

CURRICULUM VITAE

I) GENERAL

A) Name: KENNETH C. CARROLL
B) Present Position: Associate Professor
C) Principal Unit: Plant & Environmental Sciences (PES) Department
D) College: Agricultural, Consumer and Environmental Sciences

E) Educational background:

Ph.D. from University of Arizona (UA), 2007, *Advisor:* Mark L. Brusseau
Dissertation: Characterization, Dissolution, and Enhanced Solubilization of Multicomponent Nonaqueous Phase Liquid in Porous Media; *Major:* Hydrology and Water Resources; *Minor:* Soil, Water, and Environmental Science (SWES)
M.S. from Ohio University (OU), 1999, *Advisor:* Dina L. López
Thesis: The Transport and Fate of Acid Mine Drainage Along the Snowfork Flowpath in the Monday Creek Watershed, Southeastern Ohio; *Major:* Aqueous/Environmental Geochemistry
B.S. from OU, 1996
Major: Geological Sciences

F) Previous and Current Professional Experience

2017–Present Associate Professor: New Mexico State University (NMSU)
 2017–Present Principal Consultant: Kenneth C. Carroll and Associates, L.L.C.
 2013–2017 Assistant Professor: NMSU
 2010–2013 Research Scientist: Environmental Systems Group at Pacific Northwest National Laboratory (PNNL)
 2007–2010 Postdoctoral Researcher & Laboratory Manager: UA SWES Department
 2004–2007 Hydrogeochemist Project Consultant: Water Management Consultants, Inc.
 2003–2004 Hydrogeochemist Project Consultant: Hydro Geo Chem, Inc.
 1999–2003 Research Assistant: SWES Department at UA
 1997–1999 Teaching Assistant: Geological Sciences Department at OU

II) ALLOCATION OF EFFORT

	Allocation Over 12 Month FTE Year Note: KC Carroll is on a 9 Month (75% of 12 Month FTE) Contract	2013 % of Effort	2014 % of Effort	2015 % of Effort	2016 % of Effort	2017 % of Effort
Extension		0	0	0	0	0
Research	Manage research lab and network; recruit/manage grad students; conduct research; present/disseminate results; write proposals and pursue funding; write journal articles and submit for review and publication.	48	44	46	46	46
Teaching (Instruction) & Advising	(0.18) ES/WSM/CE/GEOL 452 (15x3 cr) and 452L (15x1 cr) (0.05) WSM/ES 599/700 with >2 graduate students (0.12) ES 470 Environmental Impacts of Land Use (12x3 cr) (0.12) WSM/ES 605 Arid Land Water Resources (10x3 cr)	50	53	47	47	47

	(0.2) Graduate Student (PhD/MS) Graduation (~2 /year)					
Outreach	Recruit students to Water Science & Management Program and Plant & Environmental Sciences Department	1	1	1	1	1
Service	Water Science & Management Advisory Committee and GSO Advisor; Graduate Studies; Recruiting and Retention; Professional Committees	1	2	6	6	6
	Total	100%	100%	100%	100%	100%

My official contract is 100% Teaching on 9-month. However, I teach three classes a year and advise graduate and undergraduate students, which amounts to 50% teaching for a 12-month appointment. I maintain an active research program, contribute both teaching and research scholarship, and provide both internal and external service.

III) SCHOLARSHIP AND CREATIVE ACTIVITIES FOR THE PERIOD UNDER REVIEW

A) Extension scholarship and creative activities

1) Narrative Extension and Consulting Philosophy and Program Goals:

I have an active consulting practice that provides technical support on a variety of hydrogeology and environmental geochemistry issues. Current work includes technical review of documents for DOE Los Alamos and Elephant Butte Irrigation District. My prior consulting industry experience from 2003-2007 was with Hydro Geo Chem, Inc. for one year and with Water Management Consultants, Inc. for three years. The project experience has included:

Project-related experience: Mining

- *Rock Creek and Big Hurrah, Alaska*
Conducted water balance and geochemical modelling of two open pit lakes, a tailings storage facility, and three waste rock storage facilities for new gold mine permit and preliminary closure design. Evaluated cover design and surface water routing effects on water quality after closure.
- *Gold Hill, Nevada*
Conducted various geochemical modelling scenarios for post closure mitigation alternatives for a mine pit lake. Evaluated surface water routing impact on pit lake chemistry after closure.
- *Mule Canyon, Nevada*
Conducted pit lake and backfill pore water geochemical modelling of several closure design alternatives for six open pits. Predicted changes in pit lake and pore water chemistry for backfill and lime amendments to pit lakes after closure.
- *Sari Gunay, Iran*
Conducted groundwater mixing, speciation, and sorption geochemical modelling to predict potential groundwater impact upon waste rock seepage mixing. Evaluated down-gradient groundwater chemistry and metal concentration attenuation.
- *FMC, Wyoming*
Reviewed groundwater and pump scale chemical and mineralogical data. Conducted PHRQPITZ geochemical modelling of brine-groundwater mixing and chemical reactions with aquifer materials. Predicted groundwater composition and mineral formation upon mixing brine with groundwater.
- *Phoenix Project, Nevada*
Conducted pit lake water balance and geochemical modelling of six open pits to evaluate post closure pit lake water quality without backfill, with partial backfill, and with complete backfill

closure alternatives. Evaluated feasibility for partial backfill to create passive hydraulic containment, and predicted water quality evolution after closure.

- *Pinson, Nevada*
Conducted geochemical modelling of an open pit lake to evaluate backfill closure design feasibility. Predicted lake composition after closure with and without open pit backfill.
- *Fort Knox, Alaska*
Reviewed hydrologic, operations, and chemical data, developed a site-wide water balance and chemical mass balance model of a tailings facility for closure planning. The model was compared to observed data, and used to evaluate closure strategies.
- *Pascua Lama, Chile*
Conducted geochemical modelling to predict down-gradient groundwater chemistry upon mixing of waste rock seepage and groundwater for new mine permitting and preliminary closure design. Also, developed geochemical models for the prediction of waste water storage pond chemistry and design of a waste water treatment facility.
- *El Abra, Chile*
Conducted data evaluation and geochemical modelling at a heap leach facility to evaluate the feasibility of stacking sulphide ore on top of oxide ore. Predicted seepage water metal concentrations with oxide ore only and oxide/sulphide ore mixture. Then evaluated any mineral formation potential.
- *Aqua Rica, Argentina*
Conducted geochemical modelling evaluation of pit wall runoff chemistry at a new mine. Predicted metal concentrations with and without surface water routing used to minimize pit wall contact water.
- *Carlota, Arizona*
Reviewed water balance, dewatering, and geochemistry data and reports. Then prepared review memorandums and recommendations for additional data collection and analysis.
- *Rock Creek, Alaska*
Reviewed water level and groundwater chemistry data for new mine permitting, reported results of review, and recommended improved procedures for cold weather environmental monitoring.
- *Confidential Client, Arizona*
Conducted data review, and developed geochemical sampling and analysis plan. Then collected samples of exploration core for laboratory analysis as part of a waste rock acid rock generation potential evaluation.
- *TJ Pit, Miami, Arizona*
Reviewed natural and operational hydrologic data for closure planning at a pit lake adjacent to an underground in-situ leaching operation.
- *Copperstone, Arizona*
Evaluated hydrology and water chemical data for new underground gold mine permitting and preliminary closure design.
- *FMC, Wyoming*
Compared aqueous geochemistry of mine process water, river water, and groundwater to characterize the leakage of dissolved salts from a trona mine, and used groundwater concentrations and hydraulic gradients to evaluate river mass loading.
- *Confidential Client, Arizona*
Collected sediment and surface water samples to evaluate net acid generation potential and metal concentrations for compliance with a consent decree.
- *Confidential Client, Arizona*

Collected soil samples for laboratory evaluation of net acid generation potential and metal concentrations.

- *Monday Creek and Snow Fork, Ohio*
Measured discharge and collected stream water and sediment for metals analysis, and conducted surface water flow and geochemical modelling to predict metal transport downstream of abandoned underground and surface coal mines. Collected stream water samples and measured discharge for the monitoring of an abandoned coal mine reclamation project, and assisted with hydrologic data collection at an abandoned coal tailings facility.
- *Minahasa, Indonesia*
Reviewed geochemistry data and modelling for a passive treatment wetland system. Evaluated processes responsible for kinetic precipitation of manganese oxides in open pit lakes, and predicted mineral saturation index controls on mineral formation in wetland treatment system.
- *Olympic Dam Expansion, Australia*
Conducted data review, conceptualization, and FEFLOW 2D model development for initial pore pressure evaluation in conjunction with geotechnical modelling for slope stability evaluation and open pit expansion feasibility.
- *Bingham Canyon, Utah*
Developed H2 Section 3D variably saturated FEFLOW groundwater flow models of an open pit to evaluate tunnel and/or horizontal drain construction on depressurization for slope stability. Compared the models based on cost and dewatering effectiveness, evaluated recharge sensitivity, and worked with geotechnical group to use FEFLOW results as input to FLAC slope stability models.
- *Bingham Canyon, Utah*
Developed G2 Section 3D variably saturated FEFLOW groundwater flow models of an open pit to evaluate tunnel and/or horizontal drain construction on depressurization for slope stability. Compared the models based on cost and dewatering effectiveness, and worked with geotechnical group to use FEFLOW results as input to FLAC slope stability models.
- *Bingham Canyon, Utah*
Developed I Section 3D variably saturated FEFLOW groundwater flow models of an open pit to evaluate tunnel and/or horizontal drain construction on depressurization for slope stability. Compared the models based on cost and dewatering effectiveness, evaluated clay zone conductivity sensitivity, and worked with geotechnical group to use FEFLOW results as input to FLAC slope stability models.
- *Bingham Canyon, Utah*
Developed South Wall 3D FEFLOW groundwater flow models of an open pit to evaluate the feasibility of pumping well and/or horizontal drain construction on depressurization for slope stability. Utilized geologic block model for automated hydraulic property input, calibrated model to pumping test, and worked with geotechnical group to use FEFLOW results as input to FLAC slope stability models.
- *Bingham Canyon, Utah*
Located and designed proposed boreholes and data collection for open pit expansion AFE. Conducted 4 Order of Magnitude dewatering evaluations for various open pit expansions.
- *Bingham Canyon, Utah*
Provided general hydrogeologic support for open pit dewatering operations evaluations including review of previous East Wall Seep/W modelling, assistance with surface water evaluation reporting,

piezometer water level review, hydraulic testing analysis, and assistance with conceptualization and development of a 3D FEFLOW pore pressure model of the North Wall D-Section.

- *Lone Tree, Nevada*
Developed and ran geochemical models for pit lake management and closure design. Then developed pit lake dosing pilot testing protocols for the development of pit lake management dosing curves.
- *Los Filos, Mexico*
Conducted data review, and developed geochemical sampling and analysis plan. Then collected samples of exploration core for laboratory analysis as part of a waste rock and ore acid rock generation potential evaluation.

Project-related experience: Environmental

- *Confidential Client, Arizona*
Investigated contaminant capture well-field system performance through observed groundwater flow versus pumping rate calculations, estimation of local hydraulic gradients, and evaluation of changes in groundwater chemistry.
- *Confidential Client, Nevada*
Conducted Dynaflow 3D finite element groundwater flow modelling and particle tracking to evaluate possible source area locations for chlorinated solvent compound contamination of a public water supply well, and developed a soil-gas sampling plan to confirm source locations.
- *Mohave Engineering, Arizona*
Developed a Tracer 3D variably saturated groundwater flow and transport model for the evaluation of nitrate infiltration and potential groundwater contamination from proposed development septic systems.
- *Haro Investments Gasoline Station, Arizona*
Managed and conducted soil-gas investigations at underground fuel storage tank sites. Used hydraulic drive-point rig to collect soil and soil-gas samples for mobile laboratory analysis to investigate the distribution of subsurface contamination.
- *Confidential Client, Washington*
Sampled groundwater and evaluated natural attenuation kinetics for chlorinated solvent compounds in groundwater. Calculated biodegradation and natural attenuation rates from observed groundwater concentrations.
- *Confidential Client, Washington*
Developed site-specific cleanup standards for volatile organic compounds based on a well inventory and receptor pathway investigation, measured groundwater concentrations, human health risk assessment, and vapour intrusion modelling.
- *Central and Campbellback, Arizona*
Monitored groundwater elevations, and sampled groundwater wells and treatment system for volatile organic compound analysis.
- *Arizona Portland Cement, Arizona*
Managed air rotary casing hammer (Becker Hammer) drilling and split-spoon soil sampling for fuel spill site characterization.
- *Evergreen Aircraft Center, Arizona*
Sampled soil-gas and groundwater for metals and volatile organic compounds, and evaluated concentrations using multi-phase partitioning relationships.
- *Sky Harbor Airport, Arizona*

Monitored groundwater for organic compounds and dissolved oxygen at a bioremediation pilot project.

- *Santa Cruz County Underground Storage Tank, Arizona*
Sampled groundwater for volatile organic compound analysis and developed a soil-gas survey that detected a leaking underground storage tank.
- *PCE Remediation Pilot Project, New Jersey*
Collected groundwater samples and discharge measurements at a cyclodextrin enhanced solubilization of PCE for subsurface remediation pilot scale test at Dover Air Force Base.
- *Fuel Spill Characterization, Arizona*
Sampled soil-gas at a gas phase partitioning tracer test to estimate residual fuel saturation in subsurface soils.
- *Tucson International Airport Superfund Site Remediation, Arizona*
Injected potassium permanganate solution into groundwater and soils for the oxidation of trichloroethene, and monitored groundwater elevations and collected samples for analysis.
- *Rio Mercado District Development, Arizona*
Monitored and evaluated methane concentrations within and outside of a municipal landfill to evaluate the potential for methane migration toward a proposed housing development.
- *Page Trowbridge Ranch Landfill, Arizona*
Conducted MODFLOW-Surfact 3D vapour flow and transport modelling to evaluate soil vapour extraction feasibility for remediation of a landfill containing volatile organic compounds.
- *Three Rivers Landfill, Georgia*
Performed temperature, water flow, gas flow, and pressure monitoring data analysis for evaluation of aerobic landfill operation.

Project-related experience: Hydrogeology & Water Resources

- *Mona Lisa Production Well, Arizona*
Assisted district hydrogeologist and drilling contractors with 1,200 foot deep production well reverse circulation drilling, well installation, development, new source water quality sampling, and aquifer testing (step and constant rate) and analysis.
- *Lambert-La Cholla Production Well, Arizona*
Assisted district hydrogeologist and drilling contractors with 1,200 foot deep production well reverse circulation drilling, well installation, development, new source water quality sampling, and aquifer testing (step and constant rate) and analysis.
- *Hub No. 5 Production Well, Arizona*
Assisted district hydrogeologist and drilling contractors with drilling, geophysical logging interpretation, depth-specific water quality sampling, well installation, development, and aquifer test analysis for a 600 foot deep production well.
- *Hub Service Area Well Siting Investigation*
Geographic information system mapping and quantitative evaluation of optimal new well location based on hydrogeology and economics.
- *Metro Water District Water Level and Quality Monitoring*
Collected water level (including specific capacity data) and water quality monitoring data, reviewed water quality compliance data, and managed database and data archive systems.
- *Metro Water District Hydrologic Data Collection*
Implemented hydrologic data analysis including the development of monthly water production reports, energy utilization reports, and well impact analysis studies.
- *Metro Water District Well Rehabilitation*

Supervised well maintenance and modification, reviewed video surveys, sampled microbial populations, and inspected well redevelopment including jetting.

- *OhioEPA, Ohio*

Investigated storm water complaints, reviewed Storm Water Pollution Prevention Plans, and NPDES permit inspections for construction and industrial activities.

B) Research scholarship and creative activities

1) Narrative Research Philosophy and Program Goals:

My overall goal is to develop an externally funded multidisciplinary research program that combines laboratory experimentation, field-scale testing, and theoretical analysis to investigate coupled processes and interactions that influence the environment. In general, I am interested in the mechanistic investigation of coupled physical, chemical, and biological processes and interactions that influence the environment. I employ a multidisciplinary approach to research by integrating aspects from several different science and engineering fields to investigate processes at a multitude of spatial scales from the molecular scale to the watershed basin scale. I believe a multidisciplinary approach is required for the evaluation of coupled processes that influence the environment.

My research strives to develop practical solutions to problems we are facing including the preservation and/or restoration of our natural resources, as well as, contributing to the advancement of basic science. My goal is to conduct fundamental & applied research focused on developing solutions to problems that are of current relevance to our society at a national and/or international level (e.g., clean water, renewable energy production, and CO₂ sequestration), because I also have a desire for my career to contribute to the betterment and advancement of science and our society. Specific research interests include:

- Advancing our understanding of water supply and water quality in arid regions
- Development of innovative water resources, environmental-remediation, carbon-capture, and energy-production alternatives
- Experimental and numerical evaluation of coupled multiphase-fluid flow, biogeochemical, and mass-transfer processes
- Characterization of subsurface physical and chemical heterogeneity and the associated impacts on fluid flow, transport, and fate of chemicals within various geologic systems
- Development of novel approaches for characterization of contamination natural attenuation and active-remediation enhancement

2) Evidence of research scholarship and creative activities:

(a) List of research areas, titles and sources of funding

- 2017 – **Awarded as PI** with Pierce & Brooks (ORNL), Rucker (Hydrogeophysics), and Ulery (NMSU): “Coupling Direct and Indirect Characterization Methods for Mercury Transport and Surface Water-Hyporheic Zone Exchange” from DOE-EM (\$281,071 total; \$235,103 for NMSU).
- 2017 – **Awarded as PI** with Andrew Robertson (USGS), Pei Xu & Phil King (NMSU Civil Engineering), and Brian Hurd (NMSU Agricultural Economics): “Isotopic, Geochemical, and Modeling Evaluation of Source Water, Extraction Potential, and Potential Impacts of Using Brackish Water for Desalination in the Mesilla Basin, NM” from US Bureau of Reclamation &

NM WRRI (\$76,375 for 2 years) and U.S. – Mexico Transboundary Aquifer Assessment Program (\$42,000 for 2 years).

- 2016 – **Awarded as PI** with Ulery (NMSU): “Coupling Direct and Indirect Characterization Methods for Mercury Transport and Surface Water-Hyporheic Zone Exchange” from DOE-EM (\$296,141 for NMSU).
- 2016 – **Awarded as PI** with Andrew Robertson (USGS) and Fernald (NMSU): “Isotopic and geochemical characterization of deep and shallow groundwater residence time, connectivity, and mixing in the Mesilla Basin, New Mexico” from NM WRRI’s State-Wide Water Assessment and U.S. – Mexico Transboundary Aquifer Assessment Act (\$157,829 for 1 year).
- 2016 – **Awarded as PI** “Evaluation of source water, extraction potential, and potential impacts of using brackish water for desalination in New Mexico” funded by the USDA Southwest Hub for Risk Adaptation and Mitigation to Climate Change (\$48,000 over 2 years).
- 2016 – Awarded as Co-PI with Fernald as PI “The Feasibility of Utilizing Produced Water to Improve Drinking Water Supply in Southeastern New Mexico” from NMED (\$34,613 for 1 year).
- 2015 – **Awarded as PI** "Reservoir-Stimulation Optimization with Operational Monitoring for Creation of Enhanced Geothermal Systems Investigation" DOE - Pacific Northwest National Laboratory, \$10,332 for May 1, 2015 - September 30, 2016 (with total award from PNNL >\$40,000).
- 2015 – **Awarded as PI** “Enhancing Water-Resource Sustainability Through Alternative Groundwater Contaminant Remediation Approaches in the Arid Southwest USA” from NM Ag. Experiment Station (Hatch Grant ~\$5,000/year).
- 2015 – Awarded as Co-PI with C. Brewer “Waste Processing with Pyrolysis to Recover Water and Nutrients” from NASA (\$32,585 for 1 year).
- 2014 – **Awarded as PI** with S. Timmons, M. Johnson, N. Myers, and M. Ely “Assessment of Spatiotemporal Groundwater Level Changes Throughout New Mexico” from NM WRRI’s State-Wide Water Assessment (\$30,011 for 1 year).
- 2013 – **Awarded as PI** with April Ulery and Barbara Chamberlin “Interactive, Online, Labs to Support Discovery of the Scientific Process” from NMSU Allocation of President’s Performance Fund (\$15,000/year for 3 years).
- 2013 – **Awarded as PI** with Pei Xu “Quantifying Potential Environmental Impacts and Water Treatment Requirements for Wastewater Produced in Oil & Gas Operations” from NMSU V.P. Research’s Interdisciplinary Research Grant (\$28,770 for 1 year).
- 2013 – **Awarded as PI** for Hector Yakubu (NMSU Student) “Graduate Student Research Enhancement Grant (GREG) Award for Facilitated-Transport Enabled In Situ Chemical Oxidation of 1,4-Dioxane-Contaminated Groundwater” from NMSU V.P. of Research (\$11,000 per year for 3 years).
- 2013 – **Awarded as PI** with TB Boving (U. Rhode Island), ML Brusseau (U. Arizona), R Ball (EnChem Eng., Inc.): “Facilitated-Transport Enabled In Situ Chemical Oxidation of 1,4-Dioxane-Contaminated Groundwater” from DoD through SERDP (\$1,203,000 with \$418,000 for NMSU over 4 years)
- 2012 – **Awarded proposal as PI**: “Reservoir-Stimulation Optimization with Operational Monitoring for Creation of Enhanced Geothermal Systems” from DOE-EERE Geothermal Technologies Program (~\$1,000,000 over 3 years for PNNL)
- 2012 – Awarded proposal/SOW as CoPI with MJ Truex, M Oostrom, & T Johnson: “Flux-Based Remediation Assessment Framework Development, Technical Basis, and Guidance for Inorganic

and Radionuclide Contaminants in the Deep Vadose Zone” from DVZ-AFRI (DOE-EM) Client for >\$1,000,000 total over 3 years (\$500,000 for FY12)

- 2011 – Awarded proposal as CoPI with ML Brusseau: “Use of Mass-Flux Measurement and Vapor-Phase Tomography to Quantify Vadose-Zone Source Strength and Distribution” from ESTCP (11 EB-ER1-049) \$120,000 for PNNL of \$674,000 (3 years)
- 2009 – Awarded proposal as Co-Author with ML Brusseau: “Characterization of KMnO₄ Remediation Effectiveness and Aquitard Back-Diffusion for Air Force Plant 44 in Tucson, Arizona” from U.S. Air Force and EarthTech \$82,000
- 2009 – Awarded proposal as Co-Author with ML Brusseau: “Characterizing and Enhancing Natural Attenuation of Sulfate-Contaminated Groundwater Plumes in Arizona” from UA Superfund Basic Research Program \$30,000 with another \$30,000 matching from Water Management Consultants
- 2008 – Awarded proposal as Co-Author with ML Brusseau and EP Glenn: “Pilot-Scale Evaluation for Ethanol-Enhanced Denitrification at the Uranium Mill Tailing Site in Monument Valley, Arizona” from DOE Legacy Management \$131,000
- 2008 – Awarded proposal as Co-Author with ML Brusseau and EP Glenn: “Conceptual Model Evaluation for Monument Valley, Arizona” from U.S. Department of Energy \$14,000
- 2001 – Awarded proposal as Co-Author with ML Brusseau: “Bench-Scale Analysis of Diesel-PCE Mixture Behavior for the Park-Euclid WQARF Site” from AZ Department of Environmental Quality \$35,000

(b) Nature and scope of research areas including responsibility in the above projects:

(i) Scientific leadership roles

I provide scientific leadership in all my research activities especially the projects that I have developed, submitted, and been awarded research proposals as principal investigator (PI). I am PI for a **~\$1.2 million dollar project**, and I am subcontracting collaborators from University of Arizona, University of Rhode Island, and Enchem Engineering. I was recently awarded another grant as PI for **\$300K/year**, which will likely extend for 3 or more years. I have supported several graduate students and research staff on these projects. I have been directing and reporting research for all aspects of these projects. I was also awarded approximately one \$30K project each year since 2013 (5 total) as PI and another \$15K/year for 3 years project, which require writing/submitting proposals, directing research, and reporting results.

(ii) Administrative leadership roles

I have developed, submitted, and been awarded research proposals as PI totaling over \$2.5 million dollars (~\$2 million at NMSU). As PI, I report to funding agencies, manage staff/resources, and oversee subcontracts. I also track budgets/milestones/deliverables, and my goal is to ensure **quality** and **value**. Additionally, I have developed, submitted, and been awarded research proposals as co-investigator or collaborator. I supported these efforts by collaborating with the PI and drafting proposals and conducting research and reporting.

(iii) Other (Scope and Impact)

I believe the interdisciplinary nature of my research is evident from my publication record and the types and wide variety (18) of peer-reviewed journals that I have published in. I have been publishing papers in some of the top peer-reviewed journals in environmental science, hydrology, soil science, and environmental engineering (e.g., *Green Chemistry*, *Environmental Science & Technology*, *Journal of Hydrology*, *Chemosphere*, *Water Resources Research*, *Chemical Geology*, and *Journal of Hazardous Materials*). My research is relevant, of interest to others, and advancing science. My articles

have been cited (as of Dec. 2017) by other peer-reviewed papers approximately 339 times (ISI h-index 11 [i.e., 11 papers with 11 or more citations] identified by ISI and the average citations paper is 8.9). Google Scholar has identified 597 citations with an h-index of 16, and ResearchGate found 446 citations with an h-index of 12.

My research has targeted issues that our society is currently concerned about including the mitigation of climate change, the evaluation of potential environmental impacts of hydraulic fracturing, and the development and feasibility of renewable energy. Fang et al. (2013) examined modeling prediction approaches for simulating the injection of CO₂ into the deep subsurface to decrease greenhouse gas emissions for climate change mitigation. Jung et al. (2014) examined the potential for CO₂ leakage back to the atmosphere (after subsurface injection). Shao et al. & Jung et al. (2015) document the development of an **environmentally friendly rock fracturing** technology for geothermal energy production, which may enable enhanced geothermal system development technologically and economically feasibility throughout NM and the entire western US. We are decreasing environmental impacts of hydraulic fracturing, which is common in southeastern NM. We are also increasing the feasibility of geothermal energy production in NM, which is a low CO₂ emission and renewable energy source.

My research has also contributed to the discovery of contamination characterization and remediation technologies, and has developed methods to evaluate when remediation operation closure can be considered. For example, I have published >10 papers on contaminant mass flux and mass discharge, which is a new approach to characterize contaminant sources during remediation, can be used to quantify the effectiveness of remediation application, and can even be used to define and test for achievement of remediation operation closure criteria. These methods are now being applied by my research group to evaluate groundwater contamination and remediation at the NASA White Sands Facility just north of Las Cruces, NM. Based on our research results, at least one remediation system (at DOE's Hanford Site) was allowed to close, which eliminated ongoing operations costs (**>\$ 6 million in savings from a \$ 500 K dollar investment in research**).

(c) List of research products and creative achievements

Refereed Journal Articles: (* denotes NMSU students/postdocs and † denotes other students/postdocs advised or co-advised by Carroll)

IN REVIEW:

1. Chaudhary, B.K., S. Willman*, M.A Engle, P. Xu, R.P. Sabie, and **K.C. Carroll** (In Prep.) Produced Water Quality Spatial Variability and Alternative-Source Water Analysis Applied to the Permian Basin, USA. *Applied Geochemistry*.
2. Fuchs*, E.H., **K.C. Carroll**, and J.P. King (In Review) Quantifying Groundwater Resilience Through Conjunctive Use in a Constrained Aquifer System for Irrigated Agriculture. *Journal of Hydrology*.
3. Khan*, N.A., M.D. Johnson, F.O. Holguin, B. Dungan, and **K.C. Carroll** (In Review) Cyclodextrin-Enhanced Treatment Kinetics for 1,4-Dioxane and Chlorinated Co-Contaminants Using Stabilized Aqueous Ozone. *Chemosphere*.
4. Brusseau, M.L., **K.C. Carroll**, Z. Guo, and J. Mainhagu (In Review) Borehole Diffusive Flux Apparatus for Characterizing Diffusive Mass-transfer in Subsurface Systems. *Water, Air, & Soil Pollution*.

PUBLISHED:

5. Khan^{*}, N.A., M.D. Johnson, and **K.C. Carroll** (2018) Spectroscopic Methods for Aqueous Cyclodextrin Inclusion Complex Binding Measurement for 1,4-Dioxane, Chlorinated Co-Contaminants, and Ozone. *Journal of Contaminant Hydrology*. Accepted.
6. Mateas[†], D.J., G.R. Tick, and **K.C. Carroll** (2017) In Situ Stabilization of NAPL Contaminant Source-Zones as a Remediation Technique to Reduce Mass Discharge and Flux to Groundwater. *Journal of Contaminant Hydrology*, 204(September): 40-56.
7. Padgett[†], M.C., G.R. Tick, **K.C. Carroll**, and W.R. Burke (2017) Chemical Structure Influence on NAPL Mixture Nonideality Evolution, Rate-Limited Dissolution, and Contaminant Mass Flux. *Journal of Contaminant Hydrology*. *Journal of Contaminant Hydrology*, 198:11–23.
8. Dettmer^{*}, A., R. Ball, T.B. Boving, N. Khan^{*}, T. Schaub, N. Sudasinghe, C.A. Fernandez, and **K.C. Carroll** (2017) Stabilization and Prolonged Reactivity of Aqueous-Phase Ozone with Cyclodextrin. *Journal of Contaminant Hydrology*, 196:1–9.
9. McDonald[†], K., **K.C. Carroll**, and M.L. Brusseau (2016) Comparison of fluid-fluid interfacial areas measured with X-ray microtomography and interfacial partitioning tracer tests for the same samples. *Water Resources Research*, 52 (7): 5393–5399, doi:10.1002/2016WR018775.
10. Chen^{*}, H. and **K.C. Carroll** (2016) Metal-Free Catalysis of Persulfate by Nitrogen-Doped Graphene and Aminated Graphene. *Environmental Pollution*, 215: 96–102. doi:10.1016/j.envpol.2016.04.088.
11. Engle, M.A., F.R. Reyes, M.S. Varonka, W.H. Orem, L. Ma, A.J. Ianno, T.M. Schell, P. Xu, and **K.C. Carroll** (2016) Geochemistry of formation waters from the Wolfcamp and “Cline” shales: Insights into brine origin, reservoir connectivity, and fluid flow in the Permian Basin, USA. *Chemical Geology*, 425: 76–92. doi:10.1016/j.chemgeo.2016.01.025 (top downloaded paper).
12. Khan^{*}, N.A., M.A. Engle, B. Dungan, F.O. Holguin, P. Xu, and **K.C. Carroll** (2016) Volatile-Organic Molecular Characterization of Shale-Oil Produced Water from the Permian Basin. *Chemosphere*, 148: 126–136, doi:10.1016/j.chemosphere.2015.12.116.
13. Shao, H., S. Kabilan, S. Stephens, N. Suresh, A.N. Beck, T. Varga, P.F. Martin, A. Kuprat, H. B. Jung[†], W. Um, A. Bonneville, D.J. Heldebrant, **K.C. Carroll**, J. Moore, and C.A. Fernandez (2015) Environmentally Friendly, Rheoreversible, Hydraulic- Fracturing Fluids for Enhanced Geothermal Systems. *Geothermics*, 58: 22-31.
14. **Carroll, K.C.**, K. McDonald[†], J. Marble, A.E. Russo, and M.L. Brusseau (2015) The impact of transitions between two-fluid and three-fluid phases on fluid configuration and fluid-fluid interfacial area in porous media, *Water Resources Research*, 51, 7189–7201, doi:10.1002/2015WR017490.
15. Brusseau, M.L., J. Mainhagu, C. Morrison, and **K.C. Carroll** (2015) The vapor-phase multi-stage CMD test for characterizing contaminant mass discharge associated with VOC sources in the vadose zone: Application to three sites in different lifecycle stages of SVE operations. *Journal of Contaminant Hydrology*, 179(1): 55-64.
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34. Chen, H. and **K.C. Carroll** (2015) Sulfamethoxazole Treatment by Advanced Oxidation Process with Graphene Oxide. *The Association of Environmental Engineering & Science Professors (AEESP) 2015 Conference*, Yale University, June 13-16.
35. Fernandez, C.A., A. Bonneville, H. Shao, S. Kabilan, D.J. Heldebrant, D. Hoyt, T. Varga, L. Zhong, W. Um, and **K.C. Carroll** (2015) Stimuli-Responsive Rheoreversible Fracturing Fluids for Unconventional Oil and Gas Extraction. #399581, *2015 AIChE Spring Meeting*, April 26-30, Austin, TX.
36. Bonneville, A., H.B. Jung, H. Shao, S. Kabilan, W. Um, **K.C. Carroll**, T. Varga, N. Suresh, S. Stephens, and C.A. Fernandez (2014) Stimuli Responsive/Rheoreversible Hydraulic Fracturing Fluids for Enhanced Geothermal Energy Production. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H43A-0934.
37. Brusseau, M.L., J. Mainhagu, C.N. Morrison, and **K.C. Carroll** (2014) Application of the Vapor-phase Multi-stage CMD Test to Characterize Contaminant Mass Discharge Associated with Volatile Organic Contaminant Sources in the Vadose Zone. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H51A-0562.
38. **Carroll, K.C.**, A.L. Ulery, B. Chamberlin, and A. Dettmer (2014) Interactive, Online, Adsorption Lab to Support Discovery of the Scientific Process. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract ED53B-3483.
39. Mateas, D. J., G.R. Tick, and **K.C. Carroll** (2014) Novel, In-situ NAPL Modification Technique for Persistent Source Zone Control and Remediation. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H51A-0566.
40. Khan, N.A., F. O. Holguin, P. Xu, M.A. Engle, B. Dungan, B. Hunter, and **K.C. Carroll** (2014) Geochemical Variability and the Potential for Beneficial Use of Waste Water Coproduced with Oil from Permian Basin of the Southwest USA. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H11D-0902.

41. Padgett, M., G.R. Tick, and **K.C. Carroll** (2014) Rate Limited Diffusion and Dissolution of Multicomponent Nonaqueous Phase Liquids (NAPLs) and Effects on Mass Discharge in Groundwater. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H51A-0565.
42. Dettmer, A., S. Cruz, B. Dungan, F.O. Holguin, A.L. Ulery, B. Hunter, and **K.C. Carroll** (2014) Natural Oxidant Demand Variability, Potential Controls, and Implications for in Situ, Oxidation-Based Remediation of Contaminated Groundwater. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H51A-0569.
43. Khan, N.A. , F. O. Holguin , P. Xu , and **K.C. Carroll** (2014) Oil Production Waste Water Geochemical Variability from Permian Basin of the Southwest USA. *NM WRRRI's 59th Annual New Mexico Water Conference*, New Mexico's Water Future: Connecting Stakeholder Needs to Water Information, Nov. 18-19, Santa Fe, NM.
44. **Carroll, K.C.**, S. Willman, S. Timmons, M. Ely, N. Myers, and M. Johnson (2014) Assessment of spatiotemporal groundwater level changes throughout New Mexico. *NM WRRRI's 59th Annual New Mexico Water Conference*, New Mexico's Water Future: Connecting Stakeholder Needs to Water Information, Nov. 18-19, Santa Fe, NM.
45. Dettmer, A., S. Cruz, B. Dungan, F.O. Holguin, A.L. Ulery, B. Hunter, and **K.C. Carroll** (2014) Natural Oxidant Demand Variability, Potential Controls, and Implications for in Situ, Oxidation-Based Remediation of Contaminated Groundwater. *NM WRRRI's 59th Annual New Mexico Water Conference*, New Mexico's Water Future: Connecting Stakeholder Needs to Water Information, Nov. 18-19, Santa Fe, NM.
46. Engle, M.A., M. Varonka, W.H. Orem, P. Xu, and **K.C. Carroll** (2014) Geochemistry and origin of produced waters from the Permian Basin, Texas and New Mexico. *Geological Society of America Abstracts with Programs, Annual Meeting*.
47. **Carroll, K.C.**, K. McDonald, M.L. Brusseau, and J. Marble (2013) The Impact of Immiscible Displacement and Fluid Configuration on Pore-Scale Two and Three-Phase Distribution in Porous Media Systems. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H34E-06.
48. Scheibe, T.D., E.M. Murphy, C. Xingyuan, A. Rice, **K.C. Carroll**, B.J. Palmer, A.M. Tartakovsky, I. Battiato, and B.D. Wood (2013) Multiscale Hydrogeologic Modeling with Emphasis on Hybrid Multiscale Methods. ***Invited Presentation:*** *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H24A-05.
49. Jung, H., S. Kabilan, J. Carson, A. Kuprat, W. Um, A. Bonneville, C. Fernandez, and **K.C. Carroll** (2013) Coupled X-ray Microtomography Imaging and Computational Fluid Dynamics Modeling for Evaluation of Wellbore Cement Fracture Evolution. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H12C-03.
50. Matthieu, D.E., M.L. Brusseau, **K.C. Carroll**, M. Plaschke, and F. Brinker (2013) Persistence of a Groundwater Contaminant Plume after Hydraulic Source Containment at a Chlorinated-Solvent Contaminated Site. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H41H-1346.
51. Oostrom, M., M. Truex, **K.C. Carroll**, A.K. Rice, D. Becker, and M.A. Simon (2013) A Framework for Estimating Groundwater Concentrations of VOCs Emanating from a Vadose Zone Source. ***Invited Presentation:*** *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H34D-05.
52. Marble, J., **K.C. Carroll**, M.L. Brusseau, M. Plaschke, and F. Brinker (2013) Development of a Persistent Reactive Treatment Zone for Containment of Sources Located in Lower-Permeability Strata. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H41H-1348.

53. Grover, K., S. Singla, S. Angadi, O. Holguin, and **K.C. Carroll** (2013) Evaluating Guar for its Adaptability in New Mexico. ASA-CSSA-SSSA Meeting, Tampa, FL, Nov. 3-7.
54. Truex, M.J., M. Oostrom, **K.C. Carroll**, A.L. Bunn, and D.M. Wellman (2013) Integrated Systems-Based Approach to Monitoring Environmental Remediation. *ASME INTERNATIONAL CONFERENCE ON ENVIRONMENTAL REMEDIATION AND RADIOACTIVE WASTE MANAGEMENT*, Brussels, September, 9.
55. Truex, M., **K.C. Carroll**, M. Oostrom, and D.M. Wellman (2013) Evaluating Monitored Natural Attenuation for Inorganic Contaminants in the Vadose Zone. *Bioremediation and Sustainable Environmental Technologies, Battelle Conference*, Jacksonville, FL, June 10.
56. Truex, M., **K.C. Carroll**, M. Oostrom, A. Rice, C. Johnson, and D. Becker (2013) Performance Evaluation and Selection of Shutdown Criteria for Soil Vapor Extraction. *REMTEC Conference*, CO, March 5.
57. **Carroll, K.C.**, M. Truex, M.L. Brusseau, K. Parker, R. Mackley, and V.J. Rohay (2012) Characterization of Persistent Volatile Contaminant Sources in the Vadose Zone. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H43E-1413.
58. Brusseau, M.L., D.E. Matthieu III, **K.C. Carroll**, J. Mainhagu, C. Morrison, A. McMillan, A.
59. Russo, M. Plaschke (2012) Contaminant Mass Discharge and Mass Removal Behavior for a DNAPL Field Site. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H43E-1412.
60. Murray, C.J., **K.C. Carroll**, B.N. Nguyen, M.C. Richmond (2012) Comparison of Three Levels of Constitutive Coupling for Hydro-Geomechanical Evaluation of CO₂ Leakage to Support Risk Assessment. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H23D-1392.
61. Fang, Y., B.N., Nguyen, **K.C. Carroll**, Z. Xu, S.B. Yabusaki (2012) Coupled Multiphase Flow and Geomechanical Capability for Carbon Sequestration. *11th Annual Conference on Carbon Capture Utilization & Sequestration*, Pittsburgh, PA, April 30.
62. Nguyen, B.N., **K.C. Carroll**, C.J. Murray, M.I. McKinley, M.C. Richmond (2012) Effects of Fault Width and Inclination on Fault Reactivation Induced by Underground Injection of CO₂. *11th Annual Conference on Carbon Capture Utilization & Sequestration*, Pittsburgh, PA, April 30.
63. Scheibe, T.D., E.M. Murphy, A.M. Tartakovsky, A.K. Rice, R. Ramanathan, X. Chen, **K.C. Carroll**, and I. Battiato (2012) MAP: An Analysis Platform for Multiscale Hydrogeologic Modeling with Emphasis on Hybrid Multiscale Methods. *XIX Computational Methods in Water Resources (CMWR2012) Conference*, Urbana, Illinois, June 17-21.
64. Miao, Z., **K.C. Carroll**, C. Carreon, M.L. Brusseau (2011) Application of Biostimulation for Remediation of Sulfate-Contaminated Groundwater at a Mining Site. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H21A-1046.
65. Morrison, C., J. Mainhagu, M.L. Brusseau, M. Truex, M. Oostrom, **K.C. Carroll** (2011) Characterizing Vapor Fluxes for Organic-Liquid Sources in the Vadose Zone. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H41A-1003.
66. McCray, J.E., G.R. Tick, **K.C. Carroll**, T.B. Boving, G.R. Johnson, M.L. Brusseau (2011) Future directions for the remediation of sites contaminated by Nonaqueous Phase Liquids. ***Invited Presentation:*** *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H31H-01.
67. McMillan, A.L., A.K. Borden, M.L. Brusseau, **K.C. Carroll**, N.H. Akyol, J.L. Berkompas, Z. Miao, F. Jordan, G.R. Tick, J. Waugh, E.P. Glenn (2011) Long-term Effects of Ethanol Addition on Denitrification At The Uranium Mill Tailing Site In Monument Valley, Arizona. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H21A-1057.
68. Brusseau, M.L., **K.C. Carroll**, T. Allen, J. Baker, W. DiGuseppi, J. Hatton, C. Morrison, A.

- Russo, and J. Berkompas (2011) Impact of In Situ Chemical Oxidation on Contaminant Mass Discharge: Linking Source-Zone and Plume-Scale Characterizations of Remediation Performance. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H41A-1015.
69. **Carroll, K.C.**, B.N. Nguyen, M. Richmond, and C. Murray (2011) Coupling of STOMP and ABAQUS for Hydro-Geomechanical Modeling of Fluid Flow and Rock Deformation Associated with CO₂ Injection. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H51G-1271.
70. **Carroll, K.C.**, M. Oostrom, M. Truex, V.J. Rohay, and M.L. Brusseau (2011) Assessing Performance and Closure for Soil Vapor Extraction: Integrating Vapor Discharge and Impact to Groundwater Quality. *Partners in Environ. Technology Technical Symposium & Workshop*, November 29-December 1, Washington D.C.
71. Brusseau, M.L., **K.C. Carroll**, T. Allen, J. Baker, W. DiGuseppi, J. Hatton, C. Morrison, A. Russo, and J. Berkompas (2011) Impact of In Situ Chemical Oxidation on Contaminant Mass Discharge: Linking Source-Zone and Plume-Scale Characterizations of Remediation Performance. *Partners in Environ. Technology Technical Symposium & Workshop*, November 29-December 1, Washington D.C.
72. Oostrom, M., M.J. Truex, **K.C. Carroll**, T.W. Wietsma (2011) Behavior of volatile organic mass flux emanating from persistent vadose zone sources. *American Chemical Society National Meeting*, 08/29/2011, Denver, C).
73. **Carroll, K.C.**, M. Truex, V.J. Rohay, M.L. Brusseau, and M. Oostrom (2010) Evaluating Soil Vapor Extraction Remediation Closure Criteria and Vadose Zone Source-Strength Distribution at the DOE Hanford 216-Z-9 Site. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H41A-1070.
74. Brusseau, M.L., M. Truex, J. Mainhagu, C. Morrison, M. Oostrom, **K.C. Carroll**, and T.-C.J. Yeh (2010) Characterizing Organic-Liquid Sources in the Vadose Zone. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract H41A-1073.
75. Borden, A.K., **K.C. Carroll**, N. Hakan Akyol, J. Berkompas, Z. Miao, J. Waugh, E.P. Glenn, and M.L. Brusseau (2010) Pilot Tests of Enhanced Denitrification Using Ethanol. *American Geophysical Union Fall Meeting*, Fall Meet. Suppl., Abstract B51C-0380.
76. Brusseau, M.L., **K.C. Carroll**, and W. DiGuseppi (2010) Assessing the Impact of In-situ Chemical Oxidation on Source-zone Mass Discharge for a Chlorinated-solvent Contaminated Field Site. *Partners in Environ. Technology Technical Symposium & Workshop*, November 30-December 2, Washington D.C.
77. Brusseau, M.L., M. Truex, J. Mainhagu, C. Morrison, M. Oostrom, **K.C. Carroll**, and T.-C.J. Yeh (2010) Characterizing Organic-Liquid Sources in the Vadose Zone. *Partners in Environ. Technology Technical Symposium & Workshop*, November 30-December 2, Washington D.C.
78. Marble, J.C., **K.C. Carroll**, H. Janousek, and M.L. Brusseau (2009) In Situ Oxidation and Associated Mass-Flux Reduction/Mass-Removal Behavior for Idealized Source Zones with Poorly-Accessible Organic Immiscible Liquid. *Geological Society of America Abstracts with Programs, Annual Meeting*, Portland, Oct. 18–21.
79. Borden, A.K., J. Berkompas, Z. Miao, **K.C. Carroll**, E.P. Glenn, J. Waugh, and M.L. Brusseau (2009) Pilot Tests of Enhanced Denitrification Using Ethanol. *Geological Society of America Abstracts with Programs, Annual Meeting*, Portland, Oct. 18–21.
80. **Carroll, K.C.**, A.E. Russo, and M.L. Brusseau (2009) The Impact of Immiscible Displacement and Trapped Air on Pore-Scale Fluid Configuration for Three-Phase Systems. *Geological Society of America Abstracts with Programs, Annual Meeting*, Portland, Oct. 18–21.

81. Marble, J.C., **K.C. Carroll**, H. Janousek, and M.L. Brusseau (2009) In Situ Oxidation and Associated Mass-Flux Reduction/Mass-Removal Behavior for Idealized Source Zones with Poorly-Accessible Organic Immiscible Liquid. *Partners in Environ. Technology Technical Symposium & Workshop*, Dec. 1-3, Washington D.C.
82. **Carroll, K.C.**, F.L. Jordan, E.P. Glenn, J. Waugh, and M.L. Brusseau (2009) Nitrate Attenuation Characterization Methods for Groundwater Remediation in Monument Valley, Arizona. *NGWA 2009 Ground Water Summit*, Tucson, Arizona, April 19-23.
83. DiFilippo, E.L., **K.C. Carroll**, and M.L. Brusseau (2008) Impact of Source-Zone Architecture and Flow Field Heterogeneity on Reductions in Mass Flux. *Eos Trans. American Geophysical Union Fall Meeting*, 89(53), Fall Meet. Suppl., Abstract H31D-0890.
84. **Carroll, K.C.**, F.L. Jordan, E.P. Glenn, J. Waugh, and M.L. Brusseau (2008) Comparison of Nitrate Attenuation Characterization Methods for Groundwater Remediation. *Eos Trans. American Geophysical Union Fall Meeting*, 89(53), Fall Meet. Suppl., Abstract H33G-1103.
85. DiFilippo, E.L., **K.C. Carroll**, and M.L. Brusseau (2008) Impact of Source-Zone Architecture and Flow Field Heterogeneity on Reductions in Mass Flux. *Partners in Environ. Technology Technical Symposium & Workshop*, Dec. 2-4, Washington D.C.
86. Jordan, F.L., J. Waugh, E.P. Glenn, M.L. Brusseau, and **Carroll, K.C.** (2008) A Plant-Based Approach to Remediating a Nitrate-Contaminated Soil/aquifer System IN a Desert Environment. *2008 Joint Meeting of The Geological Society of America, Soil Science Society of America, American Society of Agronomy, Crop Science Society of America, Gulf Coast Association of Geological Societies with the Gulf Coast Section of SEPM*, Houston, Texas, Oct. 5-9.
87. Johnson, B., and **K.C. Carroll** (2005) Waste Rock Backfill of Open Pits in Nevada: Design, Optimization, and Modeling Considerations. *Heap Leach and Waste Rock Facility Closure Workshop*, Reno, Nevada, June 21 and 22.
88. **Carroll, K.C.**, M.L. Brusseau, Taylor, R., and Gray, E. (2003) Compositional Effects on the Physical Properties and Partitioning Behavior of a Diesel-PCE Nonaqueous Phase Liquid Mixture. *NGWA Southwest FOCUS Conference: Water Supply and Emerging Contaminants*, Phoenix, AZ.
89. **Carroll, K.C.**, and M.L. Brusseau (2001) Ideality and Dissolution Dynamics of Multicomponent NAPL in Groundwater Systems. *Eos Trans. American Geophysical Union Fall Meeting*, 82, Fall Meet. Suppl., Abstract H12B-0279.
90. **Carroll, K.C.**, and D.L. López (1998) Modeling solute transport in acid mine drainage: The Esco No. 40 Mine, Hocking County, Ohio. *Geological Society of America Abstracts with Programs, North-Central Meeting*, Columbus, Ohio, Vol. 82/11.
91. **Carroll, K.C.** (1998) Reactive Solute Transport Modeling of the Acid Mine Drainage Contamination in the Snow Fork of the Monday Creek Watershed. *American Association of Petroleum Geologists Bulletin*, Vol. 82(11).

(e) Speeches and talks, other than those listed above, related to research activities

92. **Carroll, K.C.** (2017) Reactors in the Rocks: A Couple of Chemical Engineering Applications in the Subsurface. ***Invited Presentation:*** New Mexico State University Chemical Engineering Department Seminar, September 1.
93. **Carroll, K.C.** (2017) Brackish Water Panel Discussion and Presentation on Potential Impacts. ***Invited Presentation:*** *NM WRRRI's 62nd Annual New Mexico Water Conference*, Hidden Realities of New Water Opportunities, Aug. 15-16, Socorro, NM.

94. **Carroll, K.C.** (2017) Water & Energy at the Nexus of Hydrology & Environmental Engineering. **Invited Presentation:** *Arizona State University Environmental Engineering Department Seminar*, March 1.
95. **Carroll, K.C.** (2017) Subsurface Contaminant In-Situ Chemical Oxidation: Coupling of Hydrogeology and Geochemistry. **Invited Presentation:** *San Diego State University Geology Department Seminar*, Jan. 19.
96. **Carroll, K.C.** (2016) Flexible Subsurface Science: Pore-Scale Imaging of Two & Three-Phase Immiscible-Fluid Transitions and Switchable Fluids for Hydraulic Fracturing in Geothermal Systems. **Invited Presentation:** *Plant & Environmental Science Dept. Seminar at NMSU*, May 6.
97. **Carroll, K.C.** (2016) Flexible Subsurface Science: Pore-Scale Imaging of Two & Three-Phase Immiscible-Fluid Transitions and Switchable Fluids for Hydraulic Fracturing in Geothermal Systems. **Invited Presentation:** *Dept. of Geoscience Seminar at NMSU*, March 30.
98. **Carroll, K.C.** (2015) What is in your water? Environmental Science and Engineering Grand Challenges. **Invited Presentation:** *The New Mexico Alliance for Minority Participation (NM AMP) 2015 Student Research Conference, Las Cruces Convention Center*, October 2.
99. **Carroll, K.C.** (2015) Flexible Subsurface Science: Pore-Scale Imaging of Two & Three-Phase Immiscible-Fluid Transitions and Switchable Fluids for Hydraulic Fracturing in Geothermal Systems. **Invited Presentation:** *the EES/IGPP Frontiers of Geoscience Colloquium at Los Alamos National Laboratory*, May 18.
100. **Carroll, K.C.** (2014) Restoring and Preserving Our Water Resources for Future Generations. **Invited Presentation:** *the Science Cafe, Las Cruces Museum of Nature and Science*, Dec. 4.
101. **Carroll, K.C.** (2014) Subsurface Contaminant Source Attribution and Remediation Evaluation. **Invited Presentation:** *Geological Sciences Department Seminar, Univ. of Texas El Paso*, Nov. 20.
102. **Carroll, K.C.** and P. Xu (2014) Quantifying Potential Environmental Impacts and Water Treatment Requirements for Wastewater Produced in Oil & Gas Operations. **Invited Presentation:** *Congresswoman Michelle Lujan Grisham's Water Innovation Summit Tackling Our Water Resource Challenges by Utilizing Cutting-Edge Technologies and Innovation*, Oct. 14, University of New Mexico, Albuquerque, NM.
103. **Carroll, K.C.** (2013) Mass-Flux Source Attribution and Application to Subsurface Contaminant Remediation Evaluation. **Invited Presentation:** *the Earth and Environmental Science Department Seminar, New Mexico Tech*, March 3.
104. **Carroll, K.C.** (2013) Mass-Flux Source Attribution and Application to Subsurface Contaminant Remediation Evaluation. **Invited Presentation:** *the Earth & Planetary Sciences Department Seminar, University of New Mexico*, Jan. 31.
105. **Carroll, K.C.** (2013) Mass-Flux Source Attribution and Application to Subsurface Contaminant Remediation Evaluation. **Invited Presentation:** *the Plant & Environmental Sciences Department Seminar, NMSU*, Aug. 30.
106. **Carroll, K.C.** (2013) Mass-Flux Source Attribution and Application to Subsurface Contaminant Remediation Evaluation. **Invited Presentation:** *the School of Mathematical and Natural Sciences at Arizona State University, Phoenix, AZ*, Aug. 29.
107. **Carroll, K.C.** (2012) Recent Developments for Groundwater Remediation Using In Situ Chemical Oxidation (ISCO). **Invited Presentation:** *the Tucson International Airport Area Superfund Site Annual Technical Exchange Meeting, Tucson, AZ*, October, 15.
108. **Carroll, K.C.** (2012) Subsurface Mass-Flux Investigations of Coupled Flow and Transport, Source Attribution, and Contaminant-Remediation Evaluation. **Invited Presentation:** *the Geological Sciences Department at University of Alabama, Tuscaloosa, AL*, Jan. 18.

109. **Carroll, K.C.**, M. Truex, M. Oostrom, M.L. Brusseau, and V.J. Rohay (2011) Remediation Quantification and Endpoint Analysis Framework for Soil Vapor Extraction. *PNNL Scientist and Engineer Development Program: 2012 Poster Presentation Session*, May 11, Richland, WA.
110. Z. Miao, C. Carreón-Diazconti, **K.C. Carroll**, A. McMillan, H. Akyol, and M.L. Brusseau (2011) Characterizing Sulfate Sources and Enhanced Reduction at a Mine Site. *El Dia Del Agua 21st Annual Symposium*, Hydrology and Water Resources Department, UA, March 30.
111. Matthieu, D.E., **K.C. Carroll**, M. Plaschke, and M.L. Brusseau (2010) Field-Scale Characterization of a Chlorinated Solvent Superfund Site in Tucson, Arizona. *WSP Water Forum 2010: Our Water Future*, November 22, Tucson, AZ.
112. **Carroll, K.C.** (2009) Multi-Scale Investigation Approaches with Relevance to Enhanced Oil Recovery and Hydrology Problems. **Invited Presentation:** *the Exxon Mobil Upstream Research Corp.*, Houston, TX, Nov. 24.
113. **Carroll, K.C.** (2009) Multicomponent NAPL Dissolution, Source-Zone Architecture, and Mass Flux Impacts on Groundwater Remediation. **Invited Presentation:** *the Geological Engineering Department at Montana Tech*, Butte, MT, April 29.
114. **Carroll, K.C.** (2009) The Multicomponent NAPL Problem: To Remediate or Not to Remediate? That is the Question. **Invited Presentation:** *the Geological Sciences Department at California State University*, Los Angeles, CA, Feb. 26.
115. **Carroll, K.C.** (2009) The Multicomponent NAPL Problem: To Remediate or Not to Remediate? That is the Question. **Invited Presentation:** *the Evergreen State College*, Olympia, WA, Jan. 27.
116. **Carroll, K.C.** (2008) Characterization and Remediation of Multicomponent Nonaqueous Phase Liquids in Porous Media. **Invited Presentation:** *the U.S. Geological Survey*, Reston, VA, Dec. 5.
117. **Carroll, K.C.** (2005) Waste Rock Backfill of Open Pits: Design, Optimization, and Modeling Considerations. **Invited Presentation:** *Proseminar/Graduate Seminar*, Department of Mining and Geologic Engineering, UA, Sept. 30.
118. **Carroll, K.C.**, and M.L. Brusseau (2004) Multicomponent NAPL Dissolution and Solubility Enhancement for Groundwater Remediation Systems. *El Dia Del Agua 14th Annual Symposium*, Hydrology and Water Resources Department, UA, March 3.
119. **Carroll, K.C.**, M.L. Brusseau, R. Taylor, and E. Gray (2002) Characterizing the Physical Properties and Partitioning Behavior of a Diesel-PCE Nonaqueous Phase Liquid Mixture. *Superfund Basic Research Program 2002 Annual Meeting*, Tucson, AZ.

(f) Invited grant-review panels, task forces, etc.

Invited as reviewer of scientific research grant proposals:

- The Research Partnership to Secure Energy for America or RPSEA, 6 proposals (2013)
- The American Chemical Society Petroleum Research Fund (2015)
- DOE User Facility EMSL Terrestrial & Subsurface Ecosystems Proposals (2015)
- NSF CBET (Environmental Engineering) CAREER Program Proposals, 11 proposals (2015)
- NIWR-USGS National Competitive Grants Program (2016)
- NSF Hydrology CAREER Program Proposals (2 proposals; 2016)

C) Teaching scholarship and creative activities

1) Narrative Teaching Philosophy and Program Goals:

As an educator and a researcher, there is a natural interest for the overlap of these two roles and responsibilities. I am working with Dr. April Ulery to develop a research program in the area of teaching and education. I am very interested in self-improvement as a teacher, and I would hope to develop research to support teaching. I believe that teaching and research programs support each other, and I believe excellence in both areas can be enhanced by teaching research methods and conducting research focused on teaching methods.

2) Evidence of teaching scholarship:

(a) Books and manuals

Tian-Chyi J. Yeh, Raz Khaleel, and **K.C. Carroll** (2015) FLOW THROUGH HETEROGENEOUS GEOLOGICAL MEDIA, *Cambridge University Press*. ISBN: 9781107076136.

3) Possible areas of teaching scholarship:

(b) Developing and testing educational materials

2013 – Carroll, K.C. (as PI), April Ulery, and Barbara Chamberlin “Interactive, Online, Labs to Support Discovery of the Scientific Process” from NMSU Allocation of President’s Performance Fund (\$15,000/year for 3 years).

IV) TEACHING AND ADVISING FOR THE PERIOD UNDER REVIEW

A) Narrative of Teaching and Advising Responsibilities, Philosophy, and Impacts

My goal is to support New Mexico State, the Department of Plant & Environmental Sciences, the Water Science and Management (WSM) Program, the College of Agricultural, Consumer and Environmental Sciences, and the NMSU in contributing to the economic development and improving the quality of life of citizens through public education. I am supporting the Environmental and Soil Science focus areas of the Department, and my teaching interests cover a broad range of areas that pertain to the coupling of hydrobiogeochemical processes that mediate transport and exchange of water and chemicals within and between the hydrosphere, lithosphere, and biosphere. I also support the new interdisciplinary WSM graduate program at NMSU, which aims to provide graduate education for addressing state, national, and international water issues, and to train professionals needed to meet the challenges of water resource supply, development, quality, management, and administration.

My primary goal as a teacher is to help students learn to think logically and critically, cultivate problem-solving skills, and develop, in general, as scientists. I strongly feel that my goal as an educator is to train students to become critical-thinking scientists, which enables students to learn independently throughout their careers. I help them **build critical-thinking skills** through problem-solving and critical-review assignments of their own and published works. My curriculum applies the **scientific method** for design and evaluation of laboratory and classroom investigations, because it formalizes the critical evaluation of our observations and theories. I have also found that students develop greater understanding in courses where they participate in application of new knowledge (related to the real world), especially through laboratory and field exercises. If students can relate to the information presented in the class, they take ownership of it, long-term retention is increased, and they can more easily apply their knowledge to new problems.

B) Evidence of teaching and advising

1) Teaching responsibility:

(a) General instruction area

Geohydrology and Land Use Environmental Impacts and Contamination Remediation are part of the core required classes for the Environmental Science Degree, and they are both undergraduate and graduate classes that are cross listed to support the Department and WSM. The Arid Land Water Resources Issues Seminar meets the seminar requirements for both MS and Ph.D. students. My courses are the first courses developed to support the WSM graduate program.

(b) Nature of courses taught (e.g., service type vs. for majors)

The nature of the courses I teach are focused on upper level science with an interdisciplinary approach. Similar to my research interests, my teaching style is fundamentally multidisciplinary. Using a variety of real-life examples, I illustrate interconnections between different courses and scientific fields. I have found the integration of information and techniques from several scientific fields is required for developing a solid understanding of our natural environment, and in my experience a multidisciplinary teaching approach allows students to grasp interconnections and their importance to course content. The Environmental Science and Soil Science areas are generally interdisciplinary in nature. Also, the goal of the WSM program is to be interdisciplinary, because it supports several Departments from the Colleges of Agriculture, Engineering, and Art & Sciences. All of my courses are cross listed where appropriate.

1) Geohydrology – 452 (every fall)

Level: Undergraduate/Graduate (ES/WSM/CE/GEOL) 4 credit (3 lecture and 1 lab)

Overview: This course aims to develop a thorough understanding of groundwater hydrogeology through the lecture and laboratory, which includes experimental methods as well as analytical and numerical models. The focus is on the application of hydrogeology for water resources. It covers groundwater resource assessment, impact analysis, aquifer test analysis, monitoring/characterization, dewatering, aquifer storage and recovery, and resource management. Additionally, case studies illustrate the use of groundwater flow models for **various hydrogeologic applications**, and the course introduces the most widely used modeling software packages.

Objective: The primary objective of this course is for students to become familiar with groundwater hydrology issues, problems, and analysis methods. Another objective is for students to learn critical thinking, problem solving, and reporting skills. The students will learn to apply theories through modeling assignments in the laboratory section.

2) Arid Land Water Resources Issues Seminar – 605 (every spring)

Level: Graduate (WSM/ES) 3 credit

Overview: The course covers various issues of relevance to water resources and water supply management within the Southwest US and other semiarid and arid regions. Discussions may include development and sustainability, climate change and drought, socioeconomic and cultural, and transboundary issues. Student input is encouraged to define discussion topics, which may also mirror student's research areas. They learn how to conduct **critiques, literature reviews, and proposals**.

Objective: The primary objective of this seminar is for students to become familiar with current issues and problems facing water supply sustainability in arid regions. Another objective is for students to learn research, problem solving, teaming, interpersonal communication, presentation, and reporting skills. The students contribute to critical reviews, discussions, literature reviews, discussions, and presentations.

Also, the results of their research project are reported in a journal style paper or research proposal they can use as a start on their thesis or dissertation.

3) *Land Use Environmental Impacts and Contamination Remediation– 470 (every spring)*

Level: Undergraduate/Graduate (ES/WSM) 3 credit

Overview: This course covers the environmental impact of land use, transport, and fate of contaminants, and remediation of soil and groundwater. It focuses on physical/biological/chemical processes that influence the behavior of natural and anthropogenic contaminants in land and water environments, and it also examines both equilibrium and kinetic evaluation of partitioning and mass-transfer processes. We cover soil erosion, environmental impact statements, and environmental site assessment studies. We discuss the many factors and processes influencing contaminant transport, and an emphasis is placed on the conceptual and mathematical models used to describe these transport processes. Case studies illustrate processes under various environmental applications. This course also covers the application methods for the remediation of contaminated soil and groundwater. Characterization and monitoring of contaminated sites is examined, and discussions of innovative methodologies are supported with case studies. This course is split as half lecture and half in-class lab activities, and the term paper/project requires students to evaluate and design a remediation approach for a site **Remedial Investigation/ Feasibility Study** that integrates aspects from prior Environmental Science courses.

Objective: The primary objective of this course is for students to become familiar solute transport and contamination remediation issues, problems, and analysis methods. Another objective is for students to learn critical thinking, problem solving, and reporting skills. In class lab assignments, homework, paper reviews, and discussions illustrate and reinforce the application of theories presented in class.

4) *Master’s Thesis Research* (ES/WSM 599), and ***Doctoral Dissertation*** (WSM/ES 700) are only offered to majors in this department. The focus of these is typically directed research required to complete a thesis or dissertation. I typically meet and work with students to advise them on their research. I discuss and direct research activities, review data, and review/edit student writing.

(c) *Special instructional aids and facilities used*

In all of my classes, I try to develop problem solving and critical thinking through assignments and discussions. These problem solving activities also create active learning as a focus of the curriculum. I teach the scientific method in each of my courses. The students apply course content to real-world applications and participate in the application. I also use Canvas (online social media for courses) to interact with students and assess their individual and group progress.

In the summer of 2013, I attended a workshop on “Teaching Hydrogeology, Soils, and Low-T Geochemistry in the 21st Century” in Albuquerque, NM, which gave me several techniques that I have implemented in my courses including interactive group learning, visual aids, and various methods to introduce math concepts with physical processes. I use frequent assessment tools to evaluate my teaching and student learning each week, I typically ask the students to conduct a mid-semester review, and I also typically ask a colleague to review my teaching. I use many methods (e.g., quizzes, homework, reports, and discussions) for formative assessment of learning prior to substantive assessment including exams.

Since 2013, I have been improving my teaching, and my student evaluations have significantly improved. I include activities and discussions within slides to break up lectures, and I have decreased the amount of lecturing to increase discussion and group-work time. I continually communicate the applicability of, and why they should care about, each aspect of the course content. I have turned weekly

quizzes into discussions, and I try to use more time for solving problems at the board. When appropriate, field trips (e.g., groundwater well drilling site) are also used to support instruction.

1) *Geohydrology* –

This course couples lecture and laboratory to balance instruction with active learning. Within the lecture, I break up the instruction with problem solving and discussions. I use group study for both. For the instruction, I try to use graphics or physical props to engage and generate interest. For example:

- Group project on characterization of rock samples (used jigsaw technique from workshop). I tried to bring in visual aids (e.g., water level sounder) to engage students.
- Used short answer writing in weekly quizzes to reinforce and assess learning of lecture concepts, graded/gave correct answers, and used quiz questions on exams to repeat/reinforce key process concepts. After individual quiz time, groups discuss their quiz answers to reinforce learning.
- Added in-class contouring and water quality analysis projects, and use projector to illustrate problem solution step-by-step. I use similar problem solving for hydraulic test curve matching. Then I use the computer projector for step-by-step solution of same hydraulic test solution using computer software.
- I use small group labs to encourage team work and discussion for the in class lab projects, but I require each student to submit individual written reports.

2) *Arid Land Water Resources Issues Seminar* –

This class is focused on discussions both in and out of class, which includes the entire class or small groups and target student interests. Library staff support the 1st two classes with a tutorial on library resources, literature database searching, and bibliographic software (e.g., Web of Science & Endnote), which they use for the required research paper. I teach students how to write and submit scientific papers, a thesis/dissertation, and proposals. We discuss presentations and professional development. Guest lectures provide an overview of current water/climate research, and student presentations are required for each student. The assignments include several critical reviews of published papers and a literature-review/proposal term paper and presentation. We discuss the paper critiques in class, and the term paper is designed to be incorporated into the students' theses.

3) *Land Use Environmental Impacts and Contamination Remediation* –

I break up the lecture instruction with problem solving and discussions. This is a ½ **flipped class**. Of the 2 classes per week, one class period is used for lecture, student presentations, or discussions, and the other class period is used for lab project (in-class assignment). Group study is used for both. For the instruction, I try to use graphics or physical props to engage and generate interest. Case studies illustrate processes through real-world applications. Homework calculations and computer modeling (examples using commonly used modeling software), debates over hydraulic fracking and environmental policy, and discussions illustrate and reinforce the application of theories presented in class. I try to actively engage computer and internet use to retain student interest. Upon reviewing a **Remediation Investigation** site characterization report for a hypothetical contaminated site, the term paper assignment requires the students to develop and submit a **Feasibility Study** report, which assesses the feasibility of contamination cleanup through cost/benefit analysis of several alternatives, and reports a recommended remediation design.

4) *Master's Thesis Research* (ES/WSM 599), and *Doctoral Dissertation* (ES/WSM 700)

These generally require special equipment, computer modeling, analytical instruments, field facilities, and intense supervision. Field, lab, and computer modeling work may be required (depending

on the research topic) as well as presentations of research at professional meetings. Research is reported in a thesis or dissertation, which is reviewed by the student's committee and orally defended by the student. Submittal of reported research results for peer-reviewed journal publication is also always encouraged.

(d) Nature of subject matter (e.g., stable, changing, affecting preparation effort required)

For each class, course notes, handouts, and assignments are often updated to incorporate new information and practical examples. I am always trying to add more application and student activity into the classes. I try to incorporate more implications for several different scientific disciplines to illustrate the interdisciplinary nature of the course content, and I also try to add recent research results to illustrate application and update the material. The discussions typically change course content and focus (e.g., Arid Land Water Resources Issues Seminar assignments change every year), and I try to keep the courses up to date with new software for analysis and new technologies for teaching and research.

2) Teaching load:

(a) Percentage of allocation of effort for teaching

My average percentage of allocation of effort for teaching is ~50% (based on a 12 month schedule).

(b) Undergraduate/Graduate courses taught (regular semesters and summer)

Semester	Course #	Title	Credit ¹	Student Number	SCH ²
Fall 2013	452	Geohydrology	3	22	66
Fall 2013	452L	Geohydrology Lab	1	4	4
Spring 2014	470	Environmental Impact & Contaminant Remediation	3	13	39
Fall 2014	452	Geohydrology	4	27	108
Spring 2015	470	Environmental Impact & Contaminant Remediation	3	6	18
Fall 2015	452	Geohydrology	4	32	128
Spring 2016	470	Environmental Impact & Contaminant Remediation	3	14	42
Fall 2016	452	Geohydrology	4	27	108
Spring 2017	470	Environmental Impact & Contaminant Remediation	3	4	12
Fall 2017	452	Geohydrology	4	27	108
Total			32	176	633

¹ Number of course credits.

² Student credit hours produced.

(c) Graduate-only courses taught

Semester	Course #	Title	Credit ¹	Student Number	SCH ²
Spring 2014	605	Arid Water Resources Seminar	3	11	33
Spring 2015	605	Arid Water Resources Seminar	3	10	30
Spring 2016	605	Arid Water Resources Seminar	3	12	36
Spring 2017	605	Arid Water Resources Seminar	3	7	21

Total			12	40	120
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¹ Number of course credits.

² Student credit hours produced.

(d) Number of students per course

	ES-452 Geohydrology	WSAM-605 Arid Water Resources Seminar	ES-470 Environmental Impact & Contaminant Remediation	Semester Sum	Annual Sum
Fall 2013	22	0	0	22	
Spring 2014	0	11	13	24	46
Fall 2014	27	0	0	27	
Spring 2015	0	10	6	16	43
Fall 2015	32	0	0	32	
Spring 2016	0	12	14	26	74
Fall 2016	27	0	0	27	
Spring 2017	0	7	4	11	38
Fall 2017	27	0	0	27	

(e) Number of course credits and student credit hours produced

Course Credits:

	ES-452 Geohydrology	WSAM-605 Arid Water Resources Seminar	ES-470 Environmental Impact & Contaminant Remediation	Semester Sum	Annual Sum
Fall 2013	4	0	0	4	
Spring 2014	0	3	3	6	10
Fall 2014	4	0	0	4	
Spring 2015	0	3	3	6	10
Fall 2015	4	0	0	4	
Spring 2016	0	3	3	6	10
Fall 2016	4	0	0	4	
Spring 2017	0	3	3	6	10
Fall 2017	4	0	0	4	

Student Credit Hours:

	ES-452 Geohydrology	WSAM-605 Arid Water Resources Seminar	ES-470 Environmental Impact & Contaminant Remediation	Semester Sum	Annual Sum
Fall 2013	66	0	0	66	
Spring 2014	0	33	39	72	138
Fall 2014	108	0	0	108	
Spring 2015	0	30	18	48	156

Fall 2015	128	0	0	128	
Spring 2016	0	36	42	78	206
Fall 2016	108	0	0	108	
Spring 2017	0	21	12	33	141
Fall 2017	108	0	0	108	

3) Teaching performance:

(a) Peer evaluations

Dr. April Ulery observed and reviewed my teaching (Geohydrology) in Fall 2013. She shared her feedback with me with some suggestions for improvement, and she shared a letter documenting the review with some suggestions (Appendix). Some of her comments included: “In my opinion, the slides were well-designed and helpful, but unfortunately, were not completely visible to the entire class since the screen was too low and seating arrangements made it hard to see around other students. Dr. Carroll has excellent poise in the classroom with good vocal pitch and pace.” “Overall, his first semester of teaching at NMSU was challenging but the students felt that they learned a lot and the mid-semester evaluation was particularly valuable for Dr. Carroll. I think that he has a strong connection with the students and they respond to his enthusiasm and genuine concern for them.” I changed rooms and my teaching style in response to her comments and the mid-semester course review by the students.

Dr. Champa Gopalan and Dr. Mary O’Connell observed and reviewed my teaching (Geohydrology) September, 2015. Dr. O’Connell shared a letter documenting the review with some suggestions (Appendix). Some of Dr. O’Connell’s comments included: “There were a number of events going on in the class, but the students all anticipated what would happen so I suspect you were following a well-described plan. They all turned in homework as they walked in; once they were settled you handed out a quiz on the previous lecture. You appear to know all of the students’ names as you were also handing out graded homework while they took the quiz. Working to get names and faces together early in the term is an important skill for an instructor. You move around the classroom and engage all of the students in your presentation. Your voice level and tone are pleasant and dynamic. There were multiple levels of reinforcement for the in-class quiz, first the students answered the questions quietly on their own, then they shared their answers in small groups, and then finally you posted through the classroom projector examples of answers that you generated. I got the impression that your answers were also available through a Canvas link. A few students in the group I observed relied on their colleagues to help them answer the questions. I think that is fine, peer instruction and team learning is a great way to expand the ways a student can learn. You do a great job of linking previously mastered material to the new material in the current lecture. You also let the students know how they would apply the material in the upcoming classes. There were lots of breaks in your slides to have the students apply that material as they calculated “Darcy’s Law” in different settings and different constants for the law. All of the students I saw immediately started to do the calculations and participated fully in the class.”

Dr. Chris Cramer and Dr. Geno Picchioni observed and reviewed my teaching (Arid Land Water Resources Seminar) Spring 2016, and shared letters documenting the review with some suggestions (Appendix). Some of Dr. Cramer’s comments included: “The objectives of the class period were to review the expectations for the course as it related to critiques and reviews of seminal papers chosen by the instructor and student preparation of a class term paper. A portion of the class period was devoted to students introducing themselves and their research projects to the rest of the class. A classroom observation rubric was utilized to evaluate Dr. Carroll’s instruction. The rubric measured teacher organization, teacher strategies for engaging students, pacing of instruction, presentation skills, clarity,

rapport with students, impact upon learning, and content knowledge. For each of these areas, Dr. Carroll excelled at most criteria for each respective area. The class was well organized. Dr. Carroll arrived early to class and was well prepared for class. He used the class time very effective and used multimedia quite effectively in his instruction. His presentation skills were quite effective. He kept the students engaged with the subject material that can be difficult to do for longer class periods. He used a variety of teaching techniques-and facilitated discussion with the students. He proceeded at an appropriate pace and students were given ample time to ask questions that he promptly answered. Dr. Carroll had an excellent rapport with the students even though this class period was only the fourth meeting for the course. Students felt comfortable asking questions and he involved them in shaping the course for the semester. It was clear from this class period that Dr. Carroll wants to develop the critical thinking skills of the students in the course. While the subjects discussed during the class period were not in my content area, I easily understood much of the content delivered. My understanding was mainly due to the instruction manner of Dr. Carroll. He appeared to be knowledgeable in many different subject areas as witnessed by his ability to expand upon the discussion when each student introduced their research project ideas to the class. While he appeared to be knowledgeable in several areas, he was able to convey that knowledge in a way that was understandable by all in the class. In my limited interaction with Dr. Carroll's teaching, I learned several techniques that I will use in my own instruction.”

(b) Student course evaluations

		ES-470 Average (%)	WSM-605 Average (%)	ES-452 Average (%)
1	Apparent knowledge of subject matter.	100%	97%	97%
2	Success in communicating/explaining subject matter.	93%	95%	90%
3	Degree to which subject matter was relevant.	92%	92%	91%
4	Concern and respect for students as individuals.	96%	93%	97%
5	Fairness in assigning grades.	96%	97%	96%
6	Administration of the class.	88%	95%	93%
7	Overall rating of this instructor.	91%	95%	95%

Note: Mean is calculated over all times taught from individual student votes converted to %.

(c) Letters from former students

I have received some written feedback on teaching from students. One of my students, Logan Bridges, wrote a letter (Appendix) nominating me for a teaching award that I did receive, and his comments included: “I have had the pleasure of working under Dr. Carroll since the fall semester of 2015, and I honestly feel lucky to have been chosen by him for this program. I came into NMSU with a bachelor degree in Geology, and Dr. Carroll has helped me with my previous education and experiences to foster a passion for water systems, especially subsurface ones. I am currently in or have taken three classes by Dr. Carroll, and I can tell you that every class he lectures have very similar components in

them. The first is that he requires critical thinking in his class. Issues are covered in his classes that impact not only the students, but the entire communities, and therefore a multi-perspective view is required to reach a solution. Secondly, classes are conducted where they are environments for open discussions, where students from different social and academic backgrounds can collaborate together to evaluate and solve real world problems. Dr. Carroll is helping to prepare students by not only introducing them to the many aspects of hydrology and environmental impacts, but gives them real tools and concepts that are applicable after college. As a teacher and an advisor, Dr. Carroll has been an invaluable asset to the Water Science and Management program, and as an adviser is someone who cares about my learning and my success.”

Another student, Ereik Fuchs, sent a few emails about teaching while taking one of my classes, and his comments included: “Another great lecture that I’m excited to nab from canvas as soon as you post. Thanks for taking the time to add some comments to the quizzes and homework.”

(d) Self-improvement activities related to teaching

- “Getting Our Students to Work in Every Class - From Fast-Paced Formative Feedback Techniques to Facilitating Collaborative Problem Solving in a Flipped Course”; Jan. 30, 2017; NMSU Teaching Academy
- “Metacognition: Helping our students become self-directed learners”; Sept. 22, 2016; NMSU Teaching Academy
- “Active Learning: what is it, how do you implement it and why would you want to?”; Aug. 20, 2016; NMSU Teaching Academy
- In Fall 2015, I met with the ACES College “How Learning Works” book discussion group
- “Team Based Learning in Calculation-Heavy Courses: Lessons Learned”; 8/31/2015; NMSU Teaching Academy
- In Fall 2014, I sat in on Dr. Ulery’s course “Environmental Soil Chemistry” SOIL, CHEM, or GEOL 424/479.
- “Scientific Teaching: The Active Learning Principle”; August 18, 2014; NMSU Teaching Academy
- “Team-Based Learning: Getting Beyond Covering Content: A Key to Motivation and Success”; April 4, 2014; NMSU Teaching Academy
- “10 Easy Ways to Engage Your Students”; Feb. 26, 2014; NMSU Teaching Academy
- OCIP: Magna Online Seminar “How Can I Make My Course Content More Accessible?”; Feb. 26, 2014; NMSU Teaching Academy
- “Documenting Effective Teaching”; September 10, 2013; NMSU Teaching Academy
- On the Cutting Edge - Professional Development for Geoscience Faculty Workshop “Teaching Hydrogeology, Soils, and Low-T Geochemistry in the 21st Century”; June 5-9, 2013, University of New Mexico, Albuquerque, NM;
(<http://serc.carleton.edu/NAGTWorkshops/hydrogeo/HSG2013/index.html>)
- “Flipping Your Classroom: Going beyond the walls of the classroom”; Jeff Utecht; April 4, 2013; NMSU Teaching Academy
- “Introduction to Canvas”; 05/03/2013; NMSU Teaching Academy

4) Professional service to teaching

(a) Development of instructional resources for others

Developed, with Dr. Omar Holguin, a joint Research and Teaching Core Lab as a core teaching facility for NMSU student's to learn chemical analysis and to support research efforts. Several courses

(Instructors Dr. Sims, Dr. Holguin, and Dr. Fernald) have taught classes in the lab. In Fall 2014, I developed and presented a water chemistry modeling demo in Dr. Ulery's course "Environmental Soil Chemistry" SOIL, CHEM, or GEOL 424/479. I have met with Faculty members from the Math Department to develop strategies to support ES student success in calculus. I developed and presented a lecture in an Agriculture Extension Education class for Dr. Carlos Rosencrans to be reused each year.

(b) Assistance to other teachers, researchers and courses

- Guest Lecture on Geology and Water Cycle to classes at Sonoma Elementary School, 2014/2015/2017 (also noted in Community Service Section VI below).
- Shared lab and developed water quality lab exercise for Dr. Fernald's Watershed Class, 2014.
- Guest judge in Omar Holguin's Sampling & Analysis class in Spring, 2015.
- Guest lectured for 3 lectures for Curtis Monger's ES 110 in Spring, 2015.
- Guest lectured for 1 lecture for April Ulery's SOIL 256 in Fall, 2015/2017.
- Guest Lecture on NM groundwater in Carlos Rosencrans' ACES Dept. of Agriculture and Extension Education class Spring, 2016.
- Guest lectured for 1 lecture for Kulbhushan Grover's AGRO 100 in Spring, 2016.
- Guest lectured for 2 lectures for N. Khandan's Env. Engineering 630 Fate & Transport of Environmental Contaminants Fall, 2017.
- Guest lectured for Lin Lu Viewing Wider World Class CE 355V March 29, 2018
- Invited lecture "Multidisciplinary Science & Engineering in the Subsurface" 17th Annual URC Research & Creative Activities Fair April 4, 2018

(c) Committee memberships related to teaching at the departmental, college, university, regional or national levels

- WSM Program Management Committee Member
- Maintain Graduate Faculty Status

5) Special honors/awards for teaching

2016 – Awarded Patricia Christmore Faculty Teaching Award, which is intended to recognize and reward superior junior faculty members for excellence in teaching.

6) Academic advising

(a) Methods used

I try to act as a guide for advisees, but I realize that they are responsible for the success of their program. I look at advising as a collaboration that requires planning and documentation. I try to have weekly meetings, be clear about roles and responsibilities, and manage and track progress throughout the entire mentorship. I typically try to challenge students by asking them a lot of directed questions, and I try to conduct experimental demonstrations or draw diagrams of experiments to help them with experimental design.

(b) Number of undergraduate advisees

- *Undergraduate Research Advisee: 2016–2017* Kaitlin Cordova: *Database Spatial Evaluation of Groundwater Contamination Sites Throughout USA*. Undergraduate Environmental Science Research Advisor, NMSU

- *Undergraduate Research Advisee: 2014–2016* Sativa Cruz: *In Situ Complexation and Facilitated Transport of Oxidants*. Undergraduate Env. Science Research Advisor in the MARC Program, NMSU

2017 – Advised ~4 undergraduate students in Environmental Science

2016 – Advised ~6 undergraduate students in Environmental Science

2015 – Advised 9 undergraduate students in Environmental Science

2014 – Advised 6 undergraduate students in Environmental Science

2013 – Advised 5 undergraduate students in Environmental Science

(c) Number of graduate advisees

Ph.D. Committee Chair:

1. 2016–Present Chia-Hsing (Peter) Tsai: Evaluation of Source Water, Extraction Potential, and Potential Impacts of Using Brackish Water for Desalination in New Mexico. Ph.D. Major Advisor in the WSM Program, NMSU
2. 2015–2018 Naima Khan: 1,4-Dioxane In Situ Chemical Oxidation Using Strong Oxidants. Ph.D. Major Advisor in the WSM Program, NMSU

MS Committee Chair:

1. 2017–Present Chris Kubicki: Groundwater Age Dating for Recharge and Sustainability Assessment. M.S. Major Advisor in the WSM Program, NMSU
2. 2014–Present JR Hennessey: Mass Flux Site Characterization Supporting Remediation of NDMA and TCE in Groundwater. M.S. Major Advisor in the WSM Program, NMSU
3. 2015–2017 Justin Milavec: Trichloroethene and 1,4-Dioxane Contamination Mixture Dissolution and Sorption. M.S. Major Advisor in the WSM Program, NMSU
4. 2015–2017 Logan Bridges: Manganese Oxide Supported Oxidation of 1,4-Dioxane Contamination in Groundwater. M.S. Major Advisor in the WSM Program, NMSU
5. 2014–2016 Steven Maestas: Characterization of the Nature and Extent of the Suspended Particulate Material and Turbidity in Groundwater at the NASA White Sands Test Facility. M.S. Major Advisor in the WSM Program, NMSU
6. 2014–2015 Spencer Willman: Assessment of Spatiotemporal Groundwater Level Changes Throughout New Mexico. M.S. Major Advisor in the WSM Program, NMSU
7. 2013–2015 Naima Khan: Beneficial Use Evaluation for Oil & Gas Produced Water. M.S. Major Advisor in the WSM Program, NMSU
8. 2013–2015 Adam Dettmer: 1,4-Dioxane In Situ Chemical Oxidation and Facilitated Transport. M.S. Major Advisor in the WSM Program, NMSU

Ph.D. Committee Co-Chair:

1. 2017-Present Kaavya Polisetti: Algal Bioremediation of Emerging Contaminants. Ph.D. Co-Advisor (Major Advisor Dr. Holguin) in the PES Program, NMSU
2. 2013–Present Erek Fuchs: Groundwater Investigation, Characterization, and Analysis for an Alternative Irrigation Source for the Middle Rio Grande Agricultural Area. Ph.D. Co-Advisor (Major Advisor Dr. King) in the WSM Program, NMSU

Ph.D. Committee Member:

1. 2017–Present Khandaker Iftekharul Islam: Evaluation of Multiple Geostatistical Methods for Interpolation of Multiple Data Types. Ph.D. Thesis Committee (Major Advisor Dr. Brown) in the WSM Program, NMSU
2. 2017–Present David Amidei: Removal of n-nitrosodimethylamine (NDMA) by adsorption using waste pecan shells through pyrolysis and activation. Ph.D. Thesis Committee (Major Advisor Dr. Paul Andersen) in the Chemical and Materials Engineering Department, NMSU
3. 2016–Present Sarah Sayles: Evaluation of Groundwater Use for Pecan Irrigation Systems in Southern New Mexico. Ph.D. Thesis Committee (Major Advisor Dr. Ward) in the WSM Program, NMSU
4. 2015–Present Jose Juan Cruz Chairez: Water Balance and Quantification of Groundwater Recharge with Acequia Irrigation Systems in Northern New Mexico. Ph.D. Thesis Committee (Major Advisor Dr. Fernald) in the WSM Program, NMSU
5. 2016–2017 Lin Lu: Photocatalysis of Contaminants of Emerging Concern. Ph.D. Thesis Committee (Major Advisor Dr. Pei Xu) in Civil Engineering, NMSU

MS Committee Member:

1. 2017–Present Ashley Page: Assessment of feasibility for a desalination plant in Santa Teresa, NM. M.S. Thesis Committee (Major Advisor Dr. Fernald) in the WSM Program, NMSU
2. 2018–2018 Austin Hanson: Late Quaternary slip rates from offset alluvial fan surfaces along the Central Sierra Madre fault, southern California. M.S. Thesis Committee (Major Advisor Dr. Reed Burgette) in Geology, NMSU
3. 2014–2015 Guanyu Ma: Assessment of shale gas produced water treatment, beneficial use and management. M.S. Thesis Committee (Major Advisor Dr. Xu) in the Environmental Engineering Program, NMSU
4. 2014–2015 Celeste Lewis: NDMA Contaminant Treatment System Development and Evaluation. M.S. Thesis Committee (Major Advisor Dr. Papis) in the Environmental Engineering Program, NMSU
5. 2013–2015 Benjamin Nana O Kuffour: Assessment of water table and water quality variations with respect to river flow along Rio Grande River between Garfield NM and Fabens TX. M.S. Thesis Committee (Major Advisor Dr. Stringam) in the WSM Program, NMSU
6. 2013–2014 Rachael Jones: Estimating the Volume of the Southern Mesilla Basin Aquifer with GIS. M.S. Thesis Committee (Major Advisor Dr. Fernald) in the WSM Program, NMSU

External MS Committee Member (+4 Prior to NMSU Position):

1. 2016–Present Rebecca R. Greenberg: Remediation of polyfluorinated compound contaminant mixtures in groundwater. Ph.D. Thesis Committee (Major Advisor Dr. Tick) in Geology at University of Alabama
2. 2016–Present Joe (Boone) Abbott: Nonideal Dissolution of Multicomponent Nonaqueous Phase Liquids (NAPLs) in Contaminated Groundwater. M.S. Thesis Committee (Major Advisor Dr. Tick) in Geology at University of Alabama
3. 2013–2015 Mark Padgett: Rate-Limited Diffusion and Dissolution of Multicomponent Nonaqueous Phase Liquids (NAPLs) and Effects on Mass Discharge in Groundwater. M.S. Thesis Committee (Major Advisor Dr. Tick) in Geology at University of Alabama
4. 2013–2015 Doug Mateas: Creating NAPL-Mixtures for Solubility and Mass-Flux Reduction: A Novel In-Situ Source-Remediation Method. M.S. Thesis Committee (Major Advisor Dr. Tick) in Geology at University of Alabama

(d) Number of international-student advisees

Several of the graduate students I advise are international students from Nigeria (Yakubu), Turkey (Yalcin), and Bangladesh (Khan). I have advised international post-doctoral researchers (Dr. Hun Bok Jung is from Korea, Dr. Hao Chen is from China, and Dr. Binod Chaudhary is from Nepal).

(e) Special advising activities

I have supported and advised postdoctoral researchers (Hao Chen and Binod Chaudhary). I became a MARC mentor (2014) to support women and minorities pursuing higher education in the medical, biological, and chemical sciences, and I have been mentoring one of the top ES students (Sativa Cruz) as a MARC student who is conducting research in my laboratory. I continually write letters of recommendation for students that I mentor, and I continually meet with students to discuss graduate school. I also recently became an AMP mentor.

7) Other advising services to students

(a) Judging teams

At the American Geophysical Union annual conference, I volunteer every year to judge student posters and talks. I judged for the 12th Annual RMSAWWA/RMWEA Student Research Conference (May 21st, 2015).

(b) Student clubs

I serve as academic advisor for the WSM Graduate Student Organization Advisor (also noted in Community Service Section VI below).

V) OUTREACH FOR THE PERIOD UNDER REVIEW

A) Narrative Demonstrating Knowledge Outreach:

I do not have any part of my allocation of effort designated for knowledge outreach. However, I actively pursue opportunities to conduct outreach and research translation activities. I am interested in supporting the State and the University, and I am interested in research translation and application.

B) Evidence of outreach

2013 – Outreach meeting with National Aeronautics and Space Administration (NASA) White Sands Test Facility to discuss treatment of NDMA contamination in groundwater – Las Cruces, NM – July 9

2013 – Outreach meeting with Yates Petroleum to discuss treatment of produced water from oil production and spill and wellhead reclamation (drafted report) – Artesia, NM – July 12

1) Technology transfer (+2 Prior to NMSU Position)

Carroll, K.C. (2013) Brief Overview of Capillary Barriers for Mitigation of Infiltration, Immobilization of Contaminants, and Reclamation of Contaminated Sites. *A Report Submitted per Request to Yates Petroleum.*

2) Presentations to stakeholders

Carroll, K.C. (2015) What is in your water? Environmental Science and Engineering Grand Challenges. ***Invited Presentation:*** The New Mexico Alliance for Minority Participation (NM AMP) 2015 Student Research Conference, Las Cruces Convention Center, October 2.

Carroll, K.C. (2014) Restoring and Preserving Our Water Resources for Future Generations. ***Invited Presentation:*** the Science Cafe, Las Cruces Museum of Nature and Science, Dec. 4.

Carroll, K.C. and P. Xu (2014) Quantifying Potential Environmental Impacts and Water Treatment Requirements for Wastewater Produced in Oil & Gas Operations. ***Invited Presentation:*** Congresswoman Michelle Lujan Grisham’s Water Innovation Summit Tackling Our Water Resource Challenges by Utilizing Cutting-Edge Technologies and Innovation, Oct. 14, University of New Mexico, Albuquerque, NM.

3) Recruitment and mentoring activities

(a) Types and numbers of recruitment activities

I actively recruit students for the Plant & Environmental Sciences Department and the WSM Graduate Program. I attended and presented at the 2013 Oil and Gas Career & Education Fair (Oct. 29-30) and the 2014 Oil and Gas Career & Education Fair (October 29), Artesia, NM (also noted in Community Service Section VI below). I also visited ASU, UNM, UTEP, and NM Tech to support student recruitment. I spoke with students and presented aspects of my research. I am on the Plant & Environmental Sciences recruiting committee, and I have been active in meeting with ACES College recruiters and developing social media for the Department. I have developed a relationship with Doña Ana Community College for ongoing recruiting activities.

(b) Mentoring of students (e.g., hosting interns)

2013–2014 - Quin Ge: Undergraduate Environmental Science Internship, NMSU

2014–2015 - Janelle R. Roybal: Undergraduate Natural Science Fellowship, NMSU

VI) SERVICE FOR THE PERIOD UNDER REVIEW

A) Narrative Demonstrating Service to the Principal unit, college, university and the broader clientele community:

My goal and the goal of the New Mexico State University is to contribute to the economic development and improvement of the quality of life of citizens of New Mexico, which is partially accomplished through research and teaching activities. However, a critical component required to achieve this goal is service. My goal is to use professional and public service to improve the quality of life of New Mexico's citizens. They support the University's funding, and so New Mexico's citizens are our clients that we serve. Similarly, the University supports our College, and the College supports our Department. Thus, it is my goal to provide service to support the advancement of the Department of Plant & Environmental Sciences, the WSM Program, the College of Agricultural, Consumer and Environmental Sciences, and the New Mexico State University. Additionally, I have a desire to give back and support my profession, which has offered me many opportunities through my career.

B) Evidence of service:

1) Principal unit

- PES Graduate Studies Committee (2013-2017)
- PES Awards Committee (2017-Present)
- PES Ad Hoc Committee for Faculty Replacement Recruitment (2014-Present)
- PES Undergraduate Student Recruitment and Retention Committee (2015-Present, Chair: 2017-Present)
 - DACC develop credit transfer programs (Since 2017 ES 2+2 program).
 - Present at ACES 111 each semester (Since 2016).
 - Developed PES Student Liaison Program (Since 2017: 3 students work on recruiting).
 - Sonoma Elementary STEAM NIGHT Booth March 8, 2017
 - DACC STEM Discovery Booth March 3, 2017
 - AG DAY pre-football 2016, 2017
 - Aggie Fest 2016, 2017
 - DACC recruiting coordination and DACC College 101, Chemistry, Physics, and Biology meetings (Since 2016)
 - East Picacho Elementary School September 21, 2016
 - Night Farmer's Market Oct. 16, 2016
 - Chaparral Elementary School November 11, 2016
 - Tri-Society Conference Booth November 6-9, 2016
- Committee for "Environmental Soil Microbiology" Tenure-track Position Search, 2014/2015

2) College

- Committee to Develop new Ph.D. program in Natural Resources
- NMSU Water Initiative Committee (2017-Present)
- ACES College Dean's Faculty Advisory Team (2017-Present)
- WSM Graduate Program Management Team Committee (2013-Present)
- Faculty advisor for WSM Graduate Student Organization (2014-Present)

3) University

- Initiated and organized a joint invited lecture series with Plant & Environmental Sciences, Civil Engineering, and WSM Graduate Program (2013 to present)

- Traveled to China (June 8-13, 2014) with Provost Howard and Dr. Pratt to develop collaborative programs with agricultural universities. I continue to support development of a Joint Center for Hydrology Research with the China Agricultural University.
- Traveled to Texas Tech (2014) with V.P. Research Chaitanya to develop research collaboration
- Judging for the 12th Annual RMSAWWA/RMWEA Student Research Conference (May 21st, 2015)
- Presented on “Environmental Science and Engineering Grand Challenges” to minority high school students. The New Mexico Alliance for Minority Participation (NM AMP) 2015 Student Research Conference, Las Cruces Convention Center, October 2.

4) Community

- Presented at the Science Cafe, Las Cruces Museum of Nature and Science, Dec. 4, 2014
- Conducted GC-MS chemical analysis of samples for Eric Crespín of Dona Ana County Fire and Emergency Services (2014)
- WSM Booth at Earth Day Las Cruces 2013 NMSU OASIS at Young Park, Sunday April 21st, 2013.
- Water Cycle Lecture to >100 1st grade students at Sonoma Elementary School; April 25, 2014
- Rocks and Geology Lecture to 2nd grade students at Sonoma Elementary School; Spring, 2015
- Water Cycle Lecture to 20 5th grade students at Sonoma Elementary School; Dec. 4, 2017
- Soccer Assistant Coach for “Ninjas” Team (2014-Present)
- Robotics Assistant Coach for Sonoma Elementary Vex-Robotics Team (2017-Present)

5) State

- Member of the NM State Brackish Water Work Group (2014-2016)
- Presented at the Congresswoman Lujan Grisham’s Water Innovation Summit, Oct. 14, 2014
- Supported the training of a NM Tech student on GC chemical analysis techniques (2014)
- Attended and presented at the 2013 Oil and Gas Career & Education Fair, Oct. 29-30, Artesia, NM
- Attended and presented at the 2014 Oil and Gas Career & Education Fair, Oct. 29, Artesia, NM

6) Profession

Professional Society Membership:

- American Geophysical Union (Chair for Groundwater Technical Committee of Hydrology Section)
- Gamma Sigma Delta - The Honor Society of Agriculture
- Geochemical Society
- Geological Society of America
- National Ground Water Association
- Sigma Xi - The Scientific Research Society NMSU Chapter member (2014-Present) and Secretary (2017-Present)
- Soil Science Society of America

American Geophysical Union:

- Convener Technical Session - Advances, Breakthroughs, and Challenges in Hydrogeologic Sciences (2018 Fall Meeting, San Francisco, CA, Dec.) and judge for student presentations
- Convener Technical Session - Advances, Breakthroughs, and Challenges in Hydrogeologic Sciences (2016 Fall Meeting, San Francisco, CA, Dec.) and judge for student presentations
- Convener Technical Session - Advances and Breakthroughs in Hydrogeology (2015 Fall Meeting, San Francisco, CA, Dec.) and judge for student presentations

- Convener Technical Session - Interdisciplinary Advances in Subsurface Contaminant Transport and Remediation (2015 Fall Meeting, San Francisco, CA, Dec.)
- Convener Technical Session - Recent Advances in Groundwater Hydrology (2014 Fall Meeting, San Francisco, CA, Dec.) and judge for student presentations
- Convener Technical Session - Overcoming Remediation Barriers and Improving the Understanding of Processes Controlling Contaminant Transport (2013 Fall Meeting, San Francisco, CA, Dec.) and judge for student presentations
- Convener Technical Session – Coupled Hydraulic, Geochemical, and Geomechanical Processes in CO2 Injection and Storage (2013 Fall Meeting, San Francisco, CA, Dec.) and judge for student presentations
- Convener Technical Session - Physical, Chemical, and Biological Processes Controlling Transport and Remediation of Contaminants (2012 Fall Meeting, San Francisco, CA, Dec.) and judge for student presentations
- Convener Technical Session – Coupled Hydro-Geochem-Mechanical Evaluations of CO2 Sequestration (2012 Fall Meeting, San Francisco, CA, Dec.) and judge for student presentations
- Convener Technical Session - Advances in the Transport and Remediation of Organic Contaminants (2011 Fall Meeting, San Francisco, CA, Dec.) and judge for student presentations
- Convener Technical Session H41 - Physical, Chemical, and Biological Processes Controlling NAPL Source Zone Remediation (2008 Fall Meeting, San Francisco, CA, Dec. 15-19) and judge for student presentations
- Member Groundwater and Vadose-Zone Subcommittees of the Hydrology Section (2010-Present) and Groundwater Committee Deputy Chair (2014) and Chair (2015-2017)
- Webpage Development (<http://agugroundwater.nmsu.edu/index.html>)

Arizona Hydrologic Society:

- Tucson Chapter Treasurer (2003-2006)
- Planning Committee of Annual Symposium (2004)

National Ground Water Association (NGWA):

- Convener Technical Session - Remediation of Subsurface Contamination in Arid and Semi-Arid Environments: Impact on Water Resource Sustainability, NGWA 2009 Ground Water Summit (April 19-23 in Tucson, AZ)

Soil Science Society of America:

- Convener Technical Session - Physical, Chemical, and Biological Processes Controlling Transport and Remediation of Emerging Contaminants in Soils (2016 Annual ASA, CSSA, and SSSA Meeting, Phoenix, AZ, Nov.)

Editorial Board for Scientific Journals:

- *Journal of Contaminant Hydrology* (2015-Present)

Reviewer of Manuscripts for Scientific Journals:

Advances in Water Resources; Chemosphere; Earth and Planetary Science Letters; Ecohydrology; Environmental Chemistry; Environmental Earth Sciences; Environmental Geology; Environmental Science & Technology; Environmental Technology; Ground Water; Groundwater Monitoring & Remediation; Journal of Contaminant Hydrology; Journal of Environmental Management; Journal of Environmental Quality; Journal of Geochemical Exploration; Journal of Hazardous Materials; Journal of Hazardous, Toxic, and Radioactive Waste; Journal of Hydro-environment Research; Natural Resources Research; Science of the Total Environment; Transport in Porous Media; Water, Air, and Soil Pollution; Water Resources Research; Water Science and Technology

Reviewer of Scientific Research Grant Proposals:

- *The Research Partnership to Secure Energy for America, RPSEA (6 proposals; 2014)*
- *The American Chemical Society Petroleum Research Fund (2015)*
- *DOE User Facility EMSL Terrestrial & Subsurface Ecosystems Proposals (2015)*
- *NSF Environmental Engineering CAREER Program Proposals (11 proposals; 2015)*
- *NIWR-USGS National Competitive Grants Program (2016)*
- *NSF Hydrology CAREER Program Proposals (2 proposals; 2016)*
- *NSERC Discovery Grant Proposal, Canada (2017)*

Multistate Research Projects supporting NMSU AES:

- W3188 Multistate Research Project member “Soil, Water, and Environmental Physics across Scales.”
- W-3170 Multistate Research Project member “Beneficial Reuse of Residuals and Reclaimed Water: Impact on Soil Ecosystem and Human Health”

VII) OTHER FOR THE PERIOD UNDER REVIEW

A) Synergistic and Leadership Activities

I try to look for and engage in synergistic and leadership activities selectively and strategically. I would like to support my profession and build and strengthen networks and programs that I believe are valuable to NM and also support my interests and career goals. I do believe I am contributing to the synergistic development of research and teaching networks within my Department, College, University, and also my profession. I do try to provide leadership and develop synergy when I see opportunities that I believe are appropriate and when I have time to support these activities. I believe I am a team player, and I really enjoy working with others, especially when we share common interests. I believe that research and teaching programs can benefit from these synergistic activities. I believe leadership can be a form of service.

B) Evidence of Synergistic and Leadership Activities

1) Type of activity, including duration and level of involvement

2016 – Present: Elected Secretary of the NMSU chapter of Sigma Xi (Scientific Research Society)

2015 – Present: Chair AGU Groundwater Committee, 2015-2017 Elected Chair for Groundwater Technical Committee of Hydrology Section.

2013 – Present: Development of Research and Teaching Core Lab for NMSU, University. Omar Holguin and I have developed a Research and Teaching Core Lab for NMSU to support teaching of chemical analysis and environmental science.

2013 – Present: Initiated and organized Joint Seminar Series with Plant & Environmental Science, Civil Engineering, and WSM Graduate Program.

2013 – Present: Asked to become a mentor for the Minority Access to Research Careers (MARC) program to support underrepresented minority groups who are engaged in biomedical research and to strengthen science curricula and student research opportunities at institutions with substantial minority enrollments in order to prepare minority students for research careers.

2013: Invited to Join NSF WET Center (Multi-University I/UCRC) with Temple University, University of Arizona, Arizona State University: The NSF Water & Environmental Technology (WET) Center is an Industry/University Collaborative Research Center with a focus on water quality, emerging contaminants, and technology for water treatment.

2010 – Present: American Geophysical Union Committee Member: Groundwater and Vadose-Zone Subcommittees of the Hydrology Section. We coordinate proposals for technical sessions at the annual meeting and support coordination and completion of student judging.

Selected Training and Workshops

2015: Participated in and submitted to workshop on “Grand Challenges” for environmental engineering at The Association of Environmental Engineering & Science Professors (AEESP) 2015 Conference, Yale University, June 13-16.

2013 – Attended NMSU Research Academy and Office of Research Development workshops on proposal development September 19: “Writing Competitive NIH Proposals,” and September 24: “Writing Competitive NSF Proposals.”– NMSU

2013 – Attended NAGT On the Cutting Edge Workshop “Teaching Hydrogeology, Soils, and Low-T Geochemistry in the 21st Century” University of New Mexico – Albuquerque, NM – June 5-9

2) Measures of utility, contribution or benefit expressed in a format that is comparable to other forms of evidence that are acceptable for other sections of the curriculum vitae.

Selected Awards:

2017 – Awarded *Early Career Award* for the 17th Annual NMSU University Research Council for Exceptional Achievements in Creative Scholarly Activity.

2016 – Awarded *Patricia Christmore Faculty Teaching Award* at NMSU.

2015 – Awarded *Outstanding Reviewer Status* for being the top 10th percentile in terms of the number of reviews completed for *Journal of Contaminant Hydrology* in the past two years.

2015 – 2017 Elected Chair for Groundwater Technical Committee of American Geophysical Union Hydrology Section.

2014 – 2015 Elected Deputy Chair for Groundwater Technical Committee of American Geophysical Union Hydrology Section.