

**Walt W. McNab, Jr., Ph.D., P.G.
Managing Scientist**

Professional Profile

Dr. Walt McNab is a Managing Scientist in Exponent's Environmental Sciences practice. Dr. McNab has over 20 years of experience as a project manager, researcher, and environmental consultant. His interests and experience span a wide range of issues in physical and chemical hydrogeology, particularly those involving coupled process phenomena. He has developed and applied numerical, analytical, and semi-analytical methods for simulating flow and transport processes in porous media to problems entailing both unsaturated flow and reactive transport in a variety of environmental settings. He has also worked extensively with geochemical process models, addressing issues such as oxidation-reduction phenomena, mineral and gas phase equilibria, cation exchange, the effects of surface complexation on trace element mobility, and reconciliation of multiple environmental data sets (e.g., groundwater age data, artificial tracer data, stable isotope data) with major geochemical parameters. Dr. McNab has directed or played leadership roles in projects that have included statistical studies of populations of groundwater contaminant plumes, design and deployment of novel groundwater treatment technologies, construction of compartmentalized groundwater contamination source models, evaluation of water quality impacts associated with reservoir construction and artificial recharge, modeling the impact of geologically sequestered CO₂ on formation minerals and wellbore materials., and radiological contamination assessments.

Academic Credentials and Professional Honors

Ph.D., Mineral Engineering, University of California, Berkeley, 1995

M.S., Mineral Engineering, University of California, Berkeley, 1990

A.B., Geology, University of California, Berkeley, 1988

Member, Sigma Xi

Licenses and Certifications

Professional Geologist, California, #7312

Patents

U.S. Patent 6,431,281 B1: Catalytic Destruction of Groundwater Contaminants in Reactive Extraction Wells, issued August 13, 2002 (with Reinhard M).

U.S. Patent No. 6,214,202 B1: In Situ Treatment of Contaminated Groundwater, issued April 10, 2001 (with Ruiz R, and Pico TM).

Publications

Carroll SA, McNab WW, Torres SC. Experimental study of cement – sandstone/shale – Brine – CO₂ interactions. *Geochemical Transactions* 2011; 12:9 doi:10.1186/1467-4866-12-9.

McNab W, Carroll S. Geochemical indicators of migrating brine impacted by CO₂ identified through laboratory experiments and reactive transport modeling. *Proceedings of the Tenth Annual Conference on Carbon Capture and Sequestration*, Pittsburgh, Pennsylvania, May 2–5, 2011.

Carroll S, McNab W, Torres S, Singleton M, Zhao P. Wellbore integrity in carbon sequestration environments: 1. Experimental study of cement – sandstone/shale – brine – CO₂. *Energy Procedia* 2011; 5186–5194.

McNab W, Carroll S. Wellbore integrity at the Krechba carbon storage site, In Salah, Algeria: 2. Reactive transport modeling of geochemical interactions near the cement–formation interface. *Energy Procedia* 2011; 5195–5202.

McNab WW, Jr, Singleton MJ, Moran JE, Esser BK. Ion exchange and trace element surface complexation reactions associated with applied recharge of low-TDS water in the San Joaquin Valley, California. *Appl Geochem* 2009; 24(1):129–137.

McNab WW, Jr, Singleton MJ, Moran JE, Esser BK. Assessing the impact of animal waste lagoon seepage on the geochemistry of an underlying shallow aquifer. *Environ Sci Technol* 2007; 41(3):753–758.

Singleton MJ, Esser BK, Moran JE, Hudson GB, McNab WW, Harter T. Saturated zone denitrification: potential for natural attenuation of nitrate contamination in shallow groundwater under dairy operations. *Environ Sci Technol* 2007; 41(3):759–765.

Newell CJ, Cowie I, McGuire TM, McNab W. Multi-year temporal changes in chlorinated solvent concentrations at 23 MNA sites. *J Environ Eng* 2006; 132(6):653–663.

Beller HR, Madrid V, Hudson GB, McNab WW, Carlsen T. Biogeochemistry and natural attenuation of nitrate in groundwater at an explosives test facility. *Appl Geochem* 2004; 19(9):1483–1494.

McNab WW, Jr. Forensic analysis of chlorinated hydrocarbon plumes in groundwater: A multi-site perspective. *Environ Forensics* 2001; 2(4):313–320.

McNab WW, Jr. A Monte Carlo simulation method for assessing biotransformation effects on groundwater fuel hydrocarbon plume lengths. *Comput Geosci* 2001; 27(1):31–42.

McNab WW, Jr, Rice DW. Ascertaining the effect of reductive dehalogenation on chlorinated hydrocarbon plume lengths in groundwater: analyses of multi-site data. *Soil Sediment Contam* 2001; 10(1):1–19.

McNab WW, Jr, Ruiz R. In situ measurement of electro-osmotic fluxes and conductivity using single wellbore tracer tests. *Ground Water Monit Rem* 2001; 21(4):133–139.

McNab WW, Jr, Rice DW, Tuckfield C. Evaluating chlorinated hydrocarbon plume behavior using historical case population analyses. *Biorem J* 2000; 4(4):311–335.

McNab WW, Jr, Ruiz R, and M. Reinhard, In-situ destruction of chlorinated hydrocarbons in groundwater using catalytic reductive dehalogenation in a reactive well: Testing and operational experiences. *Environ Sci Technol* 2000; 34(1):149–153.

Cherepy N, McNab W, Wildenschild D, Ruiz R, Elsholz A. Electro-osmotic remediation of fine-grained sediments. *Proceedings, Electrochemical Society, Environmental Aspects of Electrochemical Technology*, 1999–39, 97–110, 1999.

McNab WW, Jr. Comparisons of geochemical signatures of biotransformation of fuel hydrocarbons in groundwater. *Environ Monit Assess* 1999; 59(3):257–274.

McNab WW, Jr, Dooher BP. Authors' reply to discussion of "Uncertainty analyses of fuel hydrocarbon biodegradation signatures in ground water by probabilistic modeling." *Ground Water* 1999; 37(2):167–168.

McNab WW, Jr, Dooher BP. A critique of a steady-state analytical method for estimating contaminant degradation rates. *Ground Water* 1998; 36(6):983–987.

McNab WW, Jr, Dooher BP. Uncertainty analyses of fuel hydrocarbon biodegradation signatures in ground water by probabilistic modeling. *Ground Water* 1998; 36(4):691–698.

McNab WW, Jr, Ruiz R. Palladium-catalyzed reductive dehalogenation of dissolved chlorinated aliphatics using electrolytically-generated hydrogen. *Chemosphere* 1998; 37(5):925–636.

McNab WW, Jr. Simulation of reactive geochemical transport in groundwater using a semi-analytical screening model. *Comput Geosci* 1997; 23(8):869–882.

McNab WW, Jr, Narasimhan TN. Reactive transport of petroleum hydrocarbon constituents in a shallow aquifer: Modeling geochemical interactions between organic and inorganic species. *Water Resour Res* 1995; 31(8):2027–2033.

McNab WW, Jr, Narasimhan TN. Degradation of chlorinated hydrocarbons and groundwater geochemistry: A field study. *Environ Sci Technol* 1994; 28(5):769–775.

McNab WW, Jr, Narasimhan TN. Modeling reactive transport of organic compounds in groundwater using a partial redox disequilibrium approach. *Water Resour Res* 1994; 30(9):2619–2635.

McNab WW, Jr, Narasimhan TN. A multiple species reactive transport model with sequential decay chain interactions in heterogeneous subsurface environments. *Water Resour Res* 1993; 29(8):2737–2746.

Selected Conference Presentations

McNab WW, Ramirez A, Johnson J. A Markov chain Monte Carlo inversion approach for assessing reactive chemistry along a flow path with application to subsurface CO₂ injection. Poster Presentation, American Geophysical Union, Fall Meeting, San Francisco, CA, December 2011.

McNab WW, Carroll S. Geochemical indicators of migrating brine impacted by CO₂ identified through laboratory experiments and reactive transport modeling. Poster Presentation, Tenth Annual Conference on Carbon Capture & Sequestration, Pittsburgh, PA, May 2011.

McNab WW, Carroll S. Wellbore integrity at the Krechba carbon storage site, In Salah, Algeria: 2. reactive transport modeling of geochemical interactions near the cement–formation interface. Poster Presentation, Greenhouse Gas Control Technologies (GHGT10) Conference, Amsterdam, The Netherlands, September 2010.

McNab WW, Hao Y, Foxall W, Carroll S. Hydromechanical simulations of surface uplift due to CO₂ storage, including reactive transport modeling. Ninth Annual Conference on Carbon Capture & Sequestration, Pittsburgh, PA, May 2010.

McNab WW, Carroll S, Morris J. Core-scale geochemistry: implications for wellbore integrity. CO₂ JIP Technical Review, Cambridge, UK, February 2010.

McNab WW, Carroll S, Morris J. Interaction of CO₂-rich fluid with wellbore cement and adjacent formation mineral assemblages: contrasting potential impacts to porosity. Poster Presentation, American Geophysical Union, Fall Meeting, San Francisco, CA, December 2009.

McNab WW Jr. Constraining denitrification mechanisms in shallow groundwater at an instrumented dairy site using reactive transport modeling. Poster Presentation, Groundwater Resources Association, Nitrate in California's Groundwater: Are We Making Progress?, Modesto, CA, April 2006.

McNab WW Jr, Ezzedine S, Detwiler R. Quantifying an intrinsic mass transfer rate for TCE dissolution via pore-scale experiments and simulations. Groundwater Resources Association, DNAPL Source Zone Characterization and Remediation Symposium, San Francisco, CA, December 2005.

McNab WW Jr, Singleton M, Esser B, Moran J, Beller H, Kane S, Letain T. Nitrate loading and groundwater chemistry at a dairy site in California's Central Valley. SAFEWATER 2005, International Conference on Safe Water, San Diego, CA, October 2005.

McNab WW Jr. Groundwater environmental investigation activities at Lawrence Livermore National Laboratory. Establishing research and development priorities in the environmental sciences within Ukraine, Dnipropetrovsk, Ukraine, September 2005.

McNab WW Jr. Geochemical signatures of fertilizers and soil amendments in public water supply aquifers in California. Ground Water Resources Association Annual Meeting, Rohnert Park, CA, September 2004.

McNab WW Jr. Nitrate in California groundwater: Mass loading and reactive transport across different spatial scales. University of California, Davis, Department of Civil and Environmental Engineering Distinguished Speaker Seminar Series, Davis, CA, February 2004.

McNab WW Jr. Inverse modeling of VOC plumes. Groundwater Resources Association, Environ Forensics Workshop, Emeryville, CA, November 2002.

McNab WW Jr. Forensic analysis of chlorinated hydrocarbon plumes. Environmental Litigation, Advanced Forensics and Legal Strategies, University of Wisconsin, Madison, Department of Engineering Professional Development, San Francisco, CA, March 2001.

McNab WW Jr. Remediation of plume source areas at Lawrence Livermore National Laboratory by electroosmosis. U.S. Department of Energy 12th Technical Information Exchange Workshop, Augusta, GA, November 2000.

McNab WW Jr. Using multi-site groundwater quality data to support forensic analysis of chlorinated hydrocarbon plumes. Association of Engineering Geologists/Groundwater Resources Association Joint Annual Meeting, San Jose, CA, September 2000.

McNab WW Jr, Rice D, Dooher B, Layton D. Ethanol fate and transport. California CUPA/UST Conference 2000, San Francisco, CA, February 2000.

McNab WW Jr. Results of the chlorinated volatile organic compound historical case analysis and practical implications to site managers. AEHS/U.S. Navy Ninth Annual West Coast Conference on Contaminated Soils and Groundwater, Oxnard, CA, March 1999.

McNab WW Jr. Evaluating chlorinated hydrocarbon plumes using historical case analyses. National Ground Water Association Annual Meeting, Las Vegas, NV, December 1998.

McNab WW Jr. Evaluation of chlorinated hydrocarbon plume behavior in groundwater using historical case population analyses. Ground Water Resources Association Annual Meeting, Walnut Creek, CA, October 1998.

McNab WW Jr. Natural attenuation of fuel hydrocarbons: Lessons learned from the D.O.D. Demo Program. National Stakeholders Forum on Monitored Natural Attenuation, San Francisco, CA, August 1998.

McNab WW Jr. Evaluation of chlorinated VOC groundwater plume behavior using historical case analysis. 1st International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA, May 1998.

McNab WW Jr. Uncertainty analyses of fuel hydrocarbon bioattenuation signatures in groundwater by probabilistic modeling. AEHS/U.S. Navy 7th Annual West Coast Conference on Contaminated Soils and Groundwater, Oxnard, CA, March 1997.

McNab WW Jr, Happel A, Krauter P, Reinhard M, Spormann A, Warikoo V. Fuel hydrocarbon biodegradation in ground water at elevated temperatures. Poster presentation, American Geophysical Union, Fall Meeting, San Francisco, CA, December 1995.

Selected Project Experience

Undertook geochemical modeling supporting litigation for a confidential client in South Carolina. Technical issues included the timing and extent of the evolution of pH and trace metal concentrations in soil and groundwater associated with past industrial activities.

Contributed to project involving the inversion of geophysical and geochemical data for a CO₂ storage research project. Developed a multiple 1-D reactive transport simulations in PHREEQC using a Markov chain Monte Carlo approach to assess the nature of reactive mineral phases along a flow path in a CO₂ injection zone.

Performed reactive transport modeling for CO₂ injection into a gas reservoir. Used geochemical modeling to identify key phases and dissolution rates associated with experimental data and reservoir brine chemistry; extended the data to inform reactive transport modeling along the wellbore cement-formation interface as well as at the reservoir scale. Modeling was used to assess risk of wellbore cement dissolution and well as possible impact of escaped brine and CO₂ on overlying shallow aquifer geochemistry.

Modeled the evolution of water quality in a planned reservoir in Bolivia using the DYRESM-CAEDYM codes. Modeling was performed to address potential environmental concerns in the context of due diligence requirements for the client, the Inter-American Development Bank.

Modeled mercury speciation in surface water and groundwater samples collected in Italy.

Modeled the potential impact of discharge water on water quality a lake in central Africa for a confidential client.

Studied the mobility of dechlorinating bacteria in heterogeneous porous media. Directed a combined laboratory- and computer simulation-based study of the growth patterns and activity of a commercial bacterial culture that facilitates the dechlorination of chlorinated solvents in groundwater under diffusion-limited transport conditions.

Assessed a source area remediation technology modeling for a large-scale groundwater restoration program in northern California. Conducted a comparative analysis of the suitability

for alternative remediation strategies for plume source areas. Designed a compartmentalized model of plume source areas which was used to analyze multiple source area data sets. Presented the source area remediation evaluation approach to facility management, regulatory agency representatives, a community work group, and subject matter experts from the EPA's Office of Research & Development.

Studied key groundwater quality issues in California's San Joaquin Valley for the California State Water Resources Control Board. Tasks included (1) identifying the geochemical footprint of animal waste lagoon seepage in an aquifer underlying an instrumented dairy facility, and (2) identifying ion exchange and trace element surface complexation reactions associated with an artificial recharge project.

Evaluated the dissolution of immiscible fluids in porous media across different spatial scales. Directed a combined laboratory- and computer simulation-based study of the process of dissolution of small non-aqueous phase fluid droplets within porous media on the microscale.

Evaluated the potential for *in situ* remediation of dissolved metals for a confidential client in the Midwestern U.S. Employed a reactive transport geochemical modeling approach to help design and interpret the results of a pilot test aimed at immobilizing dissolved metals in a contaminated aquifer via redox manipulation. Modeling results were also used to brief client and regulatory agencies.

Applied and evaluated a pilot-scale test of electro-osmosis as a means for remediating chlorinated hydrocarbons plume source areas. Responsibilities included planning and directing pilot tests at two separate field locations and managing staff and budget.

Led data analysis task for nation-wide statistical study of chlorinated hydrocarbon groundwater plume behavior. Responsibilities included statistical interpretation and modeling of contaminant and hydrologic data from approximately 100 groundwater contamination sites across the U.S. (DOD, DOE, and commercial/industrial facilities) impacted by chlorinated hydrocarbon plumes.

Researched *in situ* catalytic destruction of dissolved chlorinated hydrocarbons in groundwater. Results of project research yielded two peer-reviewed journal publications, two functioning groundwater treatment systems, and a U.S. patent.

As a member of an expert committee for the U.S. Department of Defense assessed the natural attenuation of fuel hydrocarbons released to the subsurface at nine military bases across the state of California. The project involved conducting site visits and reviewing data. The study yielded three peer-reviewed journal publications.

Researched fuel hydrocarbon biodegradation under the elevated temperatures of a post-thermal remediation subsurface environment. Responsibilities included data interpretation, geochemical modeling, and interacting with project collaborators at Stanford University. Project results led to regulatory closure of the site from further remediation requirements for fuel hydrocarbons.

Peer Reviewer

- Bioremediation Journal
- Environmental Science and Technology
- Ground Water Monitoring and Remediation
- Transport in Porous Media
- Water Resources Research

Professional Affiliations

- American Geophysical Union
- National Ground Water Association
- Geological Society of America