBs.

Experience in surface water modeling includes the evaluation of legally available water supplies, reservoir operational studies, delineation of flood plains, flood routing, sediment transport, and hydraulically-connected surface water/ground water systems. Mr. Lytle has also been involved in many surface water supply evaluations, including assessment of the legal and physical availability of water, surface storage siting, reservoir operational studies, assessment of containment transport via surface flows, and surface flow and water quality characterizations.

Recent projects have included the management of the surface and ground water modeling associated with two Environmental Impact Statements to construct an off-stream reservoir to provide new, renewable water supplies for a community in the southeastern Denver Metro area. These studies included the combined surface water/ground water modeling of the Cherry Creek stream system to assess hydrologic impacts and operational studies to evaluate the operational characteristics of the proposed reservoir. This work has resulted in the issuance of the first Section 404 permit for a water supply reservoir along the Front Range of Colorado in over 20 years, and the subsequent issuance of a second Section 404 permit for an expanded reservoir to serve as a regional water supply storage facility.

Mr. Lytle has also been involved in many geohydrologic investigations, including the design and installation of monitoring well and ground water sampling programs, as well as ground water modeling. This experience has included predicting the movement of contaminants to the ground water table and in the ground water system, and the associated effects of contaminant movement in ground water with regard to health and safety issues and general water quality degradation. It has

PROJECT EXPERIENCE *(Continued)*

also included the installation of ground water monitoring networks to develop underflow and water quality data bases. This work has also included studies to evaluate the need to dewater portions of an aquifer to allow mining to continue unimpeded by inflows to a pit or underground workings.

Mr. Lytle has managed numerous water supply master planning efforts that have included evaluation of interim and long-term water supply development and management options. Key to all master planning efforts has been the orderly and economic development of options to provide the most efficient water supply delivery options. These studies have been completed for municipalities, special districts, and private sector clients. Mr. Lytle has been involved in the subsequent implementation of the recommendations from these master planning efforts.

Mr. Lytle has provided expert testimony in Federal District Courts, State District Courts, and Colorado Water Courts in the areas of surface water hydrology, ground water hydrology, water rights, and water quality.

SELECT PUBLICATIONS

"Disposal of Domestic Wastewater Through the Use of Evaporation-Transpiration Beds", M.S. Thesis, University of Colorado at Boulder, May 1978.

"Artificial Recharge Demonstration Project, Denver Basin, Colorado", coauthored with K. Le and J. Halepaska, Proceedings of the International Symposium on Class V Injection Well Technology, Las Vegas, Nevada, September 1988.

"Artificial Recharge: Willows Experience, Willows Water District, Arapahoe Aquifer Recharge Project", co-authored with K. Le and J. Halepaska, Proceedings of Groundwater Engineering and Management Conference, Denver, Colorado, February 1990.

"Conjunctive Surface and Ground Water Use Through Deep Bedrock Aquifer Injection and Recovery", co-authored with K. Le, J. Halepaska, Proceedings of the 1993 AWRA - Colorado Section Annual Meeting.

"Deep Bedrock Well Injection Near Denver, Colorado," Proceedings of the Second International Symposium on Artificial Recharge of Ground Water, Orlando, Florida, July 17-22, 1994.

“Conjunctive Use Program for the Front Range Using Deep Bedrock Injection, Storage and Recovery,” Proceedings of the 1995 AIPG National Meeting, Denver, Colorado, October 1995.

“Conjunctive Use Program Using Deep Bedrock Injection Wells Near Denver, Colorado,” Proceedings of the 1997 AWWA National Conference, Atlanta, Georgia, June 1997.

SELECT PUBLICATIONS *(Continued)*

"What is the Useful life of the Denver Basin Aquifers?", co-authored with Dr. James R. Kunkel, Proceedings of the 2002 AWRA National Specialty Conference, Keystone, Colorado, July 2002.

"Case History of Feasibility Studies on Aquifer Storage and Recovery in the Denver Basin," paper included in the AEG Publication *Engineering Geology in Colorado: Contributions, Trends and Case Histories,* October 2003.

"Conversion of Municipal Water Supplies from Non-Renewable to Renewable Resources," Proceedings of the 2006 AWRA Summer Specialty Conference, Missoula, Montana, June 28, 2006.

"A Win-Win Scenario for Urban/Rural Water Supplies," The Water Report, Issue #48, February 15, 2008.

"Integrated Water Management in a Highly Urbanized Basin," Proceedings of the 33rd International Association of Hydraulic Engineering & Research Congress, ASCE, Vancouver, BC, Canada, August 2009.

"What is the Future of ASR in the Denver Basin Aquifers?", Proceedings of 2010 National Ground Water Association Conference, Denver, Colorado, April 13, 2010.

"Water Conserving Cropping Systems, Lower South Platte Irrigation Research and Demonstration Project," co-authored with Neil Hansen, Tom Holtzer, and James Pritchett, *Colorado Water*, July/ August 2010.

"2011 Final Report of the Lower South Platte Irrigation Research and Demonstration Project," co-authored with Hansen, Neil, Pritchett, James, Holtzer, Tom, Brummer, Joe, Garcia, Luis, Schneekloth, Joel, Bosley, Bruce, and Helm, Alan, prepared for the Colorado Water Conservation Board, December 2011.