

Gregory Schnaar, Ph.D., P.G.

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**EDUCATION**

Ph.D., Soil, Water, and Environmental Science, University of Arizona, 2006

B.S., Environmental Science and Policy, University of Maryland, 2002

CERTIFICATION

Certified Professional Geologist, Virginia (2801002085); Wyoming (4401), Arkansas (3073), Nebraska (G-0537)

Dr. Schnaar specializes in carbon capture and storage (CCS) and groundwater investigations. As a fellow at the U.S. EPA he was a key member of the regulatory development team for the Underground Injection Control (UIC) Class VI rulemaking, and as a consultant he supported U.S. EPA in development of technical guidance documents that support the rulemaking. He has served as an expert technical consultant to the U.S. EPA Office of Ground Water and Drinking Water, U.S. Department of Justice, the California State Water Resources Control Board and the California Department of Justice, and is an Associate Editor for the peer-reviewed journal *Groundwater*. He has taught courses in Environmental Science and Water Resources as a faculty member at the University of Maryland, College Park and an adjunct faculty member at George Washington University.

Representative Experience (DBS&A)**EPA Class VI Permit Application Support, Confidential Client, Indiana**

Retained to provide support to various permit applications for basins throughout California, including assistance with all permitting requirements.

EPA Class VI, California CARB LCFS and MRV Plans, Carbon TerraVault, California

Retained to provide support to various permit applications for basins throughout California, including assistance with all permitting requirements. Established baseline monitoring program for groundwater, soil gas, vegetation, and atmospheric air.

California CARB LCFS, Confidential Client, Wyoming

Retained to provide support to CARB permit for basins in Wyoming, including assistance with all permitting requirements. Established baseline monitoring program for groundwater, soil gas, vegetation, and atmospheric air.

EPA Class VI, California CARB LCFS and EPA MRV Plans, Confidential Client, Nebraska

Retained to provide support to monitoring-related portions of permit applications for basin in Nebraska.

Geologic Sequestration Technical Guidance Documents, The Cadmus Group/U.S. EPA Office of Ground Water and Drinking Water, Washington, D.C.

Expert technical contractor for five technical guidance documents published by U.S. EPA Underground Injection Control program regarding geologic sequestration of carbon dioxide, including modeling development and evaluation. The technical guidance documents provide permitting support to owners and operators of geologic sequestration facilities and state regulators as related to monitoring, multi-phase numerical modeling, operation, and injection well integrity testing.

Review and Technical Comments on FutureGen Underground Injection Control Permit Application for Class VI Wells, Illinois

Reviewed and provided technical comments on FutureGen permit applications on behalf of private landowner in vicinity of proposed project. Expert opinion reports

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submitted as public comment to U.S. EPA Region 5 and subsequently to the EPA Environmental Appeals Board.

Review of Archer Daniels Midland Company Underground Injection Control Permit Application for Class VI, Geologic Sequestration, The Cadmus Group/U.S. EPA Office of Ground Water and Drinking Water, Washington, D.C.

Provided assessment of permit application submitted to U.S. EPA Region 5 for injection of carbon dioxide for geologic sequestration. Evaluated completeness of permit application as compared to Underground Injection Control regulations and identified discrepancies in technical submittals. Specifically evaluated documentation of numerical modeling conducted to demonstrate non-endangerment of groundwater resources.

PFAS Investigation and Modeling at Cannon and Holloman Air Force Bases, New Mexico Environment Department, New Mexico

Performed analytical and numerical modeling to predict future groundwater impacts under various scenarios and fill data gaps, including modeling PFAS migration in paleochannels downgradient of Cannon AFB. Participated in overseeing field sampling to delineate the extent of PFAS impacts.

PFAS Rulemaking Comments Support, City of Las Cruces, New Mexico

Supported City of Las Cruces in developing technical comments on the U.S. EPA proposed PFAS National Primary Drinking Water Regulation. Comments covered topics related to Monitoring and Compliance Requirements, Treatment Technologies, and Methods for Cost Estimating.

Quality Assurance Manager, Griggs Walnut Superfund CERCLA Site, Las Cruces, New Mexico

Responsibilities include oversight and review of all project field sampling and reporting for federal Superfund Site with tetrachloroethene (PCE) as primary contaminant of concern. Identified issues in existing groundwater monitoring network (FLUTE wells) and developed strategy to revise groundwater monitoring program accordingly.

LNAPL Remediation and Vapor Intrusion Assessment at Kirtland Air Force Base, New Mexico Environmental Department, Albuquerque, New Mexico

Reviewed historical data (operations with petroleum hydrocarbons from 1958 to present) and documentation regarding LNAPL occurrence, petroleum hydrocarbons, and BTEX to provide NMED with an independent assessment of the need for a vapor intrusion investigation and additional data needs for remedial planning associated with LNAPL in the vadose zone and submerged under the groundwater table.

Representative Experience (AAAS Science and Technology Policy Fellowship, U.S. Environmental Protection Agency, 2007-2008)

Member of the original rulemaking team on the U.S. Environmental Protection Agency Class VI proposed rule in the U.S. EPA Office of Ground Water and Drinking Water. Led portions of the rulemaking related to computational modeling and post-injection site care, conducted outreach to Carbon Sequestration Partnerships, the U.S. Department of Energy, state Underground Injection Control regulators, and EPA Regional offices.

Additional Professional Training

OSHA 40-hour HAZWOPER Training
TOUGH2, including T2VOC
ESRI ArcGIS and QGIS
GSFLOW, MODFLOW, MODPATH, MT3D and Groundwater Vistas
Soil Water Assessment Tool (SWAT)

Publications and Presentations

Peer-Reviewed Journal Articles

Associate Editor, Groundwater, 2012 to present

- Brusseau, M. L., Narter, M. E., Schnaar, G., Araujo, J., & Marble, J. (2025). Fluid/Fluid Interfacial Areas Measured for Different Non-Wetting/Wetting Fluid Pairs in Natural Porous Media. *Environments*, 12(10), 380. <https://doi.org/10.3390/environments12100380>
- Schnaar, G., J. Dodge and S.J. Cullen, 2016 (invited paper). Comprehensive groundwater balance development to characterize selenium loading to surface water channels in Orange County, California. *Journal of Contemporary Water Research and Education*, 159: 5-23.
- Schnaar, G. and M.L. Brusseau. 2014. Nonideal transport of contaminants in heterogeneous porous media: 11. Testing the experiment condition dependency of the continuous distribution rate model for Sorption-Desorption. *Water Air Soil Pollut* (2014) 225:2136.
- Schnaar, G., T. Umstot, and S.J. Cullen. 2013. Correction To: "Birkholzer, J.T. et al., 2011, Brine flow up a well caused by pressure perturbation from geologic carbon sequestration: Static and dynamic evaluations. *International Journal Greenhouse Gas Control*; Vol. 5: 850-861." *International Journal of Greenhouse Gas Control*, 17: 542-543.
- Schnaar, G., and M.L. Brusseau. 2013. Measuring equilibrium sorption coefficients with the miscible-displacement method. *Journal of Environmental Science and Health, Part A*, 48: 355-359.
- Brusseau, M.L., G. Schnaar, G.R. Johnson, and A.E. Russo. 2012. 10 - Impact of co-solutes on sorption of tetrachloroethene by porous media with low organic-carbon contents. *Chemosphere*, 89: 1302-1306.
- Brusseau, M.L., A.E. Russo and G. Schnaar. 2012. Nonideal transport of contaminants in heterogeneous porous media: 9 - Impact of contact time on desorption and elution tailing. *Chemosphere*, 89: 287-292.
- Russo, A., Johnson, G.R., Schnaar, G., and M.L. Brusseau. 2010. Nonideal transport of contaminants in heterogeneous porous media: 8. Characterizing and modeling asymptotic contaminant-elution tailing for several soils and aquifer sediments. *Chemosphere*, 81(3): 366-371.
- Schnaar, G. and D.C. Digiulio. 2009. Computational modeling of the geologic sequestration of carbon dioxide. *Vadose Zone Journal* 8: 389-403.
- Brusseau, M.L., Narter, M., Schnaar, G. and Marble, J. 2009. Measurement and Estimation of Organic-liquid/Water Interfacial Areas for Several Natural Porous Media. *Environmental Science & Technology*, 43(10): 3619-3625.
- Brusseau M.L., Janousek H., Murao A., and G. Schnaar. 2008. Synchrotron X-ray microtomography and interfacial partitioning tracer test measurements of NAPL-water interfacial areas. *Water Resources Research*. 44, W01411.
- Brusseau, M.L., Peng, S., Schnaar, G., and A. Murao. 2007. Measuring air-water interfacial areas for a sandy porous medium: comparing X-ray microtomography and partitioning tracer tests. *Environmental Science and Technology*. 41(6) 1956-1961.
- Schnaar, G. and M.L. Brusseau. 2006. Characterizing pore-scale dissolution of organic immiscible liquid in natural porous media using synchrotron X-ray microtomography. *Environmental Science and Technology*. 40(21) 6622-6629.

Schnaar, G. and M.L. Brusseau. 2006. Characterizing pore-scale configuration of organic immiscible-liquid in multi-phase systems with synchrotron X-ray microtomography. *Vadose Zone Journal* 5: 641-648.

Brusseau, M.L., Peng S., Schnaar, G., and M. Costanza-Robinson. 2006. Relationships among air-water interfacial area, capillary pressure, and water saturation for a sandy porous medium. *Water Resources Research*. 42, W03501.

Schnaar, G. and M.L. Brusseau. 2005. Pore-scale characterization of organic immiscible-liquid morphology in natural porous media using synchrotron X-ray microtomography. *Environmental Science and Technology*. 39(21) 8403-8410.

Government Reports and Professional Trade Publications

Woodward N.B., Levine, A. D., Singer, M., Kobelski, B.J., Fries, J.S., Schnaar, G., Burruss, R.C., Duncan, D., Glynn, P., Neuzil, C., Huntsinger, R., Osvald, K.S., Carlson, C.P. 2008. *Water Resources Research Needs Associated with Implementation of Geologic Sequestration of Carbon Dioxide. A report to the White House Office of Science and Technology Policy, Committee on Environment and Natural Resources, Subcommittee on Water Availability and Quality.*

Schnaar, G. and D.C. Digiulio. 2008. Computational modeling of underground injection of carbon dioxide for determination of area of review and potential risk to underground sources of drinking water. Supporting document to: Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO₂) Geologic Sequestration (GS) Wells; Proposed Rule. *Federal Register* Vol. 73, No. 144, Friday, July 25, 2008.

Schnaar G., and S.J. Cullen. 2009. The Hydrology of Geologic Sequestration. *Southwest Hydrology*, 8: 20-21.

Schnaar, G. 2008. U.S. EPA Development of a Proposed UIC Rule for Geologic Sequestration of CO₂. *National Ground Water Association, AGWSE Newszine*, July 16 2008.

Conference Presentations

Umstot, T. and G. Schnaar. 2025. Risk Based Area of Review Delineation with MODFLOW and Groundwater Contaminant Fate and Transport Modeling. *Carbon Capture, Utilization and Storage (CCUS) Conference*, Houston, TX. March 4, 2025.

Botros, F. G. Schnaar, N. Blandford, A. Ewing. 2024. Numerical Modeling to Estimate Groundwater PFAS Migration Downgradient of Air Force Base AFFF Source Area. *NGWA Groundwater in the PFAS Era: Stressors, Protection & Compliance*, Tucson AZ. April 16, 2024.

Schnaar, G. 2024. EPA Permitting Process for Class VI UIC Wells (CCUS) and Current Industry Status (Invited Talk). *Carbon Capture, Utilization and Storage (CCUS) Conference*, Houston, TX. March 11, 2024.

Schnaar, G., C. Wolf, D. Schwartz, S. Finsterle. 2023. Permit Application Development for Planned Saline Formation Injection Project in San Joaquin Valley, California. *Carbon Capture, Utilization and Storage (CCUS) Conference*, University of Houston, Houston, TX. April 26, 2023.

Schnaar, G. 2022. Planned Geologic Sequestration of Carbon Dioxide at the San Joaquin Renewables Project and Class VI Application Process. *American Groundwater Trust California Groundwater Conference*. Lakewood, California, March 30, 2022.

Schnaar, G. 2019. *PFAS Forensics: How to Identify Potentially Responsible Parties.*

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- Law Seminars International, PFAS Litigation Conference (webinar). New York, NY, October 29, 2020.
- Law Seminars International, PFAS Litigation Conference. San Diego, CA, December 9, 2019.

Schnaar, G. 2019. Poly- and Perfluoroalkyl Substances: Sources and Source Identification. National Groundwater Association PFAS Management, Mitigation, and Remediation Conference, Westerville, OH. June 19 2019.

Schnaar, G. 2019. Poly- and Perfluoroalkyl Substances: Wide-Ranging Sources and Impacts to Water Supplies.

- American Ground Water Trust, Managing Florida's Aquifers Annual Conference. Orlando, Florida, October 1, 2019.
- American Ground Water Trust Information Exchange Workshops "PFAS: Solutions to Legacy Groundwater Contamination" in Pittsburgh, PA (March 4, 2019), Mount Laurel, NJ (March 6, 2019), Phoenix, AZ (July 11, 2019), Albuquerque, NM (July 24, 2019), NJ/MD/DE (September 2, 2020 via webinar), Arizona (September 24, 2019 via webinar).
- American Ground Water Trust Texas Aquifer Conference. Austin, Texas, June 12 2019.
- American Ground Water Trust/Association of Ground Water Agencies joint Annual Conference. Ontario, California, February 12, 2019.

Schnaar, G. 2018. Use of Analytical Contaminant Fate and Transport Modeling in Forensic Source Evaluation. Annual Conference of the International Network of Environmental Forensics. Salt Lake City, Utah, June 25 - 27, 2018.

Schnaar, G. 2017. Lessons learned in developing defensible groundwater budgets and evaluating sustainability indicators. American Ground Water Trust/Association of Ground Water Agencies joint Annual Conference. Ontario, California, February 15-16, 2017.

Cullen, S.J., G. Schnaar, and M. Cruikshank, 2016. Groundwater Planning and Estimating Safe Yield in California under the Sustainable Groundwater Management Act. Hydrology and the Law, Law Seminars International, Santa Monica, California, September 16, 2016.

Schnaar, G. 2015. Selenium Loading from Groundwater to Newport Bay, Orange County, California. Presentation at the Geological Society of America 2015 Annual Meeting, Baltimore, Maryland. November 1, 2015.

Schnaar, G., Blandford, N., 2015. Not Under My Back Yard: The Looming Battle Over Underground Injection. Presentation at the American Bar Association Fall Conference, Chicago, Illinois. October 28-31, 2015.

Umstot, T., G. Schnaar, N. Blandford, S.J. Cullen, P. Kaiser, J. Ayrabe. 2015. Recharge estimates from a soil water-balance model improve groundwater model calibration. MODFLOW and More 2015: Modeling a Complex World. Golden, Colorado, May 31 – June 3, 2015.

Dodge, J.J., G. Schnaar, S.J. Cullen, and J. Peng, 2015. Selenium Geohydrology, Swamp of Frogs, Newport Bay Watershed, Orange County, California. Association for Environmental Health and Sciences (AEHS) 25th Annual International Conference on Soil, Water, Energy and Air. San Diego, California. March 23 – 26, 2015.

Sweetland, N.T., S.J. Cullen and G. Schnaar. Vapor Intrusion from Groundwater Plumes: Critical Technical and Regulatory Issues. 2015. 2015 National Ground Water Association (NGWA) Groundwater Summit, San Antonio, Texas. March 16 – 18, 2015.

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- Dodge, J.J., G. Schnaar, S.J. Cullen and J. Peng. 2014. Drainage Channels Remobilize Selenium, Swamp of the Frogs, Newport Bay Watershed, Orange County, California. Groundwater Resources Association of California/U.S. Society for Irrigation and Drainage Professionals. March 4-5, Sacramento, California.
- G. Schnaar, J. J. Dodge, S. J. Cullen, and J. Peng. 2012. Water Balance Development to Characterize Selenium Flux, Newport Bay Watershed, Orange County, California. Groundwater Resources Association of California-Salt and Nitrate in Groundwater: Finding Solutions for a Widespread Problem, June 13-14, Fresno, California.
- Molina, April, G. Schnaar, P. Kaiser, and Stephen J. Cullen, 2012. Preparing Geospatial Data for Use in Watershed and Groundwater Models. ESRI, Southwest Users Group, Albuquerque, New Mexico, October 8-11, 2012.
- Kaiser, Phil, T. Umstot, G. Schnaar, Stephen J. Cullen, 2012. The Distributed Parameter Watershed Model for Predicting Recharge in Southern California. California Groundwater Association, 21st Annual Meeting and Conference, "California Groundwater: Data, Planning and Opportunities" October 4-5, 2012, Rohnert Park, California.
- G. Schnaar. Federal UIC Regulations for Geologic Sequestration: An Integrated Approach of Site Characterization, Modeling, and Monitoring. American Association of Petroleum Geologists (AAPG) Rocky Mountain Section Annual Convention, June 2010. Durango, Colorado.
- G. Schnaar. CO2 Geologic Storage: Simulation for Regulators. International Energy Agency (IEA) CO2 Geological Storage Modeling Meeting, February 2010. Salt Lake City, Utah.
- G. Schnaar. Geologic Sequestration of Carbon Dioxide: Models, Codes, and Federal Regulations. TOUGH Symposium, September 2009. Berkeley, California.
- N. Sweetland. P. Schauwecker, and G. Schnaar. MTBE Products Liability Litigation: The Role of Hydrogeologic Investigation. International Network of Environmental Forensics Conference, September 2009. Calgary, Alberta.
- G. Schnaar. Federal Regulations for Geologic Sequestration of Carbon Dioxide. Air & Waste Management Association, Carbon Sequestration 101 (via webinar), February 2009.
- G. Schnaar. Standards for Geologic Sequestration of Carbon Dioxide, EPA Proposed Rulemaking, Signed July 15, 2008.
- Big Sky Regional Carbon Sequestration Partnership Annual Meeting, October 2008. Spokane, Washington.
 - EPA Region 8 State UIC Workshop, October 2008. Salt Lake City, Utah.
 - WESTCARB Regional Carbon Sequestration Partnership Annual Meeting, October 2008 (via webinar). Anchorage, Alaska.
 - EPA Region 7 UIC Manager's Meeting, September 2008 (via webinar). Kansas City, MO.
 - Ground Water Protection Council Annual Meeting, September 2008. Session: Underground Injection Control (UIC) and Geosequestration Seminar.
 - Electric Power Research Institute Fall Environment Council Meeting, September 2008. Baltimore, Maryland.
 - Edison Electric Institute Global Climate Change Subcommittee Meeting, July 2008. Savannah, Georgia.

- G. Schnaar and N. Sweetland. Geologic Sequestration of Carbon Dioxide: Potential impacts to groundwater resources, the U.S. regulatory framework, and lessons learned from previous injection activities. Groundwater Resources Association of California Climate Change: Implications for California Groundwater Management, August 2008. Sacramento, California.
- Brusseau, M.L., Janousek H., Murao A., and G. Schnaar. Synchrotron X-ray microtomography and interfacial partitioning tracer test measurements of NAPL-water interfacial areas. American Geophysical Union Fall Meeting, December 2007. Session: Pore-Scale Modeling and Imaging of Multiphase Flow, Solute Transport, and Biogeochemical Processes in Porous Media. San Francisco, California.
- Marble, J.C., Narter M., Schnaar G., and M.L. Brusseau. Characterizing air-water interfacial area for variably saturated porous media. American Geophysical Union Fall Meeting, December 2007. Session: Pore-Scale Modeling and Imaging of Multiphase Flow, Solute Transport, and Biogeochemical Processes in Porous Media. San Francisco, California.
- Schnaar, G. and M.L. Brusseau. Characterizing pore-scale dissolution of organic immiscible liquid in natural porous media using synchrotron X-Ray microtomography. American Geophysical Union Fall Meeting, December 2006. Session: Quantitative Pore-Scale Investigations of Multiphase Bio/Geo/Chemical Processes. San Francisco, California.
- Brusseau, M.L., Schnaar, G., Marble J. Measured air-water and NAPL-water interfacial areas for sandy porous media: comparing X-ray microtomography and partitioning tracer test methods. American Geophysical Union Fall Meeting, December 2006. Session: Quantitative Pore-Scale Investigations of Multiphase Bio/Geo/Chemical Processes. San Francisco, California.
- Brusseau, M.L., Schnaar, G., Peng S., Marble J. Relationship between air-water interfacial area and water saturation for sandy porous media. Soil Science Society of America International Meeting, November 2006 (Oral Presentation by G. Schnaar). Session: NRI's Soil Processes Program: Reports, Assessments and Future Directions. Indianapolis, Indiana.
- Schnaar, G. and M.L. Brusseau. Pore-scale characterization of organic immiscible-liquid morphology in natural porous media using synchrotron x-ray microtomography.
- University of Arizona Dept. of Hydrology and Water Resources Student Showcase, 2006 (Oral Presentation). Tucson, Arizona.
 - Superfund Basic Research Program Annual Meeting, 2006. New York, New York.
 - American Geophysical Union Fall Meeting, 2005 (Oral Presentation). Session: Advances in Characterizing and Remediating Nonaqueous Phase Liquid Source Zones: From Pore Scale to Field Scale. San Francisco, California.
- Brusseau, M.L., Peng, S., Schnaar, G., and M. Costanza-Robinson. Relationships among air-water interfacial area, capillary pressure, and water saturation for a sandy porous medium. American Geophysical Union Fall Meeting, 2005. Session: Pore-Scale Processes and Their Effect on Continuum and Field-Scale Hydrology. San Francisco, California.
- Schnaar, G. and M.L. Brusseau. The impact of non-ideal sorption on low-concentration tailing behavior for chlorinated solvents in aquifer material.
- University of Arizona Water Sustainability Program Fall Forum, 2005. Tucson, Arizona.

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- American Geophysical Union Fall Meeting, 2004 (Oral Presentation). Session: Mass Transfer and Mass Flux Processes in Source-Zone Systems. San Francisco, California.
- University of Arizona Superfund Basic Research Program and Southwest Environmental Health Sciences Center 8th Annual Science Fair, 2004. Tucson, Arizona.
- Arizona Hydrological Society Annual Symposium, 2004 (Oral Presentation). Tucson, Arizona.