

**APPENDIX A**  
**RÉSUMÉS**

**STEWART L. STOVER, JR.**  
620 Apollo Road  
Scott, LA 70583  
Phone: (337) 261-1963  
Fax: (337) 261-1953  
E-mail: [stewarts@hetinc.us](mailto:stewarts@hetinc.us)

**Résumé**

<b>EDUCATION</b>	1984 - 1986	Northeast Louisiana University Master of Science in Geosciences
	1980 - 1984	Northeast Louisiana University Bachelor of Science in Geology
<b>EMPLOYMENT HISTORY</b>	1990 - Present Position	<u>Principal Hydrogeologist</u> Hydro-Environmental Technology, Inc. Lafayette, Louisiana
<b>PROFESSIONAL REGISTRATIONS</b>		<u>Registered Professional Geologist/Geoscientist</u> Louisiana #440 Arkansas #842 Tennessee #751 Alabama #269 Mississippi #360 Texas #4300  State of Louisiana Water Well Contractor #416  State of Louisiana Underground Storage Tank Closure Certification C-0180
<b>QUALIFIED EXPERT</b>		<u>Hydrogeology</u> Florida District Court Jacksonville, Florida  State of Louisiana Federal Court State/District Court  State of Texas State/District Court
<b>PROFESSIONAL ASSOCIATIONS</b>		National Water Well Association Association of Groundwater Scientists and Engineers Honor Society of Earth Scientists (Sigma Gamma Epsilon) American Water Resources Association American Association of Petroleum Geologists

## 2012-2020 List of Depositions and Testimonies of Stewart L. Stover, Jr.

(D/ HT)	C.F. Henry Properties, LLC, et al. v. Apache Corporation, et al. Docket No. 10-18683	2010-2012	Geology/Hydrogeology, Environmental Site Assessment, Groundwater and Soil Remediation <b>media:</b> hydrocarbons, chlorides, and metals
(D)	Sweet Lake Land and Oil Co., LLC v. Exxon Mobil Corporation, et al. Docket No. 2010-1272	2011-2012	Geology/Hydrogeology, Environmental Site Assessment, Groundwater and Soil Remediation <b>media:</b> hydrocarbons and chlorides
(D/ HT)	Ardoin Limited Partnership & CF Henry Properties, LLC v. Meridian Resource & Exploration, LLC et al. Docket No. 10-18692	2012	Soil and Groundwater Site Assessment, Hydrogeology, Environmental Regulations <b>media:</b> hydrocarbons, metals, and chlorides
(D)	Marcus Broussard, Jr., et al. v. Martin Operating Partnership, LP, et al. Docket No. 83406	2012	Soil Site Assessment, Hydrogeology, Environmental Regulations <b>media:</b> hydrocarbons and metals
(D)	Ruby Mhire, et al. vs. Total Petrochemicals USA, Inc., et al. Docket No. 10-18239	2013	Soil and Groundwater Site Assessment, Hydrogeology, Environmental Regulations <b>media:</b> hydrocarbons, metals, and chlorides
(D)	Joseph Dupont and Doris Petrus v. Mobil Oil E&P Southeast, Inc., et al. Docket No. 52,090	2013	Soil and Groundwater Site Assessment, Hydrogeology, Environmental Regulations <b>media:</b> hydrocarbons, metals, and chlorides
(D/T)	Del Dean v. Velsicol Chemical Corporation Docket No. 82490-L	2013	Geology, Hydrogeology, Environmental Regulations <b>media:</b> arsenic
(D/ HT)	Agrisouth vs. Exxon (A1) Docket No. 24,132	2013	Geology, Hydrogeology, Environmental Regulations <b>media:</b> chlorides
(D)	Mark Clark vs. Wagner Oil Company, Apache Corporation, and BP America, Inc. Docket No. 10-18866	2013	Geology, Hydrogeology, Environmental Regulations <b>media:</b> hydrocarbons, metals, and chlorides
(D)	The Sweet Lake Land and Oil Company, LLC, vs. Oleum Operating Company, L.C., et al. Docket No. 2010-1272	2013-2014	Soil and Groundwater Site Assessment, Hydrogeology, Environmental Regulations <b>media:</b> hydrocarbons, metals, and chlorides
(D)	Agrisouth vs. Exxon (A13) Docket No. 24,132	2014	Site Assessment, Geology, Hydrogeology, Environmental Regulations <b>media:</b> chlorides

## 2012-2020 List of Depositions and Testimonies of Stewart L. Stover, Jr.

(D)	Henry Leon Sarpy and Robert Henry Sarpy, Jr., et al. vs. Exxon Mobil Corporation, et al. Docket No. 05-4929	2015	Site Assessment, Hydrogeology, Environmental Regulation <b>media:</b> chlorides, metals, hydrocarbons
(D/T/HT)	Sweet Lake Land and Oil Company, LLC v. Oleum Operating Company Docket No. 2010-1272	2013-2016	Geology, Hydrogeology, Environmental Regulations, Site Assessment <b>media:</b> hydrocarbons, metals, and chlorides
(D/T)	Exxon Mobil v. Trade Exploration McGuire/Woods Docket No. 2009-60726	2015-2016	LA Legacy Lawsuit Indemnity Geology, Hydrogeology, Soil and Groundwater Remediation
(D)	State of Louisiana and the Iberville Parish School Board v. BP America Production Company, et al. Docket No. 072605	2016	Geology, Hydrogeology, Environmental Regulations, Site Assessment <b>media:</b> hydrocarbons, metals, and chlorides
(D)	Lewis Champagne, II, et al. v. Union Pacific Railroad Company, et al. Civil Action No. 6:14-cv-00766	2016	Geology, Hydrogeology, Environmental Regulations, Soil/Sediment Remediation, Emergency Response <b>media:</b> Dodecanol, Lube Oil, Sodium Hydroxide
(D)	Jack Anthony Devillier, et al. v. Chevron U.S.A. Inc. et al., 27 <sup>th</sup> Judicial District Court for the Parish of St. Landry Docket No. 12-C-5530	2020	Geology, Hydrogeology, Environmental Regulations, Site Assessment <b>media:</b> hydrocarbons, metals, and chlorides
(D)	Hero Lands Company, LLC v. Chevron U.S.A. Inc., et al., 25 <sup>th</sup> Judicial District Court, Docket No. 64320-A	2020	Geology, Hydrogeology, Environmental Regulations, Site Assessment <b>media:</b> hydrocarbons, metals, and chlorides
(D)	Litel Explorations, L.L.C. v. Aegis Development Company, L.L.C., et al., 31 <sup>st</sup> Judicial District Court, Docket No. C823-17	2020	Geology, Hydrogeology, Environmental Regulations, Site Assessment <b>media:</b> hydrocarbons, metals, and chlorides
(D)	James J. Martin Family, LLC v. BP America Production, et al., 16 <sup>th</sup> Judicial District Court, Docket No. 87428, Division "C"	2020	Geology, Hydrogeology, Environmental Regulations, Site Assessment <b>media:</b> hydrocarbons, metals, and chlorides

D = Deposition Testimony  
T= Trial Testimony  
HT = Hearing Testimony

### **Selected Recent Publications**

Louisiana Statewide Water Management Plan Volume I - Identification and Use Assessment of Louisiana Water Resources; prepared for the Louisiana Groundwater Management Commission, June 2002.

Louisiana Statewide Water Management Plan Volume II - Planning and Management Issues for Louisiana Water Resources; prepared for the Louisiana Groundwater Management Commission, December 2002.

### **Compensation**

Compensation for Expert Report preparation, deposition, and trial testimony are billed at \$300.00 per hour.

**BRENT T. POOLER**  
620 Apollo Road  
Scott, LA 70583  
Phone: (337) 261-1963  
Fax: (337) 261-1953  
E-mail: brentp@hetinc.us

**Résumé**

<b>EDUCATION</b>	1992 - 1996	Louisiana State University Bachelor of Science in Geology Concentration: Environmental Geology
<b>EMPLOYMENT HISTORY</b>	2003 - Present	Senior Risk Analyst/Senior Hydrogeologist Hydro-Environmental Technology, Inc. Lafayette, Louisiana
	1996 - 2003	Hydrogeologist Hydro-Environmental Technology, Inc. Lafayette, Louisiana
	1994 -1995	Laboratory Assistant Louisiana State University Department of Geology of Geophysics Baton Rouge, Louisiana
<b>PROFESSIONAL REGISTRATIONS</b>		Registered Professional Geologist/Geoscientist Texas - 6012 Louisiana - 274
<b>PROFESSIONAL ASSOCIATIONS</b>		Louisiana Groundwater Association National Groundwater Association of Scientists and Engineers
<b>QUALIFIED EXPERT</b>		LDNR Regulations, Assessments, and Remedial Processes LDEQ RECAP Assessment TCEQ TRRP Assessment Hydrogeological Assessment State and Federal Environmental Regulations Environmental Site Assessment Geology Risk Based Principals in Louisiana and Texas

## 2008-2021 List of Depositions and Testimonies of Brent T. Pooler

- (D) 2008 Goodson v. Hartford Indemnity Company, et al. (15th Judicial Court), Docket No. 2002-4415-K
- (D) 2010 Kenneth Hebert, et. al. v. Energen Resources Corporation, et al. (14th Judicial District Court, Calcasieu Parish, Louisiana), Docket No. 2005-0039
- (D/HT/T) 2011 Barbara Houssiere, et al. vs. ASCO USA, L.L.C., et al., Docket No. 84068
- (D) 2011 C.F. Henry Properties, LLC, et al. v. Apache Corporation, et al., Docket No. 10-18683
- (D) 2011 Dyrell and Rhonda Stokes v. Neumin Production Company, et al. (14<sup>th</sup> Judicial District Court, Calcasieu Parish, Louisiana), Docket No. 2008-6038
- (D) 2012 Ardoin Limited Partnership & CF Henry Properties, LLC v. Meridian Resource & Exploration, LLC et al., Docket No. 10-18692
- (D) 2012 Marcus Broussard, Jr., et al. v. Martin Operating Partnership, LP, et al., Docket No. 83406
- (D) 2012 Ruby Mhire, et al. vs. Total Petrochemicals USA, Inc., et al., Docket No. 10-18239
- (D) 2013 Joseph Dupont and Doris Petrus v. Mobil Oil E&P Southeast, Inc., et al., Docket No. 52,090
- (D/T) 2013 Mark Clark vs. Wagner oil Company, Apache Corporation, and BP America, Inc., Docket No. 10-18866
- (D) 2013-2014 The Sweet Lake Land and Oil Company, LLC, vs. Oleum Operating Company, L.C., et al., Docket No. 2010-1272
- (HT) 2014 Heloise, LLC et al. v. BP America Production Co. et al., Docket No. 120113
- (D) 2014 Carolyn R. Bunch et al. v. Brighton Energy Company, Inc., et al., Docket No. C-43-11
- (D/T/HT) 2013-2016 The Sweet Lake Land and Oil Company, LLC, vs. Oleum Operating Company, L.C., et al., Docket No. 2010-1272
- (D) 2015 Claude Coulon Jumonville, et al. v. Sunset Petroleum, Inc., et al., Docket No. 44491
- (D) 2015 Henry Leon Sarpy and Robert Henry Sarpy, Jr., et al. vs. Exxon Mobil Corporation, et al., Docket No. 05-4929
- (D) 2016 State of Louisiana and the Iberville Parish School Board v. BP America Production Company, et al., Docket No. 072605
- (D) 2016 Lewis Champagne, II, et al. v. Union Pacific Railroad Company, et al., Civil Action No. 6:14-cv-00766
- (D) 2020 Jack Anthony Devillier, et al., v. Chevron U.S.A., Inc. et al., 27<sup>th</sup> Judicial District Court for the Parish of St. Landry. Docket No. 12-C-5530.

## 2008-2021 List of Depositions and Testimonies of Brent T. Pooler

- (D) 2020 James Steven Broussard, et al. v. Mayne & Mertz, Inc., et al., 14th Judicial District Court, Docket No. 2018-2721 B
- (D) 2021 Hero Lands Company, LLC v. Chevron U.S.A. Inc., et al., 25th Judicial District Court, Docket No. 64320-A
- (D) 2021 Litel Explorations, L.L.C. v. Aegis Development Company, L.L.C., et al., 31<sup>st</sup> Judicial District Court, Docket No. C823-17
- (D) 2021 Placid Oil, LLC, F/K/A Placid Oil Company v. Avalon Plantation, Inc. United States Bankruptcy Court for the Northern District of Texas, Dallas Division Case No. 86-33419-sgj-11; Adversary Proc. No. 20-03149-sgj
- (D) 2021 James J. Martin Family, LLG v. BP America Production, et al., 16th Judicial District Court, Docket No. 87428, Division ,C, and Robert Patricia Fleming, LLG v. BP America Production Company, et al., 16th Judicial District Court, Docket No.87912, Division "8"

D = Deposition  
T = Trial Testimony  
HT = Hearing Testimony

### Compensation

Compensation for Expert Report preparation, deposition, and trial testimony are billed at \$200.00 per hour. Normal billing for other litigation matters at \$160.00 per hour.







**WADE L. BRYANT, JR.**

**RESUME'**

Senior Environmental Scientist

**AREAS OF EXPERTISE**

- Stream Investigation/Monitoring
- Ecological Risk Assessment
- Spill Response and Natural Resource Damage Assessment
- Wetland Investigation/Monitoring
- Aquatic Contaminants/Toxicity
- Endangered Species Consultation
- Statistical Analysis

**YEARS OF EXPERIENCE**

27

**PROJECT SITES**

AR, CA, FL, GA, LA, MS, NC, OH, SC, TN, TX

**EDUCATION**

M.S., Biology, East Carolina University, 1988  
B.S., Biology, East Carolina University, 1981  
University of Florida – 1989-1993 Environmental Engineering  
NOAA Sea Grant Fellowship 1992

**EXPERIENCE**

Mr. Bryant is a Senior Environmental Scientist with CK’s Ecological Team and comes to CK after 25 years of federal service. Mr. Bryant was a Senior Ecologist with the US Geological Survey for twenty two years and worked for the US Fish and Wildlife Service Division of Environmental Contaminants and the Division of Refuges. Mr. Bryant spent 4 years as a science advisor to the Federal On-Scene Coordinator for the Deepwater Horizon Oil Spill. Prior to 2010, Mr. Bryant led integrated assessments of stream ecosystem health for a national-scale federal program. These assessments included the evaluation of effects of alterations in hydrology and stream habitat, nutrient enrichment, pesticides, heavy metals, and PAHs on the stream biota. Mr. Bryant has expertise in the design and implementation of aquatic monitoring programs, wetland ecology, ecological risk assessment, and statistical analysis/modeling. Mr. Bryant has extensive experience providing technical support to federal agencies including: US Coast Guard, NOAA Office of Response and Restoration, Bureau of Safety and Environmental Enforcement, USFWS Endangered Species Program, Department of Interior Section 106 Compliance Office, and the Department of Justice.

**PROJECT HIGHLIGHTS**

**CK Associates Environmental Consultants –**

Science Team Lead – Taylor Energy Company. Conducted multiple investigations, prepared reports for Unified Command, presented findings at professional meetings, and provided technical input to various aspects of response and litigation. Conducted Ecological Risk Assessment and presented findings in court ordered public forum. Technical advisor for source and remediation alternatives for on-going sheen. Participate in negotiations with US Coast Guard, National Oceanic and Atmospheric Administration, and Bureau of Safety and Environmental Enforcement. For details and questions please contact Will Pecue, President Taylor Energy company. (Contact information will be provided upon request)

Natural Resource Damage Assessment settlement – Confidential Client settled 2021. Analyzed environmental data, technical review of Trustee assumptions and Habitat Equivalency Analysis model output, reviewed restoration alternatives, and developed integrated HEA and cost/benefit models. Represented client in negotiations with Federal and State Trustees.



Natural Resource Damage Assessment – Ongoing Confidential Client. Data collection and interpretation for multiple NRDA cases and settlement negotiations for coastal Louisiana oil spills that occurred in 2014, 2016 and 2018.

Litigation Support – submitted declarations US vs Taylor Energy LLC US Federal Court Eastern District of Louisiana. Case 2:20-cv-02910-GGG-MBN Document 115-4 Filed 04/20/21

Litigation Support - submitted declaration - United States Court of Federal Claims Case 1:16-cv-00012-NBF Document 72-8 Filed 04/25/18

Litigation Support – Reviewed materials, prepared questions, and attended declarations taken by client attorneys.

Litigation support – submitted expert report US District Court Louisiana. Case 18-14046 c/w 18-14051

Litigation support – submitted declaration US District Court – California Case No. 2:15-cv-04113-PSG-JEM

Testifying Expert - Santa Barbara California Superior Court Criminal Case No. 1495091

Offshore sampling – Conducted sonar surveys, collected current profiles, mapped extent / character of oil slicks and collected samples of oil sheens for forensic fingerprinting. Performed multivariate statistical analysis of chemical data and co-authored report. Report was submitted to US Coast Guard and Bureau of Safety and Environmental Enforcement.

Litigation Support – Ecological Risk Assessment related to oil and gas extraction activities, including evaluation of potential soil contamination, sedimentation, and altered hydrology in forested wetlands.

Wetland, Stream Delineation, and design of permittee responsible mitigation - Evaluated impacts to streams / wetlands and designed mitigation for a large-scale forest products facility in Texas. Represented client in negotiations with US Army Corps of Engineers, US Fish and Wildlife, EPA, and Texas Parks and Wildlife during the permitting process.

Marsh Restoration – Evaluated impacts to salt marsh sediment and vegetation from pipeline repair. Conducted field evaluations of marsh sediments and vegetation regrowth. Designed mitigation alternatives.

Wetlands and stream delineation and permitting - delineation and endangered species habitat evaluations (TX, MS, LA) – USACE permitting for proposed pipeline locations. – Multiple projects

Wetland delineation and assessment of indirect impacts (LA) - Conducted wetland delineation for proposed location of housing development. Evaluate impacts to adjacent properties from sediment and altered hydrology.

Phase I site assessment and wetlands delineation– site location for industrial plant

Marsh Restoration – Evaluated of sediment chemistry and hydrology of salt marsh related to restoration activities not meeting Federal and State permit requirements.

Oil Spill Response – Confidential Client Ohio. Designed and evaluated oil removal procedures; conducted stream, upland, and wetland assessments for restoration alternatives

Impact assessment - Evaluated the impacts of multiple pesticides on sediments, wildlife, wetland vegetation, and stream biota following the release of multiple pesticides after a warehouse fire.



Oil Spill Response - Environmental Unit Leader - Evaluated oil removal alternatives for emergent and forested wetlands. Represented client in negotiations with EPA and Mississippi Department of Environmental Quality. Conducted site assessment and documentation post cleanup for potential damage claims. Completed after-the-fact permit notifications.

Oil Spill Response and Natural Resource Damage Assessment – Evaluated impacts to sediment, marsh vegetation and aquatic biota after oil spill. Designed and implemented mitigation for impacts to salt marsh. Working with Trustees to develop mitigation for impacts to aquatic biota and salt marsh.

Oil Spill Response – Environmental Unit Leader – Refugio Oil Spill, Santa Barbara California. Evaluated oil removal alternatives. Designed and implemented environmental monitoring programs to assess oil impacts to human health and wildlife. Represented Responsible Party in negotiations with US Coast Guard, Environmental Protection Agency, National Oceanic and Atmospheric Administration, US Fish and Wildlife Service, California Department of Fish and Wildlife, Santa Barbara County, Regional Water Board, City of Goletta, and non-profit organizations.

Ecological Risk Assessment– Evaluated offshore pipeline abandonment and removal alternatives in Texas and Louisiana. Provided assessment of sediment mobilization and potential effects to fish and invertebrates.

Environmental Impact Assessment – Proposed development of oil and gas wells – Gulf of Mexico.

Technical review of 316b permit applications (LA) – evaluated potential impacts to fish due to entrainment.

### **Independent Consultant**

Taylor Energy Company, New Orleans LA– Represented Taylor Energy in consultations with BSEE and USCG- provided assessment of likely sources and transport of residual oil in MC20 block Gulf of Mexico; and technical review of Worst Case Discharge, Oil Spill Trajectory, and ecological impact modeling output.

General Engineering and Environmental Companies; Baton Rouge LA – Conducted wetland delineation and endangered species habitat assessment for potential chemical plant locations; litigation support related to potential environmental damages related to oil and gas extraction activities

### **US Geological Survey assigned to Deepwater Horizon Oil and Taylor MC20 Spill Responses**

Science Advisor US Coast Guard oil spill response and environmental impacts.

Science Team Lead - Sources and mechanisms of recurring oiling on beaches and marshes. (OSAT3)

Technical Expert - Delineation and recovery of submerged oil mats

Science Advisor - Impact of recovery operations on endangered species

Science Team Lead - Toxicity of oil and dispersants (OSAT1) in water and sediment.

Science Team Member - Net Environmental Benefit Analysis of fate and effects of oil on beaches – (OSAT2)

Project manager / peer review - Application of a hydrodynamic and sediment transport model for guidance of response efforts related to the Deepwater Horizon oil spill in the Northern Gulf of Mexico along the coast of Alabama and Florida: U.S. Geological Survey Open-File Report 2012–1234



Technical Expert - Developed training modules to improve Department of Interior capabilities to protect trust resources (historical, cultural, and natural) during disasters. Worked with an interagency team that included EPA, National Park Service, US Fish and Wildlife Service, and Department of Interior Office of Compliance.

Technical Expert - Ecological Risk Assessment potential impacts of ongoing release and available response options related to Taylor Energy Company MC 20-A Platform oil spill

#### **US Geological Survey, National Water Quality Assessment Program**

Contributing author summarizing nearly 2 decades of ecological research

Contributing author summarizing impacts of urbanization on stream ecosystems including altered hydrology.

Co-investigator importance of physicochemical factors to stream biological condition

Co-investigator hydrophobic organics (including PCBs) and potential toxicity in streams

Technical Expert for USFWS TX - Endangered species consultation (Cave Salamanders) related to water withdrawal and ground water contamination

Testifying Expert - Department of Justice – US. vs McWane Federal court Birmingham AL. Case involved the Illegal discharge of industrial waste into a creek

#### **US Geological Survey Southeastern Region, National Water Quality Assessment Program -**

Provided technical oversight and training for water quality and sediment assessments in Southeast region

Monitored projects to ensure quality assurance objectives, budget targets and time lines were met

Co-investigator on first national wide assessment of endocrine disruption in fish

Co-investigator effects of urbanization on stream ecosystems (Mobile Basin)

Co-investigator –evaluation of contaminants including PCBs using semi-permeable membranes

Member of the Cycle II National Implementation Team for NAWQA

Instructor USGS training course Concepts in Aquatic Ecology (Hydrology and Ecology of Wetlands)

Developed cooperative partnerships with other federal programs

#### **USFWS Division of Environmental Contaminants and Refuges -**

Team member - Design and implementation of nationwide biomonitoring program

Project lead - Modeling as an assessment tool in determining status and trends of contaminants

Project lead - Impacts of secondary uses on wildlife refuges

Project Lead – Development of Air Quality Monitoring Strategy – USFWS Refuge System

Represented U.S. Fish and Wildlife Service on Interagency Task Force on Monitoring Water Quality

Participated in briefings of Congressional staff on impacts of changes in the Clean Water Act

#### **Selected Publications:**

Bryant, Wade L.; Camilli, Richard; Fisher, G. Burch; Overton, Edward B.; Reddy, Christopher M; Reible, Danny Swarthout, Robert F.; and Valentine, David L.: June 2020. Harnessing a decade of data to inform future decisions: Insights into the ongoing hydrocarbon release at Taylor Energy's Mississippi Canyon Block 20 (MC20) site. Marine Pollution Bulletin, Volume 155. <https://doi.org/10.1016/j.marpolbul.2020.111056>

Iwanowicz D, Black MC, Blazer VS, Zappia H, Bryant W. 2016. Effects of urban land-use on largescale stonerollers in the Mobile River Basin, Birmingham, AL. Ecotoxicology. 25(3):608-21.

Carlisle, D.M., Meador M.R., Short, T.M., Tate, C.M., Gurtz, M.E., Bryant, W.L., Falcone, J.A., Woodside, M.D. 2013, Ecological health in the Nation's streams, 1993-2005: U.S. Geological Survey Circular 1391.

Coles, J.F., McMahon, Gerard, Bell, A.H., Brown, L.R., Fitzpatrick, F.A., Scudder Eikenberry, B.C., Woodside, M.D., Cuffney, T.F., Bryant, W.L., Cappiella, Karen, Fraley-McNeal, Lisa, and Stack, W.P., 2012, Effects of urban development on stream ecosystems in nine metropolitan study areas across the United States: U.S. Geological Survey Circular 1373.

Bryant, W.L. and Carlisle, D.R. 2012. The relative importance of physicochemical factors to stream biological condition in urbanizing basins: evidence from multi-model inference. *Freshwater Science* 31(1) 154-161.

Investigation of Recurring Residual Oil in Discrete Shoreline Areas in Louisiana. Prepared for Thomas Sparks, CAPT, U.S Coast Guard Federal On-Scene Coordinator Deepwater Horizon MC252. February 2014 (<http://www.restorethegulf.gov/sites/default/files/u371/OSAT-3%20LA%20AOR.pdf>)

Investigation of Recurring Residual Oil in Discrete Shoreline Areas in the Eastern Area of Responsibility. Prepared for Thomas Sparks, CAPT, U.S Coast Guard Federal On-Scene Coordinator Deepwater Horizon MC252 October 2013 (<https://www.restorethegulf.gov/sites/default/files/u372/OSAT%20III%20Eastern%20States.pdf>)

Sub-Sea and Sub-Surface Oil and Dispersant Detection: Ecotoxicity Addendum Prepared for Julia A. Hein, CAPT, U.S. Coast Guard Federal On-Scene Coordinator Deepwater Horizon MC252. July 2011 (<https://www.restorethegulf.gov/sites/default/files/u306/FINAL%20OSAT%20Ecotox%20Addendum.pdf>)

Summary Report for Fate and Effects of Remnant Oil in the Beach Environment Prepared for Lincoln D. Stroh, CAPT, U.S. Coast Guard Federal On-Scene Coordinator Deepwater Horizon MC252. February 2011. (<http://www.restorethegulf.gov/sites/default/files/u316/OSAT-2%20Report%20no%20ltr.pdf>)

Goodbred SL, Bryant WL, Rosen MR, Alvarez D, Spencer T. 2009. How useful are the "other" semipermeable membrane devices (SPMDs); the mini-unit (15.2 cm long)? *Science of the total Environment* 407(13) 4149-4156.

Elise M.P. Giddings, Amanda H. Bell, Karen M. Beaulieu, Thomas F. Cuffney, James F. Coles, Larry R. Brown, Faith A. Fitzpatrick, James Falcone, Lori A. Sprague, Wade L. Bryant, Marie C. Pepler, Cory Stephens, and Gerard McMahon. 2009. Selected Physical, Chemical, and Biological Data Used to Study Urbanizing Streams in Nine Metropolitan Areas of the United States, 1999–2004. USGS Data Series 423

Bryant, W.L., Jr., and Goodbred, S.L., 2008. The response of hydrophobic organics and potential toxicity in streams to urbanization of watersheds in six metropolitan areas of the United States, *Environmental Monitoring and Assessment*, 157(1-4):419-447.

Bryant, W.L., Goodbred, S.L., Leiker, T.L., Inouye, L., and Johnson, B.T. 2007. Use of Chemical Analysis and Assays of Semipermeable Membrane Devices Extracts to Assess the Response of Bioavailable Organic Pollutants in Streams to Urbanization in Six Metropolitan Areas of the United States. USGS Scientific Investigation Report 2007-5113, 43pp.

Schmitt, Christopher J.; Blazer, Vicki S.; Dethloff, Gail M.; Tillitt, Donald E.; Gross, Timothy S.; Bryant, Wade L., Jr.; DeWeese, L. Rod; Smith, Stephen B.; Goede, Ronald W.; Bartish, Timothy M.; Kubiak, Timothy J. 1999. Biomonitoring of Environmental Status and Trends (BEST) Program: field procedures for assessing the exposure of fish to environmental contaminants. USGS Information and Technology Report 1999-0007.

Goodbred, S.L., Gilliom, R.J., Gross, T.S., Denslow, N.P., Bryant, W.L., and Schoeb, T.R... 1996. Reconnaissance of 17 $\beta$ -Estradiol, 11-Ketotestosterone, Vitellogenin, and Gonad Histopathology in Common Carp of United States Streams: Potential for Contaminant-Induced Endocrine Disruption. U.S. Geological Survey Open-File Report 96-627

Bryant, W.L.; Brinson, M.M.; Jones, M.N.; Hook, P.B. Water and elemental exchange between marsh and estuary. Ecology of a Nontidal Brackish Marsh in Coastal North Carolina. U.S. Fish and Wildlife Service National Wetlands Research Center 91-03.

Bryant, W.L.; Brinson, M.M.; Hook, P.B; Jones, M.N. Response of vegetation in a brackish marsh to simulated burning and to nitrogen and phosphorus enrichment. Ecology of a Nontidal Brackish Marsh in Coastal North Carolina. U.S. Fish and Wildlife Service National Wetlands Research Center 91-03.

Brinson, M.M.; Bryant, W.L.; Benninger, L.K.; and Jones, M.N. Composition, distribution, and dynamics of organic sediments. Ecology of a Nontidal Brackish Marsh in Coastal North Carolina. U.S. Fish and Wildlife Service National Wetlands Research Center 91-03.

Christian, Robert R., Bryant, Wade L., and Brinson, Mark B. 1990. *Juncus roemerianus* production and decomposition along gradients of salinity and hydroperiod. Marine Ecology Progress Series, Vol. 68: 137-145.

### **Selected Presentations:**

Bryant, W., Fitzgerald, S., Camilli, R., Mallios, A., Reddy, C.. 2019. Character and Dynamics of Surface Sheens at MC20. Gulf of Mexico Oil Spill and Ecosystem Science Conference

Reddy, C., Overton, E., Valentine, D.L., Camilli, R. and Bryant, W. 2019. Chemical heterogeneity informs the source and magnitude of ongoing release at the Taylor Energy site, Northern Gulf of Mexico. Gulf of Mexico Oil Spill and Ecosystem Science Conference

Valentine, D.L., Camilli, R., Bryant, W., and Reddy, C.. 2019. Application of Physical, Chemical, Biological and Geological Constraints on Petroleum Seepage at MC20. Gulf of Mexico Oil Spill and Ecosystem Science Conference

Reddy, C.M., Overton, E., Valentine, D.L., Camilli, R. and Bryant W. 2019. Insights from the Long-Term Taylor Energy Response at the Mississippi Canyon Block 20: A Review of Several Decades of Chemical Data. Gulf of Mexico Oil Spill and Ecosystem Science Conference

Camilli, R., Mallios, A., Reddy, C., and Bryant, W. 2019. Two Decades of In-Situ Observation Guiding MC20 Response Operations: What We Have Learned and Why It Matters. Gulf of Mexico Oil Spill and Ecosystem Science Conference

Bryant, Wade. 2016. A Review of Science Based Assessments of Residual Oil along Gulf Shorelines Used to Support Response Operations – Deepwater Horizon. Gulf of Mexico Oil Spill and Ecosystem Science Conference.

Bryant, Wade. 2014 Effects of Urban Land Use Water Quality. Louisiana Water and Environment Conference.

Bryant, Wade. 2012. Throwing a scientist to the wolves: lessons learned by a scientist during Deepwater Horizon Response. National Water Quality Monitoring Conference.

Benkinney, Marie; Bryant, Wade; Edwards, Melanie; and Brown, John. 2011. Evaluating the Impact of Dispersed Oil from the MC252 Deepwater Horizon Incident Based on Laboratory Studies and Field- Collected Water and Sediments. Society of Environmental Toxicology and Chemistry

Bryant, W.L. and Carlisle, D.M. 2007. Comparison of the response of the concentration of hydrophobic organic contaminants and P450RGS and Microtox® assay results in streams to urbanization and their relations to



invertebrate community assemblages in six metropolitan areas of the U.S. –Society of Environmental Toxicology and Chemistry.

Bryant, W.L. and Goodbred S.L. 2006. Assessing the Effects of Urban Land Use on Stream Ecosystems: Integrating Chemistry, Toxicity Test, and CYP1A1 Gene Activation Data from Extracts of Semipermeable Membrane Devices, National Water Quality Monitoring Conference

Gregory, M. Brian and Bryant, Wade L., 2003. Effects of urbanization on stream ecosystems in the piedmont ecoregion of Georgia and Alabama--a study design: Georgia Water Resources Conference.

Bryant, Wade; Goodbred, Steve; McFarland, Victor; Inouye, Laura; Johnson, B,; Zappia, Humbert,; Gregory, Mark; Ang, Choo Yaw. 2002. Toxicity Testing and CYP1A1 Gene Activation of SPMD Extracts to Assess Effects of Urban Land Use on Water Quality. Society of Environmental Toxicology and Chemistry



# Helen R. Connelly, PhD

Toxicologist

Helen's experience includes evaluation of ecological and human health risk due to exposure to petroleum hydrocarbons, metals, PCBs, PAHs, salts, chlorinated compounds, and other organic and inorganic compounds. She is experienced in designing and completing complex sampling and analysis plans and biological surveys in wetland, industrial, agricultural, and rural settings. Helen's skills include managing teams to accomplish large projects, working collaboratively with other consultants and experts, and completing complex ecological and human health risk assessments. Helen has successfully provided expert testimony at trial, in regulatory hearings, and in depositions in support of litigation, and has provided expert opinions and expert reports for human and ecological exposures.



**Experience:** 19 years of experience in environmental toxicology, ecological and human health risk assessment

**Email:** [helen.connelly@erm.com](mailto:helen.connelly@erm.com)

## Education

- Ph.D., Veterinary Medical Sciences in Physiology, Pharmacology and Toxicology, Louisiana State University School of Veterinary Medicine, US, 1997
- B.S., Geology, Louisiana State University, 1985

## Professional Affiliations and Registrations

- Adjunct Faculty, Louisiana State University Department of Environmental Sciences
- Baton Rouge Geological Society
- American Association of University Women
- Society of Environmental Toxicology and Chemistry

## Languages

- English, native speaker
- French, limited working proficiency

## Honors and Awards

- US Department of Energy Graduate Research Fellowship
- US Department of Energy Post-Doctoral Research Fellowship

## Fields of Competence

- Environmental Toxicology
- Ecological Risk Assessment
- Human Health Risk Assessment
- Freshwater and Estuarine Field Studies
- Project Management
- LDEQ RECAP Risk Assessment
- Freshwater Fish Culturing
- Conservation Biology
- Environmental Data Analysis
- Biological Species Surveys
- Wetlands Rapid Assessments

## Key Industry Sectors

- Oil and Gas
- Litigation
- Chemical Production
- Pipeline

## Publications

- Connelly, H. and Means, J. International Journal of Toxicology, 2010 29: 532: Immunomodulatory Effects of Dietary Exposure to Selected Polycyclic Aromatic Hydrocarbons in the Bluegill (*Lepomis macrochirus*).

## Key Projects

### **Airborne Sulfur Dioxide and Hydrogen Sulfide Human Health Risk Assessment**

Calculated human health risk due to airborne SO<sub>2</sub> and H<sub>2</sub>S release from a major petrochemical refinery on the Gulf Coast. Potentially exposed receptors included neighborhood residents adjacent to the refinery. Health risks were calculated by comparing LDEQ monitoring station data and air data collected in the neighborhood to site specific calculated protective standards. Protective standards were calculated using exposure studies from a full review of the scientific literature. Prepared two expert reports for this study. Was deposed for opinion and testified in federal court in this matter.

### **Coastal Sediment Ecological Risk Assessment: PAHs, PCBs, Dioxins/Furans, TPH, and Metals**

Completed a screening ecological risk assessment for a brackish to saline coastal open water area based on concentrations in sediments. Ecological exposures to PCBs, Dioxins/Furans, PAHs, TPH, and metals were assessed using metals and organics comparison values, PAH toxic unit values, and metals speciation and AVS data. Receptors were assumed to be birds, mammals, and fish.

### **Airborne PM<sub>10</sub> Human Health Risk Assessment**

Calculated human health risk due to an airborne catalyst release from a major petrochemical refinery on the Gulf Coast for an expert report. Potentially exposed receptors included neighborhood residents adjacent to the refinery. Risk was calculated using EPA National Ambient Air Quality Standards (NAAQS) for particulate matter (PM<sub>10</sub>), PM<sub>10</sub> data from the nearby LDEQ monitoring station, and modeled air concentrations. Wipe sample data was collected from surfaces in the neighborhood, and were compared to US Army wipe standards. The health effects portion of this lawsuit was dropped by opposing counsel on the day that my deposition on the matter was to occur.

### **Benzene Human Health Risk Assessment**

Prepared a human health risk assessment for recreational (swimming) exposure to creek surface water. Protective standards for creek surface water were calculated, using EPA guidelines, to represent

concentrations that did not pose unacceptable risk of cancer. The setting for this risk assessment was a natural creek in a wooded area. There were 10 years of data for this evaluation, which reduced some levels of uncertainty normally present in a risk assessment.

### **Benzene Air Sampling Plan for Human Health Risk Assessment**

Wrote air sampling and analysis plan to evaluate airborne volatile hydrocarbons in the area of a residence near an underground petroleum pipeline. Researched and described best current technology for air sample collection and for identifying low levels of compounds in air. Calculated protective health-based standards for benzene in air based on LDEQ RECAP and EPA guidelines.

### **Screening Level Ecological and Human Health Risk Assessment of TPH-Impacted Canal Sediments**

Initiated a preliminary ecological risk screening of a heavily TPH impacted canal in St. Charles Parish. Compared sediment, water, and sheen concentrations in the samples collected to proxy MO-1 human health standards and NOAA SQUIRT standards. Attempted electrofishing sample collection, but the conductivity of the water was prohibitive.

### **Pipeline Spill Human Health Risk Assessment**

Planned, collected and analyzed soil and ground water samples for a major petrochemical client in response to their request for RECAP compliant investigation report for a gasoline pipeline spill near a sugar cane field. Analyzed reported constituent concentrations using LDEQ RECAP Screening Standards and prepared RECAP report for submittal to LDEQ.

### **Human Health Pipeline Worker Risk Assessment**

Evaluated health risks to pipeline workers installing a pipeline thirty feet below ground surface across a Superfund site in an area with thick clay strata in the soil lithology. Surface soil constituents included heavy metals and carcinogens. Considered inhalation, dermal and ingestion routes of exposure to workers. Used RECAP and TCEQ standards as references for toxicity assessment. Estimated the potential for constituents to migrate from the pipeline excavation via groundwater to other areas. Wrote a brief summary type letter to EPA for the client to obtain approval for the pipeline installation. EPA granted approval.

### **Oil Spill PAH Fish Immunotoxicity Study**

Designed and successfully executed a freshwater fish toxicity study to evaluate the effects of polycyclic aromatic hydrocarbons (PAH) from energy related wastes, such as oil spills, on the proliferative behavior of immune cells in a native bluegill fish model (*Lepomis macrochirus*). Worked with the Louisiana Department of Wildlife and Fisheries to collect bluegill from the LSU lakes using electrofishing. Maintained the fish in indoor tanks. Collected lymphocytes from fish after feeding them a diet of 2-methylnaphthalene, 9,10-dimethylanthracene, and 2-aminoanthracene for a period of weeks. Published the results in a peer reviewed journal. Presented this research at the Society of Environmental Toxicology and Chemistry (SETAC) annual meeting in San Francisco, 1997.

### **LDEQ RECAP MO-1 Human Health Risk Assessment of Salt and TPH Impacted Agricultural Field**

Calculated human health risk using LDEQ RECAP protocol for two agricultural sites of former and current oil and gas production in the central Louisiana area. Both sites had salt impacted soils and groundwater. Used identified background concentrations for groundwater standards. Soil was evaluated using Screening standards and MO-1 standards for metals and hydrocarbons. LDNR standards and SPLP methods were used to assess salt in soils, and to delineate areas of impact. Both projects involved collaboration with environmental scientists from many disciplines all working together on the projects. Both projects involved managing,

analyzing and reporting on large data sets. Wrote portions of the risk assessment for two reports, including calculating RECAP standards.

### **Barium Ambient Water Quality Standard Development**

Developed a barium ambient water quality standard for protection of aquatic organisms. Followed US EPA guidelines and very specific protocol for developing a chronic exposure standard based on a complete review of the scientific literature. Developed an EPA compliant standard that is one order of magnitude larger than current available standards.

### **Sediment Barium, PAH, and Mercury AOI Delineation in Fresh to Brackish Marsh**

Worked collaboratively with a team of risk assessors to develop a sampling and analysis plan to delineate areas for sediment remediation investigation in a fresh to brackish marsh. Analytical methods involved PAH pore water analysis to estimate toxic units and metals speciation by QEMSCAN to estimate metals toxicity. Calculated site-specific sediment screening for barium and mercury, which as accepted as appropriate methodology by LDEQ and LDNR.

### **LDEQ RECAP Human Health Risk Assessments**

Established human health exposure pathways and receptors and/or calculated site specific RECAP standards for the following sites: creosoting wood treatment facility, dry cleaning establishment, former industrial waste disposal site, gasoline spill site, paper mill, and former exploration and production sites.

### **Shipyards Human Health Risk Assessment**

Calculated the human health risk associated with exposure to sediments containing lead, arsenic, cadmium, and chromium at a former shipyard in St. Mary Parish.

### **Two Year Crawfish Bioaccumulation Study**

Planned and executed two crawfish collection studies in surface waters in St. Charles Parish in ditches impacted with chlorinated compounds and other organic compounds. Prepared an analysis of crawfish abundance as affected by drought and surface water contaminants. Analyzed crawfish tissues for compounds detected in surface waters to

determine if accumulation was occurring. Presented this research to the LSU Department of Environmental Sciences and was unanimously accepted as an adjunct faculty member based on the research.

### **Blue Crab Population Study**

Analyzed crab weight, size, and fullness as related to crab habitat characteristics in a study area of natural bayou, lake, and marsh ecosystems, as well as man-made oilfield canals. Collected crabs and fish under a Louisiana Department of Wildlife and Fisheries collection permit as part of a team of risk assessors working on a study of heavy metal toxicity in aquatic organisms. Reported the crab and fish collection techniques in a detailed sampling methods and results report that was submitted to LDEQ, LDHH, and LDWF. Compared the measured weights, sizes and abundance of the crabs collected in this project to annual crab studies done by LDEQ, LSU and the Gulf States Marine Fisheries Commission.

### **Freshwater/Brackish Marsh Functions and Services Analysis**

Planned and executed a field study to assess wetland functions and services in a fresh to intermediate marsh ecosystem. Evaluation methods used were based on USEPA Rapid Wetlands Assessment techniques. The study area setting was man-made canals, a bayou and a lake. The field study involved trapping native bait fish and blue crabs (*Callinectes sapidus*), recording vegetation in the habitats, and recording birds and other wildlife present. At each location, an evaluation was done using a wetlands assessment tool to quantify the functioning of the ecosystem. This wetlands function assessment report was submitted to LDEQ, LDHH, and LDWF.

### **Personal Injury Expert Reports**

Researched and prepared health toxicity expert reports for human exposures to two different compounds: carbon monoxide and gluteraldehyde, both for litigation not in the petrochemical industry. Was deposited for opinion each time.

### **Crawfish Ingestion Human Health Risk Assessment**

Performed a crawfish ingestion analysis based on

potential shellfish consumption from a ditch impacted with low levels of chlorinated compounds and other organic compounds for presentation to LDEQ for a petrochemical client. Used LDEQ RECAP ingestion and exposure parameters to calculate crawfish consumption risk assessment.

### **Data Analysis/Data Management**

Managed large amounts of soil, sediment, water and biological data for several projects. Data analysis includes work such as: identifying and analyzing effects of non-detected analytes on calculated results, analyzing effects of sample depths by location, calculating dry weights/wet weights, identifying data gaps and uncertainty, comparing results from different labs, identifying unusable data, statistical comparison of site to background concentrations, calculation of mean 95%UCL and UTL, and identifying trends and patterns in constituent concentrations.

### **Biological and Non-Biological Field Sampling**

Collected and recorded field samples under chain of custody for environmental media and biological species for many projects including: soil and sediment sampling, shallow and deep groundwater and drinking well sampling, surface water and vegetation sampling, periphyton collection, macroinvertebrate collection, crawfish trapping, blue crab trapping, electrofishing for freshwater fish species, dip netting small freshwater fish and invertebrates in submerged aquatic vegetation, and trawling for fresh and intermediate salinity fish.

### **LDEQ Community Relations**

Assisted in writing and publishing LDEQ community relations newsletters and planning town meetings in order to communicate health risks associated with Superfund sites and other inactive and abandoned sites with nearby residents. Provided public health information to communities surrounding Superfund sites such as Old Inger, Lincoln Creosote, and Combustion.

### **Fresh Marsh Flooded Forest Vegetation Survey**

Evaluated and recorded vegetation assemblages in six locations in the southern portion of the Louisiana Department of Wildlife and Fisheries White Lake Wetlands Conservation Area. Performed the study of

the fresh marsh and wooded wetlands with natural and man-made canals with my graduate students. Identified common plant species and measured associated water salinity, turbidity, pH and temperature.

### **Graduate Student Mentor Masters of Natural Science Degree in Biology**

Mentored and taught a total of eighteen graduate students over a three year period in the Gordon A. Cain Center Department at Louisiana State University. All eighteen candidates completed projects and final exams and were awarded Master's Degrees in Natural Sciences with a specialization in Biology. During the three year period, I taught classes in Biology, Environmental Science and Ecology, and led field and laboratory exercises during all semesters.

### **LDEQ MO-3 Human Health and Ecological Risk Assessment of Flooded Forest Fresh Marsh**

Completed and submitted to LDEQ, at the request of LDNR, both a human health and an ecological risk assessment of sediments from canal bottoms in a fresh marsh and flooded forest environment. Co-managed with one of my peers, all phases of the risk assessment from the initiation of sample collection planning to the final calculations of risk. Used innovative statistical methods to identify background concentrations, extensive research to identify freshwater marsh-specific/species-specific exposure parameters. Risk assessment included calculating hazard quotients for native species based on measured levels of metals in sediments and soils in a setting frequented by recreational hunters and fishermen. Sediment constituents of concern were barium, TPH, and polycyclic aromatic hydrocarbons. RECAP algorithms using recreational exposure values were used to assess potential hazard due to the human direct contact pathway. For the ecological assessment, barium exposure was assessed based on identifying the locations where soluble barium may exist (TCLP analysis) and evaluating those locations based on probable no-effects concentrations for barium in sediments. TPH and barium were evaluated for their potential for accumulation in fish, based on accumulation factors from the scientific literature. Modeled concentrations in fish were then compared to LDEQ/LDHH

calculated fish tissue screening levels for human consumption. LDEQ and LDNR has granted a no further action at this time status to the site, based on the MO-3 analysis.

### **LDNR Pit Closure Plan**

Prepared with a co-worker, and submitted to LDNR, a work plan to close four pits that exceeded 29-B standards for O&G and/or barium using site specific RECAP MO-1 industrial standards. The work plan included confirmatory sampling to completely delineate the pits to 29-B standards and sampling to complete a TPH fractions and barium RECAP assessment. The rationale behind the plan was to only excavate soils if analysis showed that the soils exceed both 29-B and RECAP standards, indicating potential effects to human health and the environment. The four former pits are lushly vegetated, in a remote setting accessible only by boat, and do not include any residences. Excavation of soils that do not demonstrate health hazards can be avoided in a setting like this, limiting destruction to the ecosystem. Also included in the work plan was a vegetation survey/wetlands assessment at each of the four pits to document expected vegetation and ecosystem functioning. Vegetation as part of ecosystem function was assessed by estimating that percentage cover of each category of vegetation was appropriate to the setting, as well as by comparing the vegetation species present to species documented in the scientific literature for each habitat type. Presented the concepts and data behind this closure approach to LDNR, prior to submitting the work plan to them, in order to include all LDNR input/comments in the plan prior to submittal.

### **Ecological Risk Assessment Brackish Marsh Estuary Approved by LDEQ and LDNR**

Worked collaboratively with a team of risk assessors to design and execute a complex data collection and ecological risk assessment in a brackish marsh estuary. Sampling included soils, sediments, surface waters, fish, and crabs. Vegetation was recorded and analyzed for providing functions and services. Crab, fish, and avian population data were compared to reference marsh data identified in the primary scientific literature. PAH and TPH ecotoxicity were assessed via USEPA 34 PAH porewater invertebrate



toxicity assessment (toxic units). Barium was speciated using scanning electron microscopy energy dispersive spectrometry (QEMSCAN). Barium sediment screening values were calculated based on the results of a large literature review. Mercury sediment screening values were calculated based on a large literature review. Mercury biomagnification was calculated based on measured levels in crab tissues and modeled levels in bird eggs. Mercury benchmarks were calculated for wildlife health. Bioaccumulation factors were calculated based on field data and literature review for barium sulfate, methylmercury and PAH. The methods used in the risk assessment and the planned further investigation were approved by LDEQ and LDNR.

#### **Fish and Vegetation Quantitative Assessment Freshwater Swamp and Bayou**

Completed a vegetation survey and fish collection to support conclusions of a large scale ecological risk assessment in a south Louisiana bayou and cypress tupelo swamp setting. Collected and released more than a thousand native freshwater fish and recorded vegetation in 30 unique quadrats. Vouchered each unique fish species. Collected fish from bayous, swamps and open water using cast netting, hoop nets and wire net traps, and recorded fish by genus and species. Surveyed and recorded vegetation at each location where fish were collected. Photographed each habitat, fish collection and vegetation location in detail. Worked collaboratively with a team of scientists to complete this bioassessment.

#### **Visiting Guest Lecturer**

Delivered several lecture presentations to educate peers, industry, attorneys and regulators in various fields of toxicology. Presented a talk and photos at an on-site event describing phytoremediation, natural attenuation, and constituent toxicity at a Superfund site at the request of USEPA. Presentation was for public service and done at the request of community members. Worked as a member of a team along with other scientist presenters for this event. Presented methods for interpreting metals data in biological tissues for both human health and ecological risk assessments to large groups of environmental attorneys on several occasions. Presented toxicity and effects of acute exposure to benzene and

arsenic to members of the Louisiana Environmental Health Association at their monthly meeting at LDEQ at the request of Bill Schramm with LDEQ. Gave a lecture on accumulation of total petroleum hydrocarbons (TPH) in fish and sediments at the Louisiana 2016 Solid Waste Conference in Lafayette, Louisiana. Presented annually to my co-workers the toxicology portion of the 40 hour health and safety training over a five year period.

#### **Groundwater Sampling in Vicinity of Brine Sinkhole**

Worked collaboratively in the field to collect and analyze groundwater samples from onsite and offsite monitoring wells at a south Louisiana industrial facility. Collected from each well more than sixty samples for metals, volatiles, hydrocarbons, salt parameters, and radionuclides analysis. Collected field data on water pH, turbidity, conductivity, temperature, well depth, and water depth. Supervised as many as six other parties at each well collecting duplicate water samples. Maintained chain of custody and sample documentation prior to transport to the lab for analytical testing. Have analyzed this data, along with three additional years of data from this location to complete an LDEQ complaint MO-2 human health risk assessment based on human exposure to well water. LDEQ and LDNR approved the risk assessment.

#### **Rapid Bioassessment of Wadeable Streams in Mississippi**

Completed Rapid Bioassessments of four streams in 100 meter reach segments. Collected macroinvertebrates, periphyton and native fish following a prescribed EPA protocol. Fish were collected by electroshocking, macroinvertebrates were collected using a jabbing dip net process and periphyton were collected by hand scraping. Each habitat was sampled in each stream according to the percentage the habitat represented of that stream. Sampling included duplicate sampling for periphyton and voucher collection for each fish species collected. Performed a scored habitat assessment comparison of the four streams and presented an evaluation of fish species diversity and richness. The entire process was photo documented in detail.

### **LDEQ MO-2 and MO-3 Human Health and Ecological Risk Assessments for Brine Sinkhole**

Completed and submitted LDEQ RECAP compliant MO-2 and MO-3 Work Plans for a Louisiana brine mining operation for review by LDNR and LDEQ. The Work Plans encompass the results of over three years of surface water and groundwater data collection and analysis. The efforts to complete the Work Plans included analysis of over 170,000 data points of more than 300 different constituents. The intended methods were presented to LDEQ and LDNR prior to creating the actual Work Plans to obtain comments. The plans describe RECAP compliant human health risk assessment for groundwater and ecological risk assessment and human health risk assessment for the surface waters. The effort involved statistical comparison of data sets using PROUCL software, calculation of RECAP health based standards and scientific literature review for ecological toxicity values. These human health and ecological risk assessment work plans represented complete assessment, even though they were termed work plans. The human health work plan was approved by LDNR and LDEQ.

### **Calculation of Worker Exposure to Volatiles During Oil Spill Clean-Up**

Prepared opinion for Mike Pisani while he was in the midst of a trial on worker exposure to volatiles during an oil spill clean-up. Estimates of likely exposure were made using data from two other oils spills, EPA, and OSHA data. Estimated levels and durations of exposure were compared to concentrations predicted to have long term or irreversible health effects, and to levels sufficient to cause short term, reversible health effects in oil spill workers. This opinion was used by Pisani to respond to questioning during the trial.

### **Human Health Lead Exposure Risk Assessment**

Performed EPA-compliant risk assessment for a lead-impacted bayou near a major petroleum refinery in St. Charles Parish. Calculated health risks to hunters and fishers consuming fish, crabs and game from the bayou area. Used the Integrated Exposure Uptake Biokinetic (IEUBK) model and the Adult Lead Model to assess lead human health risks.

### **Screening Level Chemical Plant Human Health Risk Assessment**

Estimated the toxicity and calculated risk based standards for more than 150 compounds, including many tin compounds, for which no RECAP standards exist, at a chemical plant in South Louisiana. Used chemically similar compounds with known toxicities as proxies for compounds with limited toxicity information.

### **PCB Fingerprinting Analysis in Soils and Sediments**

Compared polychlorinated biphenyl concentrations (PCB) in soils and sediments at an industrial facility to PCB concentrations in an adjacent ditch and connecting bayou to determine if site PCBs were the source of the ditch PCBs. The analysis involved a detailed review of the congeners on site by depth and by congener ratio. We provided the client with support for our conclusions in the form of statistics and graphs. We also provided an opinion as to the original Aroclor formulation that was the source of the PCBs on site. This project involved creating an extensive database from PDF files, as no Excel versions were available, as well as converting congener identifying names from different labs to consistent names for all data.

### **Chlorinated Groundwater Human Health Risk Assessment**

Worked collaboratively with the in-house research division of a large petrochemical company in St. Charles Parish to complete the risk assessment portions of a RCRA Corrective Measures Study Work Plan. Performed a detailed QA/QC evaluation of current and historical data used in the assessment. Assessed human health risk due to exposure to chlorinated compounds in shallow and deep groundwater.

### **LDNR Hearings Ecological Risk Assessment**

Presented testimony and was questioned by attorneys and LDNR regulators on my findings and results from ecological risk assessments on three separate occasions. The hearings were accomplished in order to present to the agency, in each instance, a most feasible plan for investigation and remediation of legacy E&P sites. In each

instance, I was one of many experts presenting project results. One of the investigations was for a cypress tupelo swamp and the other two were for bottomland hardwood wetland ecosystems.

#### **Expert Testimony Jury Trial**

Presented the findings and results of an ecological risk assessment performed at an industrial facility and adjacent bottomland hardwood forest to a judge and jury. The risk assessment results included evaluation of habitat for mammals, birds, and invertebrates and results of a salinity study. Data presented included avian and vegetation survey results and risk calculations based on soil TPH, PAH, and metals data. The result of the trial was a finding of no damages by the jury.

#### **Bottomland Hardwoods Ecological Risk Assessments Submitted to LDNR**

Performed an ecological risk assessment of bottomland hardwood wetlands in four different locations. These projects are throughout South Louisiana in locations of Plaquemines Parish, St. Mary Parish, and in the Lafayette area. Compared vegetation diversity to CRMS data and wildlife refuges, completed vegetation and avian surveys, documented salinity indicators, performed metals speciation analysis, SPLP analysis, hazard quotient analysis, photo documentation, and literature review. Expert reports were completed for all four ecological risk assessments. Two of the risk assessments were submitted to LDNR in support of a Limited Admission to the agency.

#### **Cypress Tupelo Swamp Ecological Risk Assessment Submitted to LDNR**

Performed an ecological risk assessment of a cypress tupelo swamp in Iberia Parish. Measured cypress tree circumferences, investigated salinity indicators, recorded birds and vegetation, researched the cypress tree scientific literature, calculated risk for avian and mammalian receptors, and made comparisons to nearby wildlife refuges. We performed a submerged wetlands assessment based on surface elevations and nearby USACOE gauging data. This risk assessment was presented to the

LDNR in a hearing associated with a limited admission.

#### **Prairie Grasslands Ecological Risk Assessment**

Performed an ecological risk assessments of prairie grassland species in industrial and agricultural settings in two locations in the Lafayette area. For assessing the grasslands, we used comparisons to wildlife refuges, vegetation and avian surveys, metals speciation analysis, SPLP analysis, hazard quotient analysis, photo documentation, and literature review. Expert reports were completed for both ecological risk assessments.

#### **Salt Marsh Ecological Risk Assessment**

Performed an ecological risk assessments of a salt marsh in Cameron Parish. For this assessment, we reviewed historical records of species native to the area and to the nearby wildlife refuge. We identified birds and mammals dedicated to salt marshes and performed risk calculations for those animals. We compared the site vegetation to expected species for the salt marsh, based on the literature review. The project included a sediment and a marsh ecological risk assessments.

#### **Flooded Forest Ecological Risk Assessment**

Performed a screening level ecological risk assessment of a flooded forest and marsh that is in direct communication with the Atchafayla River. Soils and sediments were below background levels, so the risk assessment did not advance beyond the screening level. Performed a thorough investigation of the forested area, by measuring diversity within quadrats along a transect. The flooded nature of the land made the work difficult. The quadrat vegetation data was compared to CRMS data in the nearest CRMS reference stations. We performed a submerged wetlands assessment for this risk assessment based on measured surface elevations and nearby USACOE gauging data.

#### **Mentor to Indonesian Ph.D. Candidate**

Working with a young woman in Indonesia to assist and mentor her during the process of applying for a Ph.D. program in the US. Meeting with her weekly.



**Presentation of Ecological Risk Assessment Methods to Oil and Gas In-House Scientists**

Invited to present bespoke mercury methylation assessment methods, barium SEM EDS speciation methods, and PAH ex situ porewater methods to in-house science team and attorney team for a global oil and gas client. Was afterwards requested to send to the client the methods I developed for modeling methylmercury biomagnification, to be shared with the in house science team. The methods are first of their kind and are not currently available through EPA.

**Ecological Risk Assessment of 5000-acre Freshwater Marsh in Coastal Louisiana**

Collected more than 30,000 invertebrates and over 3000 fish. Collected sediment chemistry data such as oxidation-reduction potential (ORP), pH, sulfides, and organic carbon. Used Eh-pH oxidation relationships and the relationship between metals and sulfides/organics, demonstrated that cadmium, lead, zinc, arsenic, and mercury would primarily be in sulfide and/or organic compounds (low toxicity/low availability) and that barium ( $\text{BaSO}_4$ ) and chromium ( $\text{Cr}_2\text{O}_3$ ) would be in forms that are of low solubility and toxicity.

**Dr. B.H. Kueper, BAsC, PhD, NGWA Fellow & Hubbert Award,  
Emeritus Professor, Queen’s University, Kingston, Ontario, Canada**

Dr. Kueper is a hydrogeologist with expertise in the area of soil and groundwater contamination, groundwater hydraulics, and subsurface remediation. He received his Ph.D. in hydrogeology from the University of Waterloo in 1989 and joined the faculty at Queen’s University in 1990 where he is currently emeritus professor. Dr. Kueper’s research is focused on the behaviour and remediation of soil and groundwater contaminants in unconsolidated deposits such as clays, silts and sands, as well as fractured rock. His research has included performing field experiments, laboratory experiments, and numerical simulation studies related to the behaviour and remediation of contaminants. In addition to his research duties, which include the supervision of Masters and Ph.D. students, Dr. Kueper’s responsibilities at Queen’s University included teaching undergraduate and graduate courses in groundwater flow and contaminant hydrogeology, as well as administrative duties.

Dr. Kueper is a former Associate Editor for the Journal of Ground Water, the Journal of Contaminant Hydrology and the Canadian Geotechnical Journal. He has provided professional short courses and training seminars on the topics of soil and groundwater contamination, groundwater hydraulics, and subsurface remediation to regulatory agencies including USEPA, the State of Maine, the State of Texas, CETESB (Sao Paulo), FEEMA (Rio de Janeiro), TIKTVF (Hungary), the province of Ontario, the province of British Columbia, as well as for various licensing bodies including the Massachusetts LSPA and the Connecticut LEPA. In addition, Dr. Kueper has taught in several professional short courses open to practitioners in Australia, China, England, Denmark, Switzerland, Canada and the United States. Appendix A presents a summary of his short course teaching. Dr. Kueper co-authored the definitive EPA guidance titled “Assessment and Delineation of DNAPL Source Zones at Hazardous Waste Sites”, and Dr. Kueper is the lead editor of the published textbook “Chlorinated Solvent Source Zone Remediation”. Dr. Kueper is the 2019 recipient of the prestigious NGWA M. King Hubbert award for major contribution to the groundwater industry.

In addition to being employed at Queen’s University, Dr. Kueper has provided his services as a technical consultant to government agencies and private industry around the globe for 32 years. This work has included technical expert testimony in court and at public hearings, meetings with USEPA and state/provincial agencies, oversight of site investigation activities, and the preparation of a variety of technical documents. Specific work assignments have included, but are not limited to, evaluation of oil and gas exploration and production sites, design and analysis of pump-and-treat systems, site assessment, delineation of source zones and plumes, assessment of capture zones, plume stability analysis, design of field sampling plans, assessment of remedial options, numerical simulation of groundwater flow and contaminant migration, analysis of the performance of horizontal drain systems, vadose zone leaching analyses, assessment of vapor migration above the water table, and writing of technical workplans.

**EMPLOYMENT:**

- 1999-present Professor  
Department of Civil Engineering  
Queen's University, Kingston, Ontario, Canada
- 1994-1999 Associate Professor  
Department of Civil Engineering  
Queen's University, Kingston, Ontario, Canada
- 1990-1994 Assistant Professor  
Department of Civil Engineering  
Queen's University, Kingston, Ontario, Canada

**EDUCATION:**

- 1989 Ph.D., Hydrogeology  
Department of Earth Sciences  
University of Waterloo, Waterloo, Ontario, Canada
- 1985 B.A.Sc., Civil Engineering  
Department of Civil Engineering  
University of Waterloo, Waterloo, Ontario, Canada

**OTHER APPOINTMENTS:**

- 2000 – 2003
- 2006 – 2009 Member, Queen's University Senate
- 1999 – 2006 Associate Editor, Journal of Contaminant Hydrology
- 1998 - 1999 Chair of Graduate Studies, Department of Civil Engineering,  
Queen's University.
- 1997 - 2011 Associate Editor, Journal of Ground Water
- 1996 - 1998 Chair, Canadian Geotechnical Society Hydrogeology Division
- 1994 - 1997 Associate Editor, Canadian Geotechnical Journal

## **CURRENT AND PAST UNIVERSITY TEACHING RESPONSIBILITIES:**

### **Subsurface contamination by hazardous industrial liquids**

This graduate/undergraduate course deals with subsurface contamination by hazardous industrial substances such as per- and polyfluoroalkyl substances (PFAS), coal tars, petroleum compounds, chlorinated solvents, PCB oils, and jet fuel. The fundamentals of multiphase/multicomponent flow and transport are outlined followed by specific treatments of both dense and light non-aqueous phase liquids (NAPLs). The course examines the subsurface distribution of these contaminants, sampling and detection, remediation technologies, and selected case histories.

### **Theory of groundwater flow and contaminant transport**

Graduate level course examining the theoretical foundations of groundwater flow and contaminant transport. Topics include potential concepts, groundwater flow, aquifer-aquitard systems, unsaturated flow, reactive and non-reactive solute transport, stochastic flow and transport, multiphase flow, fractured media, and density-dependent transport.

### **Leadership and teamwork**

This undergraduate course deals with the principles behind effective leadership and teamwork. Students are exposed to lectures, role playing workshops, and a personality assessment. The course recognizes that professionals may be called upon to assume both leadership and teamwork roles at various stages of their career.

### **Numerical Analysis**

This undergraduate course teaches students a variety of numerical methods applicable in science and engineering including root finding, optimization, numerical integration, solution of systems of linear and non-linear equations, solution of ordinary differential equations, and solution of partial differential equations.

### **Effective Oral Communication**

This undergraduate course teaches students the fundamentals of giving an effective oral presentation. All students are provided the opportunity to present a talk on an assigned topic.

### **Groundwater Hydraulics**

This undergraduate course teaches students the fundamentals of groundwater flow in unconsolidated deposits. Specific topics addressed include hydraulic head, flownets, Darcy's Law, the groundwater flow equation, anisotropy, storage concepts, interpretation of slug tests, and interpretation of pumping tests.

### **Engineering Design**

This undergraduate course introduces second year Civil Engineering students to the design process. Elements of the course include report writing, speaking, and a design project.

**REFEREED PUBLICATIONS:**

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Hansen, S.K. and Kueper, B.H., 2011. Challenges in forensic identification of multi-component NAPL sources – A new model and some results. Published abstract, Proceedings of the International Conference on Environmental Pollution and Remediation, Ottawa, Ontario, Canada, 17-19 August.

Martin, E. and Kueper, B.H., 2011. Observation of trapped gas during electrical resistance heating of trichloroethylene under passive venting conditions. Published abstract, Proceedings Geological Society of America Annual Meeting & Exposition, 9-12 October 2011, Abstract #194487.

Gefell, M.J. and Kueper, B.H., 2010. Passive NAPL barriers – design process and full-scale results at MGP sites. Poster presentation and published abstract. Seventh International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Battelle. Monterey, CA. May/24-27/2010.

Lebron, C., Kueper, B.H., Heron, G., LaChance, J.C., Phelan, D. and Lacombe, P., 2010. DNAPL removal from fractured rock using thermal conductive heating (TCH) – treatability study and pilot progress. Poster presentation number 214 and published abstract G-183. Partners in Environmental Technology Technical Symposium and Workshop. US Department of Defense, November 30-December 2, 2010. Washington, DC.

Lebron, C., Konzuk, J., Major, D., Kueper, B.H., West, M.R., Gerhard, J. and Pang, T., 2010. Development of a protocol and screening tool for selection of DNAPL source area remediation. Poster presentation number 215 and published abstract G-184. Partners in Environmental Technology Technical Symposium and Workshop. US Department of Defense, November 30-December 2, 2010. Washington, DC.

Lebron, C., Kueper, B.H., Heron, G., LaChance, J., Phelan, D. and Lacombe, P., 2010. Removal of Chlorinated Volatile Organic Compounds (cVOCs) from Fractured Rock Using Thermal Conductive Heating (TCH). Published abstract. Seventh International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Battelle. Monterey, CA. May/24-27/2010.

Kueper, B.H. and West, M.R., 2009. High resolution numerical simulation of DNAPL remediation in heterogeneous porous media. Published abstract, American Geophysical Union Spring Meeting and Joint Assembly, Toronto, Ontario.

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Lebron, C., Konzuk, J., Major, D., Carrara, C., Duhamel, M., Grant, G., Kueper, B.H., West, M.R., Gerhard, J.I. and Pang, T., 2009. ‘Development of a protocol and screening tool for selection of DNAPL source area remediation’. Published abstract No. 231,

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Petersen, M., Harkness, M., Kueper, B.H., Wemp, A. and Graham, J., 2008. Amendment distribution in the subsurface: Myths and realities. Proceedings, Sixth International Conference, Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA, Battelle Press.

Martin, E.J. and Kueper, B.H., 2008. Application of electrical resistance heating for the remediation of pooled trichloroethylene in heterogeneous porous media. Workshop on Performance Assessment in the Characterization and Remediation of Contaminated Soils and Groundwater. U. of Ottawa, May 5 – 6.

Petersen, M., Harkness, M., Kueper, B.H., Wemp, A. and Graham, J., 2008. Natural transport processes and amendment distribution in the subsurface. 24<sup>th</sup> Annual International Conference on Soils, Sediments, Water and Energy. University of Massachusetts Amherst. October 20 - 23.

Lebron, C., Major, D., Kueper, B.H. and Gerhard, J.I., 2007. Interim Report, Development of a DNAPL Remediation Technology Screening Tool. Environmental Security Technology Certification Program. 233 pp.

Matthews, J.G. and Kueper, B.H., 2007. Solute plume attenuation attributable to matrix diffusion in various rock types. Proceedings, USEPA/NGWA Fractured Rock Conference, National Ground Water Association, p. 114. (and poster presentation)

Daly, M.H., Drobinski, J., Legall, F.D. and Kueper, B.H., 2007. Applying tidal and density corrections at a coastal, fractured bedrock aquifer. Proceedings, USEPA/NGWA Fractured Rock Conference, National Ground Water Association, p. 385.

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Conference, DNAPL2: Source Zone Characterization and Removal, Long Beach, CA. November 14-15, 2007.

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Brown, R.A., Daly, M., Demers, G., Legall, F., Kueper, B.H. and Dimitrovic, E., An In-Depth Examination of Base Catalyzed Persulfate, Proceedings, 5<sup>th</sup> International Conference on Oxidation and Reduction Technologies for In-Situ Treatment of Soil and Groundwater, Redox Technologies, Niagara Falls, NY, September 24-27, 2007.

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Shi, J.S., Gefell, M.J., White, K.A., Kueper, B.H. and Blazicek, T., 2006. Hydraulic control of DNAPL migration without pumping groundwater. Abstract, DNAPL-1, Pittsburgh, PA, September 23 – 28.

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Gefell, M.J., Kueper, B.H., Sperry, K.L., Rawson, J.R., 2004. Measuring mass balance, oxidant half life, and treatment efficiency: field scale PCE oxidation using  $\text{KMnO}_4$  in fractured phyllite. Proceedings, USEPA/NGWA Fractured Rock Conference, pp. 404-405.



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West, M.R., Kueper, B.H., and Novakowski, K.S., 2004. Semi-analytical solutions for solute transport in fractured porous media using a finite width strip source. Abstract No. H23D-03, EOS Transactions, American Geophysical Union, 85(17), Joint Assembly, Montreal, Canada, May 17-21.

Gefell, M.J., Sperry, K.L., Rawson, J.R. and Kueper, B.H., 2004. Field-scale DNAPL zone treatment using potassium permanganate in fractured meta-sedimentary bedrock. Abstract and poster presentation, Remediation of Chlorinated and Recalcitrant Compounds, 4<sup>th</sup> International Conference, May 24-27. Battelle.

Kueper, B.H., Gerhard, J.I. and Reynolds, D.A., 2003. Timescales of DNAPL migration. Abstract No. EAE03-A-07989. EGS-AGU-EUG Joint Assembly, Nice, France. April 7-11.

Kueper, B.H., 2003. Proposed groundwater exclusion zone, Smithville, Ontario. Draft technical memorandum. Department of Civil Engineering, Queen's University, Kingston, Ontario.

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Gerhard, J.I. and Kueper, B.H., 2002. Critical Phenomena of Nonwetting Fluid Infiltration, Redistribution, and Immobilization in Saturated Porous Media. Poster presentation (and published abstract), American Geophysical Union Fall Meeting, San Francisco, CA.

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Kueper, B.H. and Thomson, N.R., 2000. DNAPL behavior and clean-up in fractured rock: An overview. Published abstract and platform presentation, Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, May 22 – 25.

Longino, B.L. and Kueper, B.H., 2000. Effect of waterflooding on DNAPL retention in rough-walled fractures. Published abstract and poster presentation, Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, May 22 – 25.

Gefell, M.J., Thompson, B.R., and Kueper, B.H., 2000. TI zone delineation at a former solvent recycling facility. Published abstract and platform presentation, Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, May 22 – 25.

Reynolds, D.A. and Kueper, B.H., 2000. DNAPL flow through fractured porous media. Published abstract and poster presentation, Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, May 22 – 25.

Kueper, B.H. and Reynolds, D.A., 2000a. Technical Memorandum, Step 7, Task 7.3.4, Numerical Simulation of Integrated Permeation Grouting and Extraction Wells – High Permeability Enclosure. Department of Civil Engineering, Queen's University, Kingston, ON. Submitted to Township of West Lincoln. 82p.

Kueper, B.H. and Reynolds, D.A., 2000b. Technical Memorandum, Step 7, Task 7.3.5, Numerical Simulation of Permeation Grouting – Low Permeability Enclosure. Department of Civil Engineering, Queen's University, Kingston, ON. Submitted to Township of West Lincoln. 82p.

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Kueper, B.H. and Reynolds, D.A., 1999a. Technical Memorandum, Step 7, Task 7.2, Numerical Model Calibration. Department of Civil Engineering, Queen's University, Kingston, ON. Submitted to Township of West Lincoln. 84p.

Kueper, B.H. and Reynolds, D.A., 1999b. Technical Memorandum, Step 7, Task 7.3.1, Numerical Simulation of Monitored Natural Attenuation. Department of Civil Engineering, Queen's University, Kingston, ON. Submitted to Township of West Lincoln. 340p.

Kueper, B.H. and Reynolds, D.A., 1999c. Technical Memorandum, Step 7, Task 7.3.2, Numerical Simulation of Excavation Option. Department of Civil Engineering, Queen's University, Kingston, ON. Submitted to Township of West Lincoln. 70p.

Kueper, B.H. and Reynolds, D.A., 1999d. Technical Memorandum, Step 7, Task 7.3.3, Numerical Simulation of Thermal Wells Option. Department of Civil Engineering, Queen's University, Kingston, ON. Submitted to Township of West Lincoln. 71p.

Kueper, B.H. and Thomson, N.R., 1999. NSERC Strategic Grant Final Report, 'Two-phase flow and aqueous phase transport in fractured rock'.

Kueper, B.H., and Gerhard, J.I., 1999. The use of waterflooding for the recovery of pooled DNAPL. NGWA Theis Conference published abstract and poster presentation, Nov. 12-15, Amelia Island Plantation, FL.

Konzuk, J.S. and Kueper, B.H., 1999. Estimation of capillary pressure and relative permeability curves in a single, rough-walled fracture using parameter estimation techniques. Proceedings, Dynamics of Fluids in Fractured Rocks, Concepts and Recent Advances, LBNL-42718, Berkeley Lab., pp. 280-283.

Kueper, B.H., and Thomson, N.R.T., 1998. The distribution of residual and pooled DNAPL in porous media. Platform Abstracts, First International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Battelle, Monterey, CA.

Thomson, N.R.T. and Kueper, B.H., 1998. The movement, retention, and removal of DNAPLs in fractured rock. Platform Abstracts, First International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Battelle, Monterey, CA.

Simpkin, T.J., Sale, T., Kueper, B.H., Lowe, D., and Pitts, M., 1998. Technology practices manual for surfactants and cosolvents: summary of findings. Poster Abstracts, First International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Battelle, Monterey, CA.

Gefell, M., Thomson, B.R.T., and Kueper, B.H., 1998. NAPL and 'TI' zone delineation at a former solvent recycling facility. Poster Abstracts, First International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Battelle, Monterey, CA.

Kueper, B.H., 1997. Hydrogeologists facing tough decisions at DNAPL sites. *Geotechnical News*, Vol. 15, No. 5, p. 20.

Longino, B.L. and Kueper, B.H., 1997. Retention and waterflooding of DNAPL in fractured rock. Abstract No. 50707, *GSA Abstracts with Programs*, Vol. 29, No. 6.

Konzuk, J. and Kueper, B.H., 1997. Estimation of capillary pressure and relative permeability functions using history-matching in a single fracture. Abstract No. 50832, *GSA Abstracts with Programs*, Vol. 29, No. 6.

Falta, R.W., Jarosch, T.R., Kueper, B.H., Looney, B.B., Sabatini, D.A., Siegrist, R.L., and Udell, K.S., 1996. Technical Evaluation of DNAPL Enhanced Removal Technologies. Prepared for U.S. Department of Energy.

The use of Alcohol Flooding to Remediate Sites Contaminated by Dense, Non-aqueous Phase Liquids, Progress Report #3, Subcontract 19Y-GUG26V. Submitted to Lockheed-Martin Inc., Oak Ridge, TN, January 8, 1996.

The use of Alcohol Flooding to Remediate Sites Contaminated by Dense, Non-aqueous Phase Liquids, Progress Report #2, Subcontract 19Y-GUG26V. Submitted to Lockheed-Martin, Oak Ridge, TN, Feb. 7, 1995, 118p.

Mason, A.R. and Kueper, B.H., 1995. Numerical simulation of surfactant enhanced solubilization of pooled DNAPL. *EOS, Transactions, American Geophysical Union*, Vol. 76, No. 17, p.123.

Gerhard, J.I. and Kueper, B.H., 1994. Sensitivity of DNAPL migration to source strength and release location in heterogeneous media. *EOS, Transactions, American Geophysical Union*, Vol. 75, No. 44, p. 254.

Longino, B.L. and Kueper, B.H., 1994. The use of solubilizing surfactants to remove pooled DNAPL under upward gradient flow conditions. Abstracts, Air & Waste Management Association 87<sup>th</sup> Annual Meeting & Exhibition, p. 142.

Turcke, M. and Kueper, B.H., 1993. A geostatistical analysis of the Borden aquifer. *EOS, Transactions, American Geophysical Union*, Vol. 74, No. 16, p.143.

Kueper, B.H. and Redman, J.D., 1993. A field experiment to study the behavior of tetrachloroethylene in a natural sand aquifer. EOS, Transactions, American Geophysical Union, Vol. 74, No. 16, p. 128.

Reitsma, S. and Kueper, B.H., 1992. Laboratory measurement of capillary pressure - saturation relationships in natural rock fractures. EOS, Transactions, American Geophysical Union, Vol. 73, No. 43, p. 213.

Kueper, B.H. and Poulsen, M., 1991. A field experiment to study the behavior of non-aqueous phase liquids in the unsaturated zone. EOS, Transactions, American Geophysical Union, Vol. 72, No. 44, p. 160.

**SELECTED SEMINARS, INVITED CONFERENCE PRESENTATIONS, AND RELATED:**

Scientific Committee Member, 4<sup>th</sup> International Conference on Environmental Sustainability, Development, and Protection (ICESDP'19), April 7-9, 2019, Rome, Italy.

Invited presentation. Remediation of Soil and Groundwater – State of the Practice. BCEER Thermal Remediation Symposium, Beijing, China, May 23, 2018.

Invited presentation. Soil and Groundwater Contamination by Chlorinated Solvents. Contaminant Workshop, Tsinghua University, Beijing, China, May 24, 2018.

Invited presentation. Contaminated Site Assessment in Fractured Bedrock. Ontario Ministry of Environment and Climate Change provincial meeting of hydrogeologists, Toronto, ON, March 20, 2018.

Invited expert panelist. Enough is enough: When do you have enough data? 11<sup>th</sup> International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Palm Springs, USA, April 2018.

Session Co-Chair. Manufactured Gas Plants. 11<sup>th</sup> International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Palm Springs, USA, April 2018.

Invited keynote presentation, 'Remediation of Organic Contaminants in Groundwater', International Conference on Environmental Pollution and Remediation (ICEPR'17), Rome, Italy. June 6-8, 2017.

Invited presentation, ‘Remediation of DNAPL Sites and the Influence of Matrix Diffusion’, The Langan Remediation Summit, Hamburg, NJ. September 28 – 30, 2016.

Co-chair of conference session, ‘Characterization and Risk Management in Fractured Bedrock’. Tenth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Palm Springs, California. Battelle Memorial Institute, Columbus, OH. May, 2016.

Invited keynote presentation, ‘Remediation of Soil and Groundwater Impacted by Chlorinated Solvents – State of the Practice’. International Conference on Environmental Sustainability, Development and Protection (ICESDP’16), Prague, Czech Republic, March 30-31, 2016.

Member of Scientific Committee, International Conference on Environmental Sustainability, Development and Protection (ICESDP’16), Prague, Czech Republic, March 30-31, 2016.

Co-chair of conference session, ‘Environmental Sustainability, Development and Protection II’, International Conference on Environmental Sustainability, Development and Protection (ICESDP’16), Prague, Czech Republic, March 30-31, 2016.

Mumford, K.G. and Kueper, B.H., 2015. Invited presentation ‘Thermal remediation – A look at fundamental mechanisms and implications for field implementation’. In-Situ Thermal Seminar, Euremtech, Bruges, Belgium, June 3-4, 2015.

Closing Keynote Presentation, ‘Source Zone Remediation – Key Points for Moving Forward’. REMTEC Remediation Technology Summit, The Future of Remediation Technology, Westminster, CO, March 2-4, 2015.

Invited lecture ‘Groundwater contamination by dense non-aqueous phase liquids’, CEE 275K-01, Stanford University, February 27, 2015

Co-chair of conference session, ‘Remediation of chlorinated solvent source zones’. Ninth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California. Battelle Memorial Institute, Columbus, OH. May, 2014.

Kueper, B.H., Stroo, H.F., Vogel, C.M. and Ward, C.H. Invited talk. Chlorinated solvent source zone remediation – Key issues and State of the Practice. Ninth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California. Battelle Memorial Institute, Columbus, OH. May, 2014.

Kueper, B.H., Invited presentation. Use of thermal conductive heating to remove chlorinated solvents from fractured bedrock. Workshop on Characterization, Modeling, Monitoring, and Remediation of Fractured Rock. National Research Council of the National Academies, Washington, DC, USA. May 29 – 30, 2013.

Co-chair of conference session, ‘NAPL source zone characterization and management’. Remediation Technology Summit – The Future of Remediation Technology. March 4 – 6, 2013. Westminster, Colorado, USA.

Stroo, H.F., Kueper, B.H., Vogel, C.M., Ward, C.H. and Leeson, A. DNAPL source zone remediation: status and research needs. Invited talk and published abstract, H33K-01, American Geophysical Union Fall Meeting, December 9 – 13, 2013. San Francisco, USA.

Kueper, B.H., Soil and groundwater impacted by chlorinated solvents – Discussion items. Invited talk, Water Environment Association of Ontario, Kingston, ON. February 12, 2013.

Kueper, B.H., Invited Presentation. Use of thermal conductive heating to remove chlorinated solvents from fractured bedrock – Importance of site characterization. International Association of Hydrogeologists 2012 Congress, Niagara Falls, ON. September 17-21, 2012.

Kueper, B.H., Invited Presentation. Remediation of soil and groundwater impacted by chlorinated solvents – State of the practice. International Association of Hydrogeologists 2012 Congress, Niagara Falls, ON. September 17-21, 2012.

Invited Expert Panel Member, The State of Environmental Remediation in 2012: Present and Future Research Needs. Eighth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Battelle. Monterey, CA, May 21-24, 2012.

Kueper, B.H., Invited Keynote Presentation. Remediation of Dense, Non-Aqueous Phase Liquids. International Conference on Environmental Pollution and Remediation, Ottawa, ON, Aug 17-19, 2011. Member, Scientific Organizing Committee. Published abstract.

Kueper, B.H., Invited Keynote Presentation. Delineation and Remediation of DNAPLs in Heterogeneous Geology. REMTEC Remediation Technology Summit, Chicago, IL, May 16 – 19, 2011.

Co-chair of Conference Session, “Remediation of MGP Sites”, Seventh International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Battelle, Monterey, CA. May/24-27/2010.

Kueper, B.H. Invited Seminar. Workshop on NAPL in bedrock. EPRI Manufactured Gas Plant Fall 2009 meeting. Old Town Alexandria, VA, USA. September 1, 2009.

Kueper, B.H. and West, M.R. Invited Talk. High resolution numerical simulation of DNAPL remediation in heterogeneous porous media. American Geophysical Union Spring Meeting and Joint Assembly, Session H33C, Toronto, Ontario, May 27<sup>th</sup>, 2009.

Kueper, B.H. and West, M.R. ‘Remediation of organic contaminants in groundwater’. Invited talk. 1<sup>st</sup> International Congress on Subsurface Environment. September 15<sup>th</sup> – 18<sup>th</sup>, 2009. Sao Paulo, Brazil.

Kueper, B.H. Invited Panel member, ‘Investigation and rehabilitation of contaminated sites’. 1<sup>st</sup> International Congress on Subsurface Environment. September 15<sup>th</sup> – 18<sup>th</sup>, 2009. Sao Paulo, Brazil.

Kueper, B.H. Invited Keynote Talk. Characterizing and Remediating DNAPL Sites – What we Have Learned From the Past 10 Years. VI International Seminar on Remediation and Redevelopment of Contaminated Sites. EKOS Institute Brazil, Sao Paulo, October 27 – 28, 2008.

Kueper, B.H., Invited Talk. Remediation of Dense, Non-Aqueous Phase Liquids. Central New York Association of Professional Geologists Subsurface Remediation Symposium, April 29, 2008.



Co-Chair of Conference Session, “PAH Contaminated Sites – Session A6”, Sixth International Conference, Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA. May 19 – 22, 2008.

Invited plenary conference presentation, “Behaviour and Remediation of Dense, Non-Aqueous Phase Liquids“, London Geological Society 200<sup>th</sup> Anniversary Conference: Earth Sciences in the Service of Society, Westminster, London, September 10-12, 2007. (and published abstract)

Invited plenary conference presentation, “Capture zone analysis in fractured rock: designing pump-and-treat remedies”, USEPA/NGWA Fractured Rock Conference, Portland, ME, September 24-26, 2007. (and published abstract)

Invited conference presentation, “Selection of monitoring times to assess remediation performance”. Canadian Geotechnical Society Annual Conference, Ottawa, ON, October 21-24, 2007.

University of Waterloo Distinguished Alumnus Lecture, “Behaviour and Remediation of Dense, Non-Aqueous Phase Liquids”, University of Waterloo Department of Earth and Environmental Sciences, October 19, 2007.

Invited Expert Panel Member, “Performance Assessment – Measuring the Success of Remediation”, USEPA/NGWA Fractured Rock Conference: State of the Science and Measuring Success in Remediation. Portland, ME. September 24-26, 2007.

Member Conference Advisory Council, USEPA/NGWA Fractured Rock Conference: State of the Science and Measuring Success in Remediation. Portland, ME. September 24-26, 2007.

Panel Discussion Moderator, “Case Studies Revisited: A Long-Term Look at Cost and Performance”. USEPA/NGWA Fractured Rock Conference: State of the Science and Measuring Success in Remediation. Portland, ME. September 24-26, 2007.

Co-Chair of Conference Session, “Numerical Modeling”, USEPA/NGWA Fractured Rock Conference: State of the Science and Measuring Success in Remediation. Portland, ME. September 24-26, 2007.

Invited expert panel member; DNAPL Source Treatment: Lessons Learned and Implications for Future Applications. The Fifth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Battelle, May 22 – 25, 2006. Monterey, CA.

Co-chair of conference session: Passive NAPL Collection and Interception Systems. The Fifth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Battelle, May 22 – 25, 2006. Monterey, CA.

Member, USEPA/NGWA Advisory Council for the Conference on Remediation of Contaminated Ground Water in Fractured Rock to be held September, 2007.

Canadian Geotechnical Society Annual Conference. Invited talk, Design of a hydraulic capture system in tidally influenced fractured rock. Vancouver, B.C., October 2 – 4, 2006.

Invited member; SERDP/ESTCP DNAPL Source Zone Workshop, Baltimore, MD, March 7 – 8, 2006.

Member, International organizing committee; DNAPL-1 The First International Conference on DNAPL Characterization and Remediation. Pittsburgh, PA, September 25 – 28, 2006.

Groundwater Resources Association of California, 15<sup>th</sup> Symposium, DNAPL Source Zone Characterization and Remediation. San Francisco, CA. December 7-8, 2005. Invited platform presentation: Remediation Concepts in Fractured Rock.

Australian Contaminated Land Consultants Association, Melbourne, Australia. June 29, 2005. Invited seminar: DNAPL migration and remediation.

The American Geophysical Union, Fall Meeting, San Francisco, December 13-17, 2004. Invited presentation: Timescales of DNAPL migration in heterogeneous porous media.

SERDP/ESTCP Partners in Environmental Technology Conference, Washington, DC. Invited talk: Developing a protocol and a screening tool for selection of DNAPL source are remediation. Nov/30/04 – Dec/02/04.

USEPA/NGWA Fractured Rock Conference: State of the Science and Measuring Success in Remediation, Portland, Maine, September 13 – 15, 2004. Invited talk: ‘DNAPL behaviour in fractured rock – transport facilitated by Pickering emulsions’. Member, conference organizing committee. Session chair, Lessons Learned in Monitored Natural Attenuation. Expert Panel member, Technical Impracticability.

Canadian Geotechnical Society Annual Conference, Quebec City, Quebec. Invited talk: Successive delineation of DNAPL source zones at a Superfund site. Canadian Geotechnical Society, October 25 – 27, 2004.

American Geophysical Union Joint Assembly, Session Co-Chair: Groundwater Remediation in Fractured Rock. Session H23D, American Geophysical Union, Montreal, Canada, May 17-21, 2004.

General Electric Remedial Council, June 9-11, 2004. Invited speaker. “Comparison of source zone concentration decay to plume decay on meeting remedial action objectives in fractured rock”, Chicago, Ill.

U.S.E.P.A. Groundwater Forum, 2003. Invited panel member. October 22-24, Niagara Falls, NY.

U.S.E.P.A. Groundwater Forum, 2003. Invited keynote speaker (and panel member). ‘Characterization of DNAPL Source Zones’. Seattle, WA, April 22-24, 2003.

American Geophysical Union/European Geophysical Union Spring Meeting, Invited talk. ‘Timescales of DNAPL migration’. Nice, France, April 7-11, 2003.

British Geological Survey, NAPL Contamination: Investigation and Remediation Conference, Invited keynote address: “Timescales of DNAPL migration in porous and fractured media”, BGS Keyworth, April 9, 2002.

General Electric Remedial Council, June 13 – 14, 2002, Baltimore, MD. Invited speaker: “Timescales of DNAPL migration”.

U.S.E.P.A. Groundwater Forum, 2002. Invited keynote speaker. ‘Timescales of DNAPL migration’. Pensacolla, Florida.

IAHS International Conference, Groundwater Quality 2001. Invited keynote speaker and member of Scientific Advisory Committee. ‘DNAPL migration through fractured clay/sand sequences’. Sheffield, England, June 18 – 21, 2001.

U.S.E.P.A. Sponsored Fractured Bedrock Workshop. Invited speaker, ‘Overview of Field Applications’. Providence, RI, November 8 – 9, 2000.

Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, May 22 – 25, 2000, Monterey, CA. Platform presentation (and session chair): ‘DNAPL behavior and clean-up in fractured rock: An overview’.

General Electric Remedial Council, April 27-28, 2000, Washington, DC. Invited speaker: 'Overview of DNAPL Remediation'.

General Electric Remedial Council, June 14-16, 1999, Lake Placid, NY. Invited keynote speaker: 'Behaviour, Migration, and Clean-up of Dense, Non-aqueous Phase Liquids'.

GQ'98 - International Conference and Special Seminars on Groundwater Quality: Remediation and Protection, Tübingen, Germany, September 21-25, 1998. Invited presentation: 'DNAPL pool mobilization in fractured rock.'

Gordon Conference - Modeling Flow in Permeable Media, Andover, New Hampshire, August 2 - 7, 1998. Invited presentation: 'Multiphase flow in fractures'.

International Conference on Groundwater Quality Protection, Remedial Technology and Management Policy for NAPL Contamination, Taipei, Taiwan, December 1 - 3, 1997. Invited presentation: 'The use of surfactant/alcohol flooding to remediate DNAPL sites'.

Canadian Geotechnical Society 1997 Colloquium. Presented at 50<sup>th</sup> Annual Meeting, Ottawa, Ontario, October 20-22, 1997. 'Behaviour, Migration, and Clean-up of DNAPLs in the Subsurface'.

Information Network for Superfund Settlements Conference, Denver, CO, March 12-13, 1997. Invited presentation: 'The use of surfactant/cosolvent flooding for DNAPL remediation, State-of-the-art.'

University of Arizona, Department of Hydrology and Water Resources. Invited seminar: 'The behavior of dense non-aqueous phase liquids in fractured rock', November 20, 1996.

Center for Mathematics and Computer Science, Amsterdam, Holland. NAPL Movement in the Subsurface Conference. Invited presentation: 'The behavior of DNAPL in fractured rock', October 25, 1996.

Oregon Graduate Institute, Department of Environmental Science and Engineering. Invited seminar: 'Behavior and clean-up of DNAPL in fractured rock', May 17, 1996.

Zurich Technical University Vadose Zone Workshop, Ascona, Switzerland, September 18 -22, 1995. Invited lecture: 'Migration of DNAPL in Heterogeneous Porous Media'.

VEGAS Symposium on Remediation of Contaminated Groundwater, University of Stuttgart, Stuttgart, Germany, September 25-27, 1995. Invited lecture: 'Numerical simulation of surfactant flooding to remove pooled DNAPL from porous media: parameter identification'.

Royal Military College of Canada, Kingston, Ontario, June 12-16, 1995. Invited lecture in 'Site Assessment and Remediation' shortcourse.

American Geophysical Union CHAPMAN conference on Aqueous and Multiphase Flow in Fractured Rock, Burlington, VT, September 12-15, 1994. Invited keynote presentation: 'Two-phase flow in single fractures'.

Geological Society of America PENROSE conference on Groundwater Flow and Contaminant Transport in Fractured Unlithified Deposits, Racine, WI, June, 1994. Invited keynote presentation: 'Multiphase flow in fractured media'.

American Nuclear Society SPECTRUM'94 Specialty Conference, Atlanta, GA, August 15, 1994. Invited presentation: 'Advantages and Disadvantages of Chemical Flooding to Remediate Sites Contaminated by DNAPL'.

CSCE/ASCE Conference on Environmental Engineering, Montreal, PQ, July 12-14, 1993. Invited presentation: 'DNAPL migration in sandy deposits: Field and numerical experimentation'.

Geological Society of America Annual Conference, Boston, MA, October 26, 1993. Invited lecture in 'Contaminant Hydrogeology' workshop: 'Fuels, Solvents, and Other Immiscible Phase Contaminants in Groundwater'.

U.S. Department of Energy Subsurface Science Program, Intermediate Scale Experiment Workshop, Norfolk, VA, October 8-9, 1993. Invited lecture: 'Benefits and Challenges of Experiments on Isolated Volumes of Sediments'.

Kueper, B.H., Feenstra, S., Rivett, M. and Cherry, J.A., 1992. A series of controlled field experiments to study DNAPL behavior: Implications for site remediation. Invited presentation: HAZMAT International, Hazardous Materials & Environmental Management Conference, Atlantic City, June 10-12.

Kueper, B.H. and Frind, E.O., 1990. Numerical modeling of multiphase/multicomponent flow and transport in porous media: An overview. Invited presentation: IAH Conference on Subsurface Contamination by Immiscible Liquids, Calgary, Alberta, April 18-20.

Technical University of Denmark, Department of Environmental Engineering, Lyngby, Denmark. April 12, 1989. 'The Behavior of Dense Non-Aqueous Phase Liquids in Heterogeneous Porous Media'.

Stanford University, Department of Civil Engineering, Stanford, California. December 5, 1988. 'Multiphase Flow in Heterogeneous Porous Media'.

**PROFESSIONAL SHORT COURSES TAUGHT:**

- 2019 Co-Instructor: Transport Mechanisms and Remediation Technologies for NAPL Contaminants in Soil and Groundwater. Professional Short Course, October 21-22, Beijing, China.
- 2016 Co-Instructor: Sustainable Resources Industry Training Pty, Soil and Groundwater Pollution, Characterization, Remediation and Risk Management. Professional Short Course, September 13-16, Melbourne, Australia.
- 2016 Co-Instructor: 'Hydrogeology of Fractured Rock: Characterization, Monitoring, Assessment and Remediation'. Two day shortcourse presented to the Ontario Ministry of the Environment and Climate Change. Kingston, ON, February 3 – 4, 2016.
- 2014 Co-instructor, Sustainable Resources Industry Training Pty, Soil and Groundwater Pollution, Characterization, Remediation and Risk Management. Professional Short Course, December 1-4, Sydney, Australia.
- 2014 Co-Instructor: 'Hydrogeology of Fractured Rock: Characterization, Monitoring, Assessment and Remediation'. Two day shortcourse presented to the British Columbia Ministry of the Environment. Vancouver, March 4 – 5, 2014.
- 2012 Co-Instructor: 'Investigation, Remediation and Management of Contaminated Soil and Groundwater'. Four day professional shortcourse, Australian Contaminated Land Consultants Association, Melbourne, Australia. September 24 – 27, 2012.
- 2011 Co-instructor: 'DNAPL Delineation and Remediation Workshop' presented to USEPA Region 4. December 7, 2011. Louisville, KY.
- 2011 SERDP/ESTCP, Partners in Environmental Technology Technical Symposium and Workshop. Co-instructor: 'Thermal Treatment Technologies: Lessons Learned'. December 1, 2011. Washington, DC.
- 2011 PIA, Brazil. Co-instructor: 'Groundwater Hydrology, Site Characterization, Contaminant Transport and Site Remediation'. Three-day professional shortcourse, Centro Universitário SENAC, Campus Santo Amaro, São Paulo, Brazil. June 20 – 22, 2011.

- 2002-2009 Centre For Groundwater Studies, Australia.
- Co-instructor: ‘NAPLs and Groundwater’. Four-day professional shortcourse (1<sup>st</sup> Australian NAPLs course), Sydney, Australia, July 1-4, 2002.
- Co-instructor: ‘NAPLs and Groundwater’. Four-day professional shortcourse, Melbourne, Australia, June 30 – July 3, 2003.
- Co-instructor: ‘NAPLs and Groundwater’. Four-day professional shortcourse, Brisbane, Australia, June 29 – July 2, 2004.
- Co-instructor. ‘NAPLs and Groundwater’. Four-day professional shortcourse, Melbourne, Australia, June 27 – 30, 2005.
- Co-instructor: ‘NAPLs and Groundwater’. Four-day professional shortcourse, Sydney, Australia, July 18 – 21, 2006.
- Co-instructor: ‘Soil and Groundwater Pollution’. Four-day professional shortcourse, Perth, Australia, June 12 – 15, 2007.
- Co-instructor: ‘Soil and Groundwater Pollution’. Five-day professional shortcourse, Melbourne, Australia, June 18 – 22, 2007.
- Co-instructor: “Soil and Groundwater Pollution”, Five-day professional shortcourse, August 25 – 29, 2008, Perth, Australia.
- Co-instructor: “Soil and Groundwater Pollution”, Five-day professional shortcourse, September 1 – 5, 2008, Sydney, Australia.
- Co-instructor: “Soil and Groundwater Pollution”, Four-day professional shortcourse, June 9 – 12, 2009, Surfers Paradise, Australia.
- 1997-2022 Princeton Groundwater, Co-Instructor: ‘The Princeton Remediation Course’ Semi-annual professional shortcourse, various locations and dates.
- 2003-2022 Princeton Groundwater, Co-instructor: “The Groundwater Pollution and Hydrology Course”. Semi-annual professional shortcourse, various locations and dates.
- 2003 U.S.E.P.A. Co-instructor: Hydrogeology of Fractured Rock. 1-day workshop presented to U.S.E.P.A. Groundwater Forum. Niagara Falls, NY. Oct. 21.
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- 2003 CETESB – Sao Paulo Hidrogeologia em Meio Fraturado: Monitoramento, Investigacao e Remediacao (Hydrogeology in Fractured Media). 2-day workshop presented to Brazilian regulatory agency – notes translated to Portuguese. November 6 – 7, Sao Paulo, Brazil.
- 2003 FEEMA – Rio de Janeiro Hidrogeologia em Meio Fraturado: Monitoramento, Investigacao e Remediacao (Hydrogeology in Fractured Media). 2-day workshop presented to Brazilian regulatory agency – notes translated to Portuguese. November 10 – 11, Rio de Janeiro, Brazil.
- 2003 Connecticut Licensed Environmental Professional (LEP) Association, Co-Instructor: ‘Behavior and remediation of DNAPLs in the subsurface’. 1-day short-course, Hartford, CT, February 25.
- 2002 Massachusetts Licensed Site Professional (LSP) Association, Co-Instructor: ‘Characterization and remediation of DNAPLs’, Marlboro, MA, June 17.
- 2002-2008 Fractured Rock Educational Services. ‘Groundwater flow, contaminant transport, and remediation in fractured rock’. Four-day professional shortcourse:  
  
Newport, RI., April 22-25, 2002.  
  
Niagara Falls, NY., December 2-5, 2002.  
  
Princeton, NJ., May 19-22, 2003.  
  
Burlington, VT., February 21-24, 2005.  
  
Boston, MA., April 30 – May 3, 2007.  
  
Boston, MA., December 8 – 11, 2008.
- 2002 Hudson-Mohawk Professional Geologist’s Association Workshop, Co-Instructor: “Practical Site Characterization & Remediation Techniques for DNAPLs and their Associated Dissolved Phase Plumes”. May 8, 2002, Albany, NY.
- 2001 U.S. Environmental Protection Agency, Region VII., Co-Instructor: ‘Groundwater Contamination and Remediation’. 4-day Professional Shortcourse, Kansas City, MO
- 1998-2002 University of Sheffield, Co-Instructor: ‘Organic Contaminants in Land and Groundwater’ Professional shortcourse, Sheffield, England.
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- 2001 Massachusetts Licensed Site Professional (LSP) Association, Co-Instructor: 'Behavior and remediation of DNAPLs in the subsurface' 1-day short-course, Boston, MA, March 15, 2001.
- 2001 Connecticut Licensed Environmental Professional (LEP) Association, Co-Instructor: 'Behavior and remediation of DNAPLs in the subsurface' 1-day short-course, Hartford, CT, May 8, 2001.
- 2001 State of Maine, Co-Instructor: 'Groundwater flow, solute transport, multiphase flow, and remediation in fractured rock' Four-day in-house shortcourse, Augusta, ME, May 22-25, 2001.
- 2001 State of Texas, Instructor: "Groundwater flow, solute transport, multiphase flow, and remediation in fractured rock'. Two-day in-house shortcourse, Austin, TX.
- 2000 Central New York Association of Professional Geologists, Co-instructor: 'Practical Site Characterization and Remediation Techniques for DNAPLs and Their Associated Dissolved Phase Plumes. 1 day workshop, Syracuse, NY.
- 1997 University Consortium Solvents-In-Groundwater Research Program, Co-Instructor: 'DNAPLs in Fractured Geologic Media: Behavior, Monitoring and Remediation', Professional shortcourse, November 10 - 12, San Francisco, CA.
- 1989-1997 Waterloo Center for Groundwater Research, Co-instructor: 'Behavior and Clean-up of Dense, Immiscible Phase Liquids in Porous and Fractured Media'. Annual 4-day professional short course, various locations and dates.
- 1996 Waterloo Center for Groundwater Research in collaboration with the Denmark Committee on Groundwater Pollution, Co-instructor: 'Diagnosis & Remediation of DNAPL Sites'. May 6-8, Vingsted, Denmark.
- 1996-1997 University of Bradford, Co-instructor: 'In-situ restoration of contaminated land and groundwater', Professional Short-course, Bradford, England, April 15-18.
- 1994 Central New York Association of Profession Geologists, Co-instructor, 'DNAPL Shortcourse'. Two-day shortcourse, November 1-2, Syracuse, NY.
- 1994 E.P.A. Northeast Hazardous Substance Research Center, Co-instructor: 'Remediation of NAPL Contaminated Sites'. Two-day professional short course, March 14-15 (Hoboken, NJ) and April 5-6 (Boston, MA).
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- 1993 University of Birmingham, Co-instructor: 'Groundwater Contamination by Organic Chemicals'. Four-day professional short course, April 19-22, Birmingham, England.
- 1992 ETH Zurich Technical University, Co-instructor: 'Groundwater Pollution by Mineral Oils and Organic Solvents'. Five-day professional short course, March 2-6, Zurich, Switzerland.
- 1991 U.S. Department of Energy, Co-instructor: DNAPL Workshop. Two-day workshop, July 30-31, Atlanta, GA.
- 1988 41st Canadian Geotechnical Conference, Co-instructor: 'Selected Topics in Contaminant Hydrogeology for Geotechnical Engineers'. One-day professional short course, Kitchener, Ontario.

Dr. M.R. West, B.Sc.Eng., Ph.D.

Hydrogeologist, B. Kueper & Associates, Ltd., Kingston, Ontario, Canada

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Dr. West is a hydrogeologist with expertise in the areas groundwater flow and contaminant transport, analytical and numerical modeling, and site characterization. He received his Ph.D. in contaminant hydrogeology from Queen's University in 2009 and has been employed with B. Kueper & Associates, Ltd as a consultant since 2004. He has 20 years of consulting experience in the contaminant hydrogeology field. His Ph.D. research and publications focused on the development and utilization of analytical and numerical models to evaluate groundwater flow, solute transport and remediation of non-aqueous phase liquids (NAPLs) in the subsurface environment. His Ph.D. course work included flow and solute transport in porous media and fractured rock, analytical modeling, numerical modeling, and applied geostatistics. Dr. West's consulting work has included the modeling of groundwater flow and contaminant transport and remediation in fractured rock and unconsolidated deposits at sites in Canada, Australia, Europe and the United States. In addition, he routinely performs site characterization including, but not limited to, groundwater flow analysis, hydraulic testing analysis, capture zone assessment, plume delineation and plume stability analysis, and geologic model development.

### Academic

Doctor of Philosophy (Ph.D.) October 2009  
Queen's University, Department of Civil Engineering  
Kingston, Ontario, Canada

Bachelor of Science in Civil Engineering (B.Sc.Eng.) May 2003  
Queen's University  
Kingston, Ontario, Canada

Civil Engineering Technology June 1998  
St. Lawrence College  
Kingston, Ontario, Canada

### Professional

Licensed Professional Engineer (P.Eng.) Current  
Professional Engineers Ontario  
Membership No. 100171404

### Employment

B. Kueper & Associates, Ltd. June 2009 - present  
*Hydrogeologist*  
Full-time Employee

Kingston, Ontario, Canada K7L 4V1

B. Kueper & Associates, Ltd. April 2004 – May 2009  
*Hydrogeologist*  
Sub-consultant

Queen's University May 2003 – May 2009  
Research Associate  
Department of Civil Engineering  
Kingston, Ontario, Canada K7L 3N6

Concord Engineering June 1998 – April 2003  
*Civil/Environmental Technologist*  
Kingston, Ontario Canada K7M 6P6

DuPont Canada September 1997-June 1998  
*Engineering Intern*

Kingston, Ontario, Canada K7L 4Z6

### Scholarships/Awards

Natural Science and Engineering Research Council (NSERC) 3-year Canada Graduate Scholarship Doctoral (CGS D3)	May 2005
Natural Science and Engineering Research Council (NSERC) 2-year Canada Graduate Scholarship Masters (CGS M)	September 2004
Ontario Graduate Scholarship (OGS)	September 2003
Canadian Geotechnical Society (CGS) National Undergraduate Student Report (Group) Award	September 2003
St. Lawrence College Academic Council Medal for Highest Proficiency in Graduate Class	June 1998
Ontario Building Officials Association Award for Academic Excellence	June 1998

### Thesis

Doctor of Philosophy, Queen's University Mathematical Modelling of DNAPL Source Zone Remediation	May 2009
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### Peer Reviewed Publications

West, M. and Kueper, B., (2012), Numerical Simulation of DNAPL Source Zone Remediation with In Situ Chemical Oxidation (ISCO), *Advances in Water Resource*, 44, pp.126-139.

West, M. and Kueper, B. (2010), Plume Detachment and Recession Times in Fractured Rock, *Ground Water*, 48 (3), pp. 416-426.

Ungs, M., West, M., and Kueper, B., and Ungs., M. (2009), Reply to "Comment on 'On the Use and Error of Approximation in the Domenico (1987) Solution'" by Prakash, *Ground Water*, 47 (6), pp.759-760.

West, M., Grant, G., Gerhard, J., and Kueper, B. (2008), The influence of precipitate formation on the chemical oxidation of TCE DNAPL with potassium permanganate, *Advances in Water Resources*, 31, pp. 324 - 338.

West, M., Kueper, B., and Ungs., M. (2008), Reply to "Comment on 'On the Use and Error of Approximation in the Domenico (1987) Solution'" by Aziz et al., *Ground Water*

West, M., Kueper, B., and Unga, M. (2008), Reply to "Comment on 'On the Use and Error of Approximation in the Domenico (1987) Solution'" by V. Batu, *Ground Water*, 46 (5), pp. 666-668

West, M., Kueper, B., and Unga, M. (2007), On the Use and Error of Approximation in the Domenico (1987) Solution, *Ground Water*, 45 (2), March-April, pp. 126-135

Mundle, K., Reynolds, D., West, M. and Kueper, B. (2007), Concentration Rebound Following In Situ Chemical Oxidation in Fractured Clay, *Ground Water*, pp. 1-11

West, M., Novakowski, K., and Kueper, B. (2004), Semi-analytical solutions for solute transport in fractured porous media using a strip of finite width, *Advances in Water Resources*, 27, pp. 1045-1059

### Conference Proceedings

West, M., Kueper, B.H. and Gerhard, J.I., 2007. Evaluation of DNAPL source zone removal technologies in porous media and implications for site monitoring. Proceedings, Canadian Geotechnical Society Diamond Jubilee Conference, Ottawa, ON. 5 pp.

Pang, TW, J.I. Gerhard, M. West, and B.H. Kueper, 2007. Numerical Simulation of ISCO to Remediate DNAPL in Fractured Rock, Proceedings of the 2007 U.S. EPA/ NGWA Fractured Rock Conference: State of the Science and Measuring Success in Remediation, pp.133-147.

West, M. and Kueper, B.H., 2007. Plume detachment and recession times following source treatment in bedded fractured rock. Proceedings, USEPA/ NGWA Fractured Rock Conference: State of the Science and Measuring Success in Remediation, pp. 343-356.

West, M.R. and Kueper, B.H., 2005. Numerical simulation of chemical oxidation of trichloroethylene with potassium permanganate. Conference proceedings, First International Conference on Challenges in Site Remediation. Chicago, IL, October 23-27, 2005.

Kueper, B.H., Roy-Perreault, A., and West, M., 2004. DNAPL behaviour in fractured rock – transport facilitated by Pickering emulsions. Invited Paper. Proceedings, USEPA/NGWA Fractured Rock Conference, pp. 1-13.

West, M. and Kueper, B.H., 2004. Natural attenuation of solute plumes in bedded fractured rock. Proceedings, USEPA/NGWA Fractured Rock Conference, pp. 388-401.

### Chapters in Books

Stroo, H.F., West, M.R., Kueper, B.H., Borden, R.C., Major, D.W. and Ward, C.H., 2014. In situ

bioremediation of chlorinated ethene source zones. Chapter 12 in Chlorinated Solvent Source Zone Remediation, Springer Science + Business Media, LLC, New York, NY, USA.

Other Scholarly Activities

Invited journal peer reviewer for Advance in Water Resources, Ground Water, Contaminant Hydrogeology, and Journal of Hazardous Materials

# JOHN R. FRAZIER, Ph.D., CHP

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## *Professional Qualifications*

Dr. Frazier has over 45 years of health physics experience in external and internal dosimetry, environmental dose assessment, radiation risk assessment, radiation spectroscopy, health physics training, bioassay, radiation detection and measurement, and radiological site characterization. Numerous federal agencies including the Nuclear Regulatory Commission (NRC), Environmental Protection Agency (EPA), U.S. Department of Agriculture (USDA), U.S. Department of Defense (DOD), and U.S. Department of Justice (DOJ) have sought his advice on a wide range of health physics and radiation protection topics from operational health physics program design to environmental radiation dose and risk assessments. He has also served as a consultant to private companies and individuals on numerous health physics issues. He is a Distinguished Emeritus member of the National Council on Radiation Protection and Measurements (NCRP). Dr. Frazier has made presentations on introductory and advanced health physics and radiation protection topics for professional society meetings, student groups, and public interest forums. His publications are in the areas of fundamental interactions of radiation with matter, radiation detection instrumentation, radiological site assessments, and external and internal radiation dosimetry.

## *Education*

Ph.D., Physics, University of Tennessee, Knoxville, Tennessee; 1978.

M.S., Physics, University of Tennessee, Knoxville, Tennessee; 1973.

B.A., Physics, Berea College, Berea, Kentucky; 1970.

## *Registrations/Certifications*

Comprehensive Certification by the American Board of Health Physics in 1981; recertified through 2025.

## *Experience and Background*

2004 - *Independent Health Physics Consultant*  
*Present*

Dr. Frazier provides consultation services to individuals, private companies, and government agencies on a wide range of radiation protection topics. His principal areas of expertise are internal and external radiation exposure assessments, environmental radiation dose and radiological risk assessments from occupational



and environmental exposures, and evaluations and assessments of all aspects of operational health physics programs.

1993 - ***Senior Radiological Scientist, Auxier & Associates, Inc., Knoxville, Tennessee.***  
2004

Dr. Frazier served as senior consultant on radiation protection issues for private companies and government agencies. He performed assessments of internal and external radiation exposures, environmental radiation doses and radiological risks from occupational and environmental exposures. He also performed evaluations and assessments of all aspects of operational health physics programs. Dr. Frazier served as technical advisor to organizations that performed environmental radiological assessments and risk assessments and that provided occupational radiation protection services in government and industry.

1986 - ***Senior Radiological Scientist, Nuclear Sciences, IT Corporation, Knoxville, Tennessee.***  
1993

Dr. Frazier served as senior radiological scientist and technical manager of the health physics consulting group within IT. He was responsible for health physics professional services provided by IT for federal, state, and local agencies, contractors, and private companies. These services included development of all aspects of the health physics programs for nuclear facilities, technical assessments and evaluations of existing health physics programs, and environmental and occupational radiation dose assessments. He served as technical advisor and task manager for radiological aspects of remedial investigations and feasibility studies (RI/FSs). He also served as manager and technical director for specific projects in areas that included design and implementation of environmental monitoring and sampling programs, assessment of operational health physics programs, and radiation dose and risk assessments for occupational exposures and environmental releases. Previous responsibilities included serving as senior technical consultant for upgrading Environmental Health and Safety Programs at the Department of Energy Rocky Flats Plant, Oak Ridge National Laboratory, and the Oak Ridge Y-12 Plant.

1980 - ***Health Physicist, Oak Ridge Associated Universities, Oak Ridge, Tennessee.***  
1986

Dr. Frazier developed and coordinated Oak Ridge Associated Universities (ORAU) health physics training programs. He taught health physics and radiation protection courses for several hundred students each year at ORAU Professional Training Programs. He developed new lectures, laboratory exercises, and training materials for health physics training for the Nuclear Regulatory Commission, Department of Energy, and corporate clients. In addition to his training responsibilities, Dr. Frazier served as division health physicist for the Manpower Education, Research, and Training Division of ORAU. He served as technical consultant to federal and state agencies, other training institutions, and ORAU clientele on environmental, health and safety issues. He evaluated radiation measurement and radiation protection instrumentation equipment.

- 1978 - ***Chief Radiation Physics Section, Bureau of Radiological Health, Rockville, Maryland.***  
 1980  
 Dr. Frazier supervised research and support activities of a staff of seven health physics professionals and technicians. He planned and implemented radiation research projects pertaining to ionizing radiation detection/ measurement. He scheduled personnel requirements in accordance with the scope of such projects. He coordinated support for external radiation dosimetry by the Radiation Physics Section for all other branches in the Division of Electronic Products. He supervised and performed multi-point calibrations of radiation detection/ measurement instruments per month. Dr. Frazier also assisted in planning radiation dosimetric surveys of large numbers and types of ionizing radiation sources to reduce population exposure. He coordinated environmental radiation dosimetry for extended geographical areas using external radiation dosimeters.
- 1977- ***Research Physicist, Bureau of Radiological Health, Rockville, Maryland.***  
 1980  
 Dr. Frazier calibrated X-ray detection/measurement instruments. He maintained radiation calibration secondary standards traceable to the National Bureau of Standards. He evaluated new X-Ray detection/measurement instruments with radio-frequency fields under controlled environmental conditions and a wide range of ionizing radiation fields. He also developed external radiation dosimetry techniques with both active and passive dosimeters.

### ***Awards/Activities***

Joyce P. Davis Memorial Award, American Academy of Health Physics, 2016  
 John C. Villforth Lecture, Conference of Radiation Control Program Directors, 2007  
 Fellow, Health Physics Society, 2000  
 Distinguished Technical Associate, IT Corporation, 1990  
 Elda E. Anderson Award, Health Physics Society, 1988  
 National Council on Radiation Protection and Measurements (NCRP)  
 Distinguished Emeritus Member, 2014-2022  
 Council Member, 2002-2014  
 Scientific Committee 46, 1999-2006  
 Scientific Committee 2-1, 2004-2006  
 PAC-2 Committee 2006-20017

### ***Professional Affiliations***

Health Physics Society  
 (Plenary Membership since 1981; President, 2002-3; President-Elect, 2001-2;  
 Board of Directors, 1992-5; Treasurer-Elect, 1997-8; Treasurer, 1998-2000)  
 American Academy of Health Physics (Past-president 2013; President 2012;  
 President-elect, 2011; Secretary, 1996-1997, Director, 1998)  
 East Tennessee Chapter of the Health Physics Society (Past President)  
 International Radiation Protection Association (Plenary Membership since 1981)

## ***Publications***

Dr. Frazier has prepared or contributed to over 130 reports and publications in the fields of health physics and environmental science.

### ***List of Peer-reviewed Publications***

Frazier, J. R., "Negative Ion Resonances in the Fluorobenzenes and Biphenyl" Ph.D. Dissertation, University of Tennessee, Knoxville, Tennessee, 1978.

Frazier, J. R., "Low-Energy Electron Interactions with Organic Molecules: Negative Ion States of Fluorobenzenes," Journal of Chemical Physics, Vol. 69, No. 3807, 1978.

Frazier, J. R., "Performances of X-ray Measurement Instruments in RF Fields," HEW Publication (FDA) 78-8065 Rockville, Maryland, 1978.

Frazier, J. R., "A Dosimetry System for Evaluating Chest X-Ray Exposures," HEW Publication (FDA) 79-I 107, 1979.

Film Badge Dosimetry in Atmospheric Nuclear Tests, National Academy Press, Washington, D.C., 1989.

Operational Radiation Safety Training, NCRP Report No. 134, National Council on Radiation Protection and Measurements, Bethesda, Maryland, October 13, 2000.

Key Elements of Preparing Emergency Responders for Nuclear and Radiological Terrorism, NCRP Commentary No. 19, National Council on Radiation Protection and Measurements, Bethesda, Maryland, December 31, 2005.

Radiation Protection in Educational Institutions, NCRP Report No. 157, National Council on Radiation Protection and Measurements, Bethesda, Maryland, June 25, 2007.

Self Assessment of Radiation-Safety Programs, NCRP Report No. 162, National Council on Radiation Protection and Measurements, Bethesda, Maryland, June 3, 2009.

Radiological Health Protection Issues Associated with Use of Active Detection Technology Systems for Detection of Radioactive Threat Materials, NCRP Commentary No. 22, National Council on Radiation Protection and Measurements, Bethesda, Maryland, 2011.

Investigation of Radiological Incidents, NCRP Report No. 173, National Council on Radiation Protection and Measurements, Bethesda, Maryland, September 14, 2012.

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***Contact Information***

John R. Frazier, Ph.D., CHP  
Health Physics Consultant  
325 Sugarwood Drive  
Farragut, TN 37934

Phone: 865-414-9271  
E-mail: [chpconsult1981@gmail.com](mailto:chpconsult1981@gmail.com)