

**BEFORE THE OFFICE OF ADMINISTRATIVE HEARINGS
STATE OF KANSAS**

IN THE MATTER OF THE APPLICATION OF)
THE CITIES OF HAYS, KANSAS) OAH Case No. 23AG0003 AG
AND RUSSELL, KANSAS FOR APPROVAL TO)
TRANSFER WATER FROM EDWARDS)
COUNTY, KANSAS PURSUANT TO THE)
KANSAS WATER TRANSFER ACT)

PREPARED REBUTTAL TESTIMONY OF DAVE ROMERO
ON BEHALF OF
BIG BEND GROUNDWATER MANAGEMENT DISTRICT NO. 5

MAY 28, 2023

1 **QUESTION: Please state for the record your name, position, and business address.**

2 ANSWER: My name is Dave Romero. I am the President of and a hydrologist with Balleau
3 Groundwater, Inc., 901 Rio Grande Blvd. NW, Suite F-146, Albuquerque, NM 87104.

4 **QUESTION: Mr. Romero, will you please describe your qualifications and experience in the**
5 **field of groundwater hydrology and groundwater modeling?**

6 ANSWER: I have 27 years of experience with analyses related to interaction of groundwater and
7 surface-water, development of field programs involving testing of wells and aquifers, water-
8 resource planning and management, and water rights litigation support. I have a Bachelor of
9 Science in Mathematics from the University of New Mexico and a Master of Science in Hydrology
10 from the University of Arizona. I am a Certified Professional Hydrologist (08-HGW-1817) with
11 the American Institute of Hydrology.

12 I have advised a diverse field of clients throughout my career. I advise cities regarding water-
13 resource planning and management. I have also advised industrial water users, irrigation and
14 conservancy districts, state and federal agencies, Indian tribes, water associations and private water
15 users with matters involving water availability and management. My experience includes
16 development of, adaptation of and working with more than 100 hydrogeologic models involving
17 assessments of source water availability and assessment of hydrologic effects from groundwater
18 development. I specify and analyze aquifer testing programs that are used to recommend
19 operational well yields and pump settings and to characterize well service life in settings with
20 declining regional water levels.

21 I have engaged in peer review services that involve hydrogeologic analyses for municipal water
22 districts in settings of groundwater pumping, return flow discharge, artificial aquifer recharge and
23 remediation of groundwater contamination. I have presented at conferences involving groundwater
24 hydrology and I have been invited to submit a manuscript describing a groundwater analysis
25 technique for consideration in a Theme Issue of the journal *Groundwater*, which was accepted for
26 publication after peer review.

27 I have been qualified as an expert in the Superior Court of the State of Arizona and in
28 administrative hearings in New Mexico and Kansas.

29 Since the mid-2000s, Balleau Groundwater, Inc. (BGW) has advised Groundwater Management
30 District 5 (GMD5) on matters related to water use. Part of that effort involved development of a
31 model in part of the Arkansas river basin focused on the area of GMD5. That model is the model
32 used by Burns & McDonnell (BMcD) in their evaluation of the R9 Ranch transfer application and
33 used by S.S. Papadopulos and Associates, Inc. (SSPA).

34 **QUESTION: What were you asked to do in this matter?**

35 ANSWER: Review the pre-filed testimony and reports of Steven P. Larson of SSPA and Paul
36 McCormick, P.E. of BMcD disclosed in this matter and identify any issues with the analysis or
37 use of the model.

38 **QUESTION: What pre-filed testimony and reports did you review?**

39 ANSWER: A list is below.

40 Steven P. Larson testimony: *Prepared Direct Testimony of Steven P. Larson on Behalf Of Water*
41 *Protection Association Of Central Kansas and Edwards County, Kansas (Collectively*
42 *“Intervenors”)*, dated May 30, 2023.

43 Steven P. Larson Report (attached to testimony dated May 30, 2023): *Revaluation of Burns &*
44 *McDonnell’s R9 Ranch Modeling Results*, dated February 1, 2023.

45 Paul McCormick Testimony: *Direct Testimony of Paul McCormick, P.E., Senior Associate*
46 *Geological Engineer, Burns and McDonnell Engineering Company, Inc.*, dated May 26, 2023.

47 Paul McCormick Report (attached to testimony dated May 26, 2023): *R9 Ranch Modeling Results*
48 *Summary*, prepared for City of Hays, Kansas, R9 Ranch Development Edwards County, Kansas.

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50 **QUESTION: Did you identify any issues with the analysis or use of the model?**

51 ANSWER: Yes.

52 **QUESTION: What issue or issues did you identify?**

53 ANSWER: Steve Larson of S.S. Papadopoulos & Associates, Inc. writes on Page 3 of his report:

54 *“The BMcD projected future scenarios did not account for the reduction in*
55 *groundwater recharge associated with changing the status of lands on the R9*
56 *Ranch from irrigated to non-irrigated. The BGW groundwater model was premised*
57 *on the concept of increased groundwater recharge from precipitation on irrigated*
58 *lands. To be consistent with this premise when evaluating a transfer, the*
59 *groundwater recharge on irrigated land must be reduced when that land is no*
60 *longer irrigated.”*

61 I agree with Mr. Larson’s description of this hydrologic concept and associated reduction of local
62 groundwater recharge at the R9 Ranch. I have not reviewed Mr. Larson’s analysis at the level of
63 detail associated with examining the actual input and output associated with the model simulations;
64 however, my review of his reported analysis and the accompanying conclusions set forth in pages
65 3-7 of his report are compatible with my expectations. To that extent, I agree with Mr. Larson’s
66 analysis and conclusions.

67 **QUESTION: Do you concur with the methodology Larson used to re-run the various**
68 **simulations of potential future conditions considered by Burns & McDonnell, reducing the**
69 **amount of recharge on the R9 ranch lands that would not be irrigated under future**
70 **municipal pumping conditions?**

71 ANSWER: I have not developed an alternative methodology or reviewed Mr. Larson’s analysis at
72 the level of detail associated with examining the actual input and output associated with the model

73 simulations; however, my review of his reported methodology set forth in pages 4-5 of his report
74 are compatible with my expectations. To that extent, I concur with Mr. Larson's methodology.

75 **QUESTION: Have you included with this testimony a copy of your current curriculum**
76 **vitae?**

77 ANSWER: Yes. It is attached as Exhibit 1.

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81 I state under penalty of perjury that the foregoing is true and correct.

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83 FURTHER AFFIANT SAYETH NAUGHT.

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DAVE ROMERO

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SUBSCRIBED AND SWORN to before me this 28th day of June, 2023.

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Notary Public

My commission expires: 05/25/2026

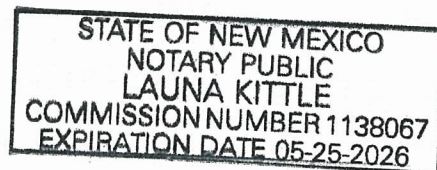


Exhibit 1

Curriculum Vitae of Dave Romero

DAVE M. ROMERO, M.S., P.H.

Hydrologist

EDUCATION: Master of Science in Hydrology, 1996, University of Arizona
Bachelor of Science in Mathematics, 1992, University of
New Mexico

CERTIFICATION: Certified Professional Hydrologist (#1817) by the
American Institute of Hydrology (2008)

PROFESSIONAL

SOCIETIES: National Ground Water Association
American Geophysical Union
Integrated Groundwater Modeling Center
International Association of Hydrogeologists
American Water Resources Association
New Mexico Geological Society

PROFESSIONAL EXPERIENCE:

2012 to Present: President and Hydrologist, Balleau Groundwater, Inc.
2002 to 2011: Vice President and Hydrologist, Balleau Groundwater, Inc.
1999 to 2002: Senior Hydrologist, Balleau Groundwater, Inc.
1996 to 1999: Hydrologist, Balleau Groundwater, Inc., Albuquerque, NM
1994 to 1996: Research Assistant, University of Arizona, Tucson, AZ
1992 to 1995: Staff Research Assistant, Los Alamos National Laboratory,
Los Alamos, NM (summers only)

SUMMARY OF PROFESSIONAL EXPERIENCE:

Professional experience in major aspects of hydrology and hydrogeology, with emphasis on numerical modeling of both groundwater and surface-water hydrologic processes and interaction. Water-rights litigation support, development of field-testing programs, wellfield assessment, water-resource planning and management, arid zone hydrology, artificial recharge, and mine dewatering have also been major activities. Developed, adapted or worked with more than 100 hydrogeologic models. Assessed the hydrologic effects of water systems serving cities and water suppliers in New Mexico, California and Kansas. Work activities have specialized in regional source-water assessments and analyzing long-term yield of wellfields. Experience with aquifer characterization including specification of well and aquifer tests and interpretation of test data to determine local and regional properties of aquifer systems. Author on expert reports describing regional water budgets and hydrologic effects associated with applications or proposals that affect area wells and rivers. Qualified as an expert in administrative hearings in New Mexico and Kansas, district court in Arizona and developed technical information which guided the outcome of settled cases.

PUBLICATIONS/PRESENTATIONS:

“Upper Santa Ana River Integrated Model – Peer Review Process”, invited to speak at 2nd Annual Santa Ana River Science Symposium, *Success through Collaboration*, Tuesday, October 22, 2019 at the University of California, Riverside.

“Water Accounting Model Analysis - Two Case Studies”, invited to speak as faculty at Law Seminars International, Using Hydrology as Proof in Water Cases, Session: Constructing and Deconstructing Hydrologic Models, July 17, 2017, La Fonda Hotel, Santa Fe, New Mexico.

“Water Accounting Analysis - Understanding Viable Solutions to Water Disputes”, invited to speak as faculty at CLE International, Law of the Rio Grande, 15th Annual Conference - Live!, Session: Real Wet Water Solutions to Legal Disputes, March 5-6, 2015, La Fonda Hotel, Santa Fe, New Mexico.

“Simulation of Aquifer System in Part of the Española Basin, New Mexico”, abstract accepted for presentation at National Ground Water Association Conference on Hydrology and Water Scarcity in the Rio Grande Basin, February 25 - 26, 2014.

“Simulation of the Aquifer System in Part of the Hondo Basin from the Sierra Blanca to Riverside, New Mexico”, abstract in Geological Society of America, Rocky Mountain Section – 64th Annual Meeting, May 9 – 11, 2012, *Abstracts with Programs*, Vol. 44, No. 6, p.23.

“How Much Have We Got? Sandia Labs and USGS Studies of Regional Water Resources”, Focus on the Future: Water and Energy in Southern New Mexico, 2012 Southern New Mexico Conference, invited to give presentation and speak on panel for panel discussion, Ruidoso Convention Center, Ruidoso, New Mexico.

“Effluent Recharge to the Gila Group Aquifer near Silver City, New Mexico”, abstract and presentation at 2011 American Water Resources Association Annual Conference, November 7 – 10, 2011, Hyatt Regency, Albuquerque, New Mexico.

“Model Accounting of Water-Use and Availability in Southeastern Union County, New Mexico, Part of Cimarron County, Oklahoma and Parts of Dallam and Hartley Counties in Texas”, abstract in 2009 Annual Water Symposium Proceedings, *Managing Hydrologic Extremes*, Arizona Hydrological Society and American Institute of Hydrology, August 30 – September 2, 2009, Westin Kierland Resort & Spa, Scottsdale, Arizona.

“Grid Cell Distortion and MODFLOW’S Integrated Finite-Difference Numerical Solution”, National Ground Water Association, Ground Water Journal, Theme Issue: Understanding through Modeling, Vol. 44, No. 6, pgs. 797-802, November-December 2006.

“MODFLOW: A Finite-Difference Groundwater Flow Model or an Integrated Finite-Difference Groundwater Flow Model?” MODFLOW and More 2003: Understanding through Modeling – International Groundwater Modeling Center, Colorado School of Mines, Conference Proceedings (with Thomas Maddock, III).

“IFD: An Integrated Finite-Difference Package for Use with MODFLOW,” Master’s Thesis, Department of Hydrology and Water Resources, University of Arizona, Tucson, Arizona, 1996.

"Mechanical and Physical Properties of Perlite from the Geophysical Array for Small-Scale Explosive Experiments in Socorro, New Mexico," Los Alamos National Laboratory, LAUR-95-217, January 1995 (with H.N. Plannerer).

Over 75 other confidential consulting reports.

SPECIFIC EXPERIENCE IN WATER RESOURCE PROJECTS:

-Southeast, Kansas: Technical evaluation of a proposal to permit lowering of the level from which groundwater credit associated with an aquifer storage and recovery (ASR) project could be diverted from City of Wichita wells. The project involved an Administrative Hearing on the proposal. The evaluation involved reducing an existing analysis into its constituent parts to analyze the proposal. The resulting analysis provided new information that isolated the hydrologic and water quality effects of the proposed change in ASR operations on nearby wells and streams.

-Southern California: Peer review of model development in the Upper Santa Ana River watershed. A regional geohydrologic model was developed based on previous work completed in five areas: the Yucaipa Basin, the San Bernardino Basin, the Rialto-Colton Basin, the Riverside-Arlington Basin and the Chino Basin. The project was a joint effort involving three water districts, two water suppliers, the California Department of Fish and Wildlife and the U.S. Fish and Wildlife Service. The regional model was developed to enhance understanding of groundwater and surface water interaction along the Upper Santa Ana River. The technical work involved an assessment of hydrologic effects associated with proposed projects addressed in a Habitat Conservation Plan associated with an application for an incidental take permit under Section 10 of the Endangered Species Act.

-Southeastern Arizona: Evaluation of proposed augmentation pumping that is part of a Federal Reserved Water Right for the San Pedro Riparian National Conservation Area. The work involved model analysis and development of an augmentation scheme to support river flow during drought conditions and evaluation of local monitor wells developed for observing shallow water-level conditions in areas near the river. Testified in district court.

-Southern California: Peer review of Groundwater Management, Monitoring and Mitigation Plan (Plan) for a water development project. The plan involves development of

groundwater from the eastern Mojave Desert and transporting it west to enhance the water supply of certain populated areas in southern California. A general concept of the project is to develop groundwater from the Mojave region that otherwise would evaporate (unused) from the basin lowlands. The peer review involved evaluating whether the Plan was sufficient to ensure that the proposed groundwater pumping would not result in potential adverse impacts that could not be effectively mitigated.

-Southeastern New Mexico: Expansion of municipal water supply for a city. The wellfield is located in the High Plains aquifer. The wellfield was expanded with eight new production wells and seven monitor wells. The project involved coordinating with an engineer on well specifications, overseeing drilling and testing of completed wells, and recommending operational pump settings and well yield for individual wells planned for connection to the existing water system.

-Southeastern New Mexico: Development of a water supply for a cryogenic gas processing facility. The facility is located in an area with water known to be of poor quality in a deep aquifer system within Permian bedrock. Treatment of the area water supply is necessary for facility operations. A key question was whether a suitable quantity of water could be produced from a shallower aquifer with significantly better quality than the deep system. Analysis of geophysical logs in the area suggested the presence of a Triassic bedrock aquifer as a candidate source of water. Exploratory drilling and testing identified good quality water and yield at a quantity suitable to meet facility water demand. The end product was identification of a long-term water supply with reduced cost of treatment and a production well to access that supply.

-Central Kansas: Development and analysis of a river augmentation plan to address low flow conditions for a downstream senior water user. The assessment involved evaluation of candidate wellfield locations in consideration of areas with degraded water quality, fluctuations in seasonal water quantities, and management of augmentation pumping to supply water on a specific schedule of water demand.

-West Texas: Assessment of regional water development potential from a deep Triassic aquifer system. The work involved guiding the specification of 1,000+ feet deep wells, development of a well/aquifer testing program, interpretation of aquifer test results, incorporation of local and regional aquifer test data into a model of the aquifer system. Model development included compilation of a three-dimensional framework of a shallow fresh-water aquifer system with a deeper brackish water system. Results of the analysis provided information to quantify the deep aquifer resource and guide whether additional sources of water would be needed to meet projected demand.

-Santa Ana Basin, California: Scientific peer review of groundwater model development. The project progressed over a two-year period involving development of a work plan, review of previous associated works, development of a lithologic model, development and calibration of a groundwater flow model and development and calibration of a contaminant transport model. The model was developed as part of an integrated regional water planning

and management process among agencies in the area of the Upper Santa Ana River Watershed. A key to progress involved facilitating technical discussion amongst members of a technical team in attempt to reach model development decisions through a collaborative process. The work was conducted on behalf of four regional water agencies and one private company involved with local groundwater remediation.

-Upstate New York: Analysis of data and subsurface processes related to coal-tar (DNAPL) transport. Technical evaluation involved team development of an approach to characterize the timing of coal-tar transport originating from an early 20th century manufactured gas plant. Coal-tar migrated from processing plant areas and from a tar disposal pond predominantly through unconsolidated sediments before reaching an adjacent river.

-Bernalillo County, New Mexico: Technical evaluation of the administrative setting for a specific License of water use in the Middle Rio Grande Administrative Area. The License has a requirement for offsetting Rio Grande depletion with either return flow to the river or retirement of existing water rights, but it did not explicitly state how depletion to the river is to be calculated. Through technical coordination with the New Mexico Office of the State Engineer, developed an agreed upon technique for calculating river depletion from well use by the Licensee. The approach provided the Licensee with information necessary to plan future water use within a framework of managing return flow to the river and use of its existing water rights portfolio.

-Quay County, New Mexico: Designed aquifer testing program for production wells completed in the High Plains (Ogallala) aquifer. Interpreted aquifer test data, pertinent geologic publications and local lithologic data. Directed development of an aquifer model to analyze the hydrologic effect of changing the location of two wells. Developed a set of technical exhibits for use in an Administrative Hearing regarding use of the wells. Coordinated with legal counsel on the foundation of the technical approach and on development of a technical opinion regarding the hydrologic effect of moving the two wells.

-Sierra County, New Mexico: Developed technical opinion on serviceability of a well providing a thermal source of water for commercial purposes. Planned field test for the well. Interpreted water-level and thermal data collected during testing. Interpreted aquifer testing program previously conducted by the U.S. Geological Survey in local the thermal water artesian basin. Evaluated historical records of water diversions and records of permitted use. Authored technical report describing future well serviceability within the context of permitted well use.

-Sierra County, New Mexico: Evaluated an aquifer testing program conducted in the McRay bedrock aquifer system. Inspected geologic reports to conceptualize a structure for the regional aquifer system. Directed development of an aquifer model to quantify the hydrologic effect of transferring and using water rights to divert groundwater from a well in the McRae aquifer system. Authored a report for use as technical evidence in an Administrative Hearing. Prior to hearing, attended and presented technical information at a formal mediation session. The mediation involved coordination and discussion amongst

the parties and other technical experts. The end result was the Parties reached an agreement and matter was settled.

-Santa Ana Basin, California: Conducted a scientific peer review of a groundwater flow model of the San Bernardino Valley aquifer system. The model represents the Bunker Hill and Lytle Creek geologic basins, including certain Environmental Protection Agency operable units related to the Newmark and Muscoy contamination plumes. The scope of review focused on the model functionality for meeting objectives of a Superfund Consent Decree and for guiding basin-wide water management and planning initiatives regarding artificial recharge, regional wellfield operations, and variable climate effects. Authored a peer-review report and presented recommendations for enhancement of model performance in key management areas. The end result was the model authors moved forward with addressing the proposed recommendations for enhancement and Balleau Groundwater, Inc. was brought into the project as a technical team member to peer review the enhancement work. The work was conducted on behalf of eight regional water agencies.

-Raton Basin, New Mexico and Colorado: On behalf of the City of Raton, analyzed hydrologic impacts to the City's municipal water system from proposed coalbed methane development. The work was initiated by four energy companies that collectively petitioned (the Petitioners) to change the administrative status of groundwater within an area where groundwater pumping affects the City's municipal water supply. Conducted assessment of the conceptual model, hydrologic data, and the numerical model developed by the Petitioners and authored an expert report of comments. The end result was the Petitioners addressed key comments and settled with the City of Raton by agreeing not to request a change in the administrative status of groundwater within a buffer area of the City's municipal watershed.

-Central Kansas: Development of a three-dimensional hydrogeologic flow model that includes the High-Plains aquifer and deeper bedrock in the Great Bend area of Kansas. The Principal stream in the model domain is the Arkansas River. Model aquifer properties are based on results from regional aquifer tests. Aquifer recharge and runoff to streams is linked to regional precipitation patterns over a 68-year historical period. Return flow from irrigation pumping is estimated based on monthly variations in precipitation and crop requirements in conjunction with LANDSAT imagery to identify active irrigation acres. The model represents a component of degraded water quality that rises from deep bedrock to shallow groundwater. The model is in use by the Kansas Department of Agriculture - Division of Water Resources to assess hydrologic effects from proposed water management plans and administration of water rights.

-Mimbres Basin, New Mexico: Developed hydrologic program to assess the fate of treated effluent after infiltration beneath the ephemeral stream bed of San Vicente Arroyo. The approach is based on using the seasonal variability of surface-water temperature as a tracer to track effluent as it percolates through the vadose zone toward the regional water table. The work involved specifying a monitoring system comprised of monitoring wells and of vadose zone instrumentation nests to collect data. Data indicated that subsurface effluent

could be tracked as it moves through the vadose zone down to the regional water table. The monitoring program was developed to understand the fate and timing of effluent percolation to the regional water table in the area of the Town of Silver City.

-Union County, New Mexico: Developed aquifer testing program for wells completed in the Jurassic and Cretaceous bedrock aquifers beneath the Tertiary/Quaternary sediments of the Ogallala Formation. The work involved specifying the test procedure, managing data collection and interpretation of test results. The work resulted in characterizing hydrologic properties of the bedrock and Ogallala aquifer system in eastern central Union County in the vicinity of Seneca Creek.

-Grant County, New Mexico: Hydrologic evaluation of regional water budget in area of Silver City, New Mexico. The work involved comparing the flow budget associated with a specific area of influence to the flow budget of designated boundaries in the State of New Mexico Southwestern Regional Water Plan. Provided comments on the distinction between regional availability of source water and the source water available to a particular distribution of wells in Grant County.

-Santa Fe, New Mexico: Assessment of shallow water-table dewatering requirements for a construction project. Designed protocol for shallow aquifer test and interpreted test results. Coordinated development of an associated groundwater flow model to project yield and schedule required for dewatering site prior to beginning construction activities.

-Middle Rio Grande Valley, New Mexico: Assessed hydrologic effects of Bernalillo County Water Utility Authority well diversions. The work involved analyzing stream depletion to specific reaches of the Rio Grande and inspecting the extents of aquifer drawdown resulting from diverting water from municipal wells.

-Union County, New Mexico: Developed hydrologic program of aquifer testing, aquifer system model development and analysis of projected hydrologic effects from development of new irrigation project. The work involved interpretation of aquifer stress and response data, geophysical logs, geologic information, water use patterns, historical model calibration and model scenario development to assess effects from projected levels of groundwater use. The end product was a regional model of the geohydrologic system and of regional water use suitable for assessing the effects of groundwater development. Authored reports for use at State Engineer Administrative Hearing and provided expert witness testimony.

- Clayton, New Mexico: Provided hydrologic support for filing a Declaration of water use with New Mexico Office of the State Engineer. The work involved field inspection of wells and interpretation of historical aerial imagery to inspect water use in categories of dryland farming, surface-water irrigation and irrigation from wells. Potential support for New Mexico Office of the State Engineer Administrative Hearing.

-Estancia Basin, New Mexico: Participated in a four-member Hydrology Committee established to review hydrologic and geophysical interpretations used to assess the future

service life of a bedrock wellfield. The Committee was formed as part of a joint stipulation between a confidential client and the New Mexico Office of the State Engineer.

-Middle Rio Grande Valley, New Mexico: Provided technical reports for use at State Engineer Administrative Hearings regarding transfer of water rights from Bernalillo and Socorro Counties to the City of Santa Fe Buckman wellfield. Two transfer applications were submitted to the State Engineer. The work involved analysis of hydrologic effects caused by discontinued well use and commenting on administrative accounting associated with the Buckman wellfield permit. Commented on the hydrologic implications of State Engineer policy regarding Middle Rio Grande water rights transfers. Provided expert witness testimony at State Engineer Administrative Hearing.

-Village of Corrales, New Mexico: Provided a technical report describing hydrologic effects for use at a New Mexico Office of the State Engineer Administrative Hearing on a new groundwater appropriation. The analysis was in the context of State Engineer administrative guidelines for use in assessing water rights transfers. The appropriation was within the hydrologic area of influence that includes major municipal wellfields operated by the City of Albuquerque and City of Rio Rancho.

-Middle Rio Grande, New Mexico: Simulation of multiple model scenarios to investigate depletion effects to the Rio Grande caused by variable groundwater pumping schedules for an industrial water user. The work was done in support of a management plan for eventual cessation of well operations as a transition is made to alternative sources of water. The analysis involved accounting for well diversions, stream depletion, treated return flow and available offset water rights. Model scenarios were developed to analyze alternative schedules of reduced wellfield pumping while maintaining associated residual stream depletion to a level less than or equal to available depletion offsets.

-Estancia Basin, New Mexico: Assessed future water-level drawdown at regional scale to investigate the service life of existing wells. The work involved categorizing existing wells into those with and without future water columns remaining for future public supply use. Future projections of water levels were based on a model of the regional aquifer system that takes into account basin-wide estimates of irrigation, commercial, municipal, domestic and stock water use. The analysis provided a basis for identifying areas where long-term source water from existing wells would be expected for planning purposes.

-Pojoaque River Basin, New Mexico: Provided hydrologic support for an Environmental Assessment of impacts associated with converting the source water for a turf irrigation project from well diversions to treated wastewater reuse. Developed an approach and recommended a method for quantifying the associated hydrologic effects. The work involved compiling regional information regarding water use, existing well and water feature locations, and developing model scenarios appropriate for quantifying hydrologic effects related to the change in source water use. The analysis involved an assessment of the effect to water levels in shallow wells and to a stream system caused by a proposed change in deep well pumping. The analysis was based on a published U.S. Geological Survey

model, which was spatially refined to provide larger-scale detail to individual wells and to surface-water points of diversion for irrigation. The results were reported in an environmental assessment document submitted to the U.S. Bureau of Indian Affairs for compliance with the National Environmental Policy Act and related legislation.

-Estancia Basin, New Mexico: Assessed the fate of seepage from septic drainfields situated in basin fill deposited on limestone. Developed an approach and chose method for the analysis. The aquifer system includes groundwater flow through the geologic sequence of basin fill and limestone. The analysis involved characterizing an expected range of hydrologic properties for the basin fill sediment and using a variably saturated model technique to account for migration of drainfield seepage through the vadose zone and ultimately to the water table of the regional groundwater system. The approach provided a method to account for water that supports evaporative losses from the shallow vadose zone. Authored a report describing findings for use at a State Hearing regarding return flow from septic drainfields.

-Middle Rio Grande Basin, New Mexico: Assessed regional groundwater flow model developed by the U.S. Geological Survey and adapted model to include data from an aquifer testing program in the Jemez Basin. The aquifer testing data provided a basis for adjusting Santa Fe Group aquifer properties. A later phase of work involved coupling the groundwater flow model to a surface water model using response functions. Developed technique for derivation of groundwater response functions via the groundwater flow model. Response functions accounted for groundwater withdrawal and injection, seepage from reservoirs, seepage from irrigation canals and deep percolation associated with irrigation return flow. The end result was a hydrologic model of the Jemez Basin that links with a surface-water model of the Rio Grande Basin. The model has been used to assess the effects of Jemez Basin water development on State of New Mexico Rio Grande Compact obligations to Texas.

-Sandia Uplift/Hagan Basin, New Mexico: Developed regional model of the hydrologic system. Model development involved creation of predevelopment, historical and future projection versions of the model. The model provided a tool suitable for analyzing effects to the hydrologic system caused by 50 years of groundwater development and importation of water from an adjacent basin. The model is situated between two regional models used by the New Mexico State Engineer to administer water rights. The model provided a basis to assess the hydrologic effects to water levels and to the regional surface-water system caused by a future planned use of water for a subdivision.

-Middle Rio Grande, New Mexico: Provided hydrologic support for quantifying water consumption associated with development of a managed refuge for the Rio Grande silvery minnow. The Rio Grande silvery minnow is an endangered species under the Endangered Species Act of 1973, as amended. The work involved quantifying the water consumption change associated with clearing Rio Grande Bosque vegetation and replacing it with an open water body. The analysis was based on evapotranspiration data collected from eddy covariance flux towers located in the Middle Rio Grande Bosque. The objective of the work

was to estimate the total acreage of Bosque vegetation that would have to be cleared and maintained so that the new open water habitat would not cause more water evaporation than would otherwise occur without the habitat. The approach was required to prevent new depletion to surface water which would affect State of New Mexico Rio Grande Compact delivery obligations to Texas.

-Grant County, New Mexico: Authored a supplemental report to the Town of Silver City 40-year plan. The 40-year planning report serves as the basis for the municipality to acquire and hold unused water rights in the State of New Mexico. The report documents regional geohydrology, the Town's existing wellfield facility, wellfield performance testing, history of water use, permitted water use, projected demand and model analyses that focus on an assessment of future wellfield service life. Modeling was based on a regional groundwater flow model developed by the State Engineer and adapted to reflect individual well details observed during a program of field testing. The analysis accounted for water use by the Town and regional water for mines, irrigation, domestic and stock use.

-Lea County, New Mexico: Developed a model of the Southern High Plains aquifer system to assess source water for an existing wellfield and a planned wellfield. In the area of interest, the Ogallala aquifer overlies less permeable rocks of Cretaceous and Late Triassic age. The objective was to assess the future availability of water that could be accessed as individual wells are affected by pumping water levels, well interference, partial aquifer penetration, reduced performance as the aquifer dewateres and declining yield as individual well water levels reach a threshold required to maintain a suitable net positive suction head. The work involved developing a model with a detailed account of well hydraulics in the context of the regional geologic structure and hydrologic system. Results of the project provided information for consideration in decisions for management action regarding a capital improvement plan for potential expansion of a City water system.

-Middle Rio Grande, New Mexico: Analysis of groundwater seepage from Jemez Canyon reservoir. Results from a U.S. Geological Survey groundwater flow model were interpreted and used to estimate historical seepage from Jemez Canyon reservoir during historical operations.

-Estancia Basin, New Mexico: Analysis of future water availability from a limestone aquifer. The work involved implementing a geophysical technique to characterize the relative change in borehole permeability with depth for a wellfield completed in the Madera Limestone aquifer. The approach involved a geophysical technique of combining thermal log data with well specific capacity to arrive at a method for estimating future well yield as regional water levels decline and the limestone aquifer partially dewateres. The work was done to provide a regional water supplier with information regarding the future availability of water in the area of its existing wellfield.

-Española Basin, New Mexico: Developed model of geohydrologic system to assess the effects of historical water use on a regional scale. The model accounted for historical water use by the County of Los Alamos, the Town of Española, the City of Santa Fe and rural

domestic and stock water use. Irrigation operations were simulated along the Rio Chama, the Rio Grande, the Santa Cruz River, the Santa Fe River and Pojoaque River Basin Streams.

-Santa Fe County, New Mexico: Assessed hydrologic impacts associated with a water system for the Pojoaque River Basin and the City of Santa Fe. Impact evaluation included integration of population growth with water use and development of model scenarios. The work was prepared for the U.S. Bureau of Reclamation under the direction of the Aamodt Technical Committee and reported in a Feasibility Study to the 108th Congress of the United States.

-Pecos River Basin, New Mexico: Assessment of hydrologic impacts to Pecos River under degrees of priority enforcement on irrigation wells in the Roswell Basin. The analysis included coupling priority enforcement with direct augmentation pumping to provide flow to the Pecos River. The analysis provided a method to inspect the feasibility of administrative action as a means to provide required deliveries of Pecos River water from New Mexico to Texas under a situation of Compact shortfall. Authored an expert report describing findings for the New Mexico Interstate Stream Commission for use in potential litigation.

-Lincoln County, New Mexico: Evaluation of hydrologic impacts associated with wellfield diversions by the Village of Ruidoso. Authored expert report on hydrologic effects associated with water use transfer. Testified at state administrative hearing.

-Rio Arriba County, New Mexico: Evaluation of hydrologic impacts associated with transfer of water use from state engineer permitted irrigation operations to surface-water storage. Development of hydrologic exhibits for use at State Hearing. Expert testimony at state administrative hearing.

-Albuquerque South Valley, New Mexico: Assessment of hydrogeologic and water quality conditions affecting private domestic well owners. Conducted a degraded water quality vulnerability analysis of domestic wells within the service area of a planned municipal water system expansion. Provided technical input for development of an Environmental Assessment Document for compliance with the National Environmental Policy Act.

-Middle Rio Grande, New Mexico: Developed a geographic information system (GIS) based hydrologic model of the Placitas area. Hydrologic model information was based on data derived from an exploratory drilling and aquifer testing program, and from available data regarding the regional geohydrology of the area. The model coupled the groundwater and surface water system for a complete assessment of hydrologic effects caused by a proposed subdivision.

-Santa Fe, New Mexico: Development of a water-use plan that involved a water source assessment, a water-use and demand study, modeling of hydrologic impacts from planned

wells and evaluation of water-use alternatives. Developed technical specifications for planned water supply wells and monitoring wells.

-Middle Rio Grande, New Mexico: Assessment of City of Albuquerque wellfield impacts to Rio Grande and Middle Rio Grande Conservancy District canals and drains. The analysis was conducted with the New Mexico Office of the State Engineer Administrative Groundwater Flow model of the regional groundwater flow system.

-Silver City, New Mexico: Assessment of City wellfield performance. Well pump tests were conducted at each of the City's active wells to determine specific capacity and estimate well service life with model projections. Aquifer properties of the Gila Conglomerate at selected wells were derived from monitoring water-level recovery data after individual wells were shutdown.

-Grant County, New Mexico: Design and conceptualization of numerical model to integrate with existing New Mexico Office of the State Engineer model for use in Gila River Basin administration. Application of the model to a water rights transfer application submitted to the State Engineer. Designed and developed hydrologic exhibits for use at State Hearing. Provided expert witness testimony at State Administrative Hearing.

-Santa Fe County, New Mexico: Application of hydrologic model scenarios to quantify impacts to Pojoaque River Basin streams and to Rio Grande. Presented model results to Aamodt negotiation/settlement team and a presiding Judge. Team participants included State and Federal legal counsel and State and Federal technical staff.

-Santa Fe County, New Mexico: Design of hydrologic modeling program to assess impacts from future development of water use in Pojoaque River Basin. Water use options include comparative analysis of wellfield development versus installation of a regional water system.

-Santa Fe County, New Mexico: Design of observation well monitoring network to quantify long-term local drawdown impacts from Ranney-type radial well collector planned for regional water supply distribution system.

-Middle Rio Grande Basin, New Mexico: Evaluation of aquifer testing program conducted at four sites in Rio Grande alluvium in the vicinity of the City of Albuquerque. Analyzed aquifer test data and commented on applicability of use in localized hydrologic modeling. The tests were conducted as part of the City's investigation of options to divert San Juan Chama Project water for municipal use.

-Middle Rio Grande Basin, New Mexico: Evaluation of hydrologic model conceptualization and results from simulation of San Juan Chama Project water diversion from a Ranney-type well collector in the City of Albuquerque. The model was designed to investigate the hydrologic effect to the Rio Grande and Middle Rio Grande Conservancy District canals and drains from a shallow subsurface diversion.

-Middle Rio Grande Basin, New Mexico: Evaluation of impacts to Rio Grande and Jemez River from City of Rio Rancho groundwater appropriation. Impacts were calculated with the New Mexico Office of the State Engineer Administrative model. Designed and developed hydrologic exhibits for use at State Hearing. Exhibits were designed in the context of the Middle Rio Grande Administrative Area Guidelines published by the State Engineer.

-Pecos River Basin, New Mexico: Evaluation of hydrologic model of Roswell Basin. Inspected the behavior of the model with regard to climatic and groundwater withdrawal effects on Pecos River baseflow gain. Provided technical comments and advice on adaptations to update the model for use in analysis of Pecos River Compact compliance.

-Sandoval County, New Mexico: Evaluation of hydrogeology in area of Placitas. Expanded the Middle Rio Grande Administrative model to include the area of interest and applied the model to a water rights transfer application submitted to the New Mexico Office of the State Engineer. Designed and developed hydrologic exhibits for use at State Hearing. Exhibits were designed in the context of the Middle Rio Grande Administrative Area Guidelines published by the State Engineer.

-Luna County, New Mexico: Evaluation of hydrology in Mimbres Basin. Performed model simulations with the U. S. Geological Survey/State Engineer model of the Mimbres Basin. Designed and developed hydrologic exhibits for use at State Hearing. Exhibits were designed in the context of the Mimbres Basins Administrative Criteria published by the State Engineer.

-Eddy County, New Mexico: Evaluation of Carlsbad Basin administrative model developed by New Mexico Office of the State Engineer. Performed multiple model simulations to inspect depletion impacts to the Pecos River from wells completed in the adjacent Reef aquifer and in the overlying alluvium.

-Santa Fe County, New Mexico: Evaluation of hydrologic response of two models developed by the U. S. Geological Survey in the Santa Fe Embayment area. The analysis compared the depletion effects to local streams from City of Santa Fe wellfield withdrawals.

-Middle Rio Grande Basin, New Mexico: Comparison of methods for calculating consumptive irrigation requirements for selected crops. Provided technical comments on methods and effects of amounts derived from various methods.

-Santa Fe County, New Mexico: Evaluation of Buckman wellfield impacts to Pojoaque River Basin streams. The analysis compared depletion effects to retired water rights on file with the New Mexico Office of the State Engineer

-Santa Fe County, New Mexico: Preparation of a model designed for administering water rights in the Pojoaque Valley River Basin. Modification of an existing U.S. Geological

Survey model for the purpose of simulating the impacts of applied-for changes in water use on existing or declared water rights within the basin.

-Taos County, New Mexico: Evaluation of a hydrologic model used for estimating groundwater yield potential at future pumping centers.

-Doña Ana County, New Mexico: A study of impacts to the Rio Grande from the transfer of water use from one location to another in the Mesilla Valley. The U.S. Geological Survey model (Frenzel, 1992) was used to quantify the impacts. Calculations were consistent with the New Mexico Office of the State Engineer Lower Rio Grande Administrative Guidelines.

-Doña Ana County, New Mexico: Research of well development and water use activities of selected wells in the Mesilla Valley. Quantified impacts to the Rio Grande from wellfield withdrawals.

-Torrance County, New Mexico: Supervised and performed pump tests at numerous wells within the Estancia Basin. Tests in 1999 resulted in characterizing properties of the San Andres/Glorieta aquifer unit.

-Torrance County, New Mexico: Developed the recharge and overland flow components to a detailed hydrologic model of the Estancia Basin. Used the model in a basin-wide study of long-term water sustainability.

-Middle Rio Grande Basin: Adapted the New Mexico Office of the State Engineer Middle Rio Grande administrative model to incorporate hydrologic impacts in the Placitas mountain zone. Impacts were quantified based on the Middle Rio Grande Draft Administrative Guidelines.

-Middle Rio Grande Basin: Adapted the U.S. Geological Survey model of the Middle Rio Grande Basin to quantify impacts to the Jemez River.

-Santa Fe County, New Mexico: Adapted the U.S. Geological Survey Model of the Tesuque aquifer system near Santa Fe to quantify impacts to Cienega Creek and extended the historical period from 1985 to 1998.

-Lower Rio Grande Basin: Adapted the Maddock/Hamilton model of the Mesilla Basin to quantify impacts to the Rio Grande from explicit withdrawal of groundwater. The work provided a basis for estimating the magnitude of depletion to surface water from unmetered groundwater withdrawals.

-Rio San Jose Basin, New Mexico: Developed a model of the geohydrologic system for use in quantifying long-term post mining effects to water levels and groundwater flow. Determined and managed approach for assessment of post mining effects on hydrologic system. The work included a particle tracking analysis to investigate the advective transport

potential of groundwater with degraded quality from the mine site to the regional groundwater flow system. The analysis was done for a Closeout Plan of an underground uranium mine. The Closeout Plan was submitted to and accepted by the Mining and Minerals Division of the New Mexico Environment Department.

-Cibola County, New Mexico: Simulated groundwater flow and transport of uranium tailings with the fully three-dimensional, saturated/unsaturated, density-driven model FEMWATER. Simulations included a sensitivity analysis and long-term projections of the fate of tailings water. The analysis involved variably saturated contaminant transport with geochemical retardation. The work was done for a mine Closeout Plan. The Closeout Plan was submitted to and accepted by the Mining and Mineral Division of the New Mexico Environment Department and by the U.S. Nuclear Regulatory Commission.

-Lander County, Nevada: Provided second opinion on mine-dewatering requirements, the overall water operations plan and the hydrologic model used for analyzing mine water operations. The work involved assessing a numerical model of groundwater flow, comparing analytical models for mine dewatering, commenting on factors of concern to mine planning and commenting on required future dewatering rates and environmental impacts.

-Elko County, Nevada: Developed the surface-water flow component for an expanded version of an open pit mine-dewatering model. The model was used to analyze mine dewatering rates and to assess well placement for future dewatering operations. The surface-water system was integrated with the groundwater system in a numerical model of the hydrologic system. Historical mine dewatering operations were calibrated and used to project future dewatering requirements alongside an assessment of changes to the regional hydrologic system resulting from dewatering operations.

-Los Alamos County, New Mexico: Implementation of the U.S. Department of Agriculture model KINEROS to predict sediment yield due to flood events. The interest in sediment transport was related to two watersheds with deposits of depleted uranium in valley sediments and evaluation of potential for elevated uranium levels in downstream drainages.

EXPERT TESTIMONY:

State of Kansas, Before the Division of Water Resources, Kansas Department of Agriculture, *In the Matter of Wichita's Phase II Aquifer Storage and Recovery Project in Harvey and Sedgwick Counties, Kansas, Case No. 18 WATER 14014*, March 4 - 5, 2020) - Assessment of hydrologic and water quality effects to area wells and rivers associated with a proposal to lower the level from which groundwater credit associated with aquifer storage and recovery could be diverted from City of Wichita wells.

Superior Court of the State of Arizona, In and For the County of Maricopa (Contested Case Name: *In re San Pedro Riparian National Conservation Area*, March 12 - 14, 2019) - Assessment of augmentation pumping and use of monitor wells in the context of a federal reserved water right for the San Pedro Riparian National Conservation Area.

New Mexico Office of the State Engineer (Administrative Hearing No. 08-091 & 09-003 Consolidated, January 28 - 29, 2014) - Application for permit to drill a supplemental well within Causey Lingo Underground Water Basin in New Mexico.

New Mexico Office of the State Engineer (Administrative Hearing No. 06-059; October 31 - November 1, 2007) – Application to appropriate groundwater for irrigation use from the High Plains aquifer system in northeastern New Mexico.

New Mexico Office of the State Engineer (Administrative Hearing No. 06-023; May 8, 2007) – Application to transfer groundwater use from a point of diversion in the middle Rio Grande Basin to a municipal supply upstream in the Santa Fe area.

New Mexico Office of the State Engineer (Administrative Hearing No. 00-041, 02-038, 02-068, 02-069, 02-070, & 04-019 consolidated; February 14 - 17, 2005) – Application for a groundwater diversion from a wellfield near an intermittent stream in the Rio Hondo Groundwater Basin.

New Mexico Office of the State Engineer (Administrative Hearing No. 04-003; April 19 - 22, 2005) – Application to transfer a surface-water diversion from irrigation purpose of use to offset storage and evaporation in an upstream reservoir.

New Mexico Office of the State Engineer (Administrative Hearing No. 01-121; September 11 - 13, 2002) – Application to transfer a groundwater point of diversion from a mining purpose of use to municipal use at another location.