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EXPERIENCE

Director of Engineering, R.O. Anderson Engineering, 2007–present. As one of five directors of engineering, my responsibilities include development of research- and practice-oriented projects, interaction with clients and research sponsors, and execution of civil engineering projects, especially those dealing with hydrology and hydraulics.

Adjunct Professor, Texas Tech University, Lubbock, Texas, 2007–Present. Responsible for oversight of graduate students and research projects. Although I am no longer a tenured faculty member, my work continues to support graduate students and I am still a member of the graduate faculty at Texas Tech University.

Associate Professor, Texas Tech University, Lubbock, Texas, 1993–2006. During my tenure at Texas Tech University, I was responsible for developing and teaching courses to undergraduate and graduate students treating hydrologic and hydraulic analysis and design. I was also responsible for developing and executing an externally-funded research program, which I did successfully, executing work exceeding \$5M over the course of 14 years of academic life. I advised hundreds of undergraduate students and oversaw the research work and thesis preparation of 29 graduate students, of which two were for the Ph.D.

Hydrologist, U.S. Geological Survey, Water Resources Division, Office of Surface Water, Stennis Space Center, Mississippi, 1989–1993. When I finished my tenure with the U.S. Federal Government, I was chief of the *Deterministic Models Project* with an annual budget of \$300,000. My prime responsibility was the technical support and training of Division personnel in use of hydrologic and hydraulic models. Additional responsibilities included developing numerical models of hydrologic and hydraulic processes, conducting research in support of deterministic modeling, executing project reviews, completing district surface-water reviews, and instructing theory and practice of hydrologic and hydraulic modeling.

Consulting Hydrologist, self-employed, 1980–present. As a consulting hydrologist, I undertake a variety of assignments. I was involved in legal cases involving flooding of adjacent properties. I worked on legal cases related to groundwater. I analyzed the effect of different pumping strategies for a well field on an alluvial aquifer. I conducted hydrologic studies for coal mine permits, including surface- and ground-water baseline and impact analyses. I analyzed the hydrologic adequacy of spillways for the Missouri Dam Safety program, including dam-breach analyses. I analyzed the impact of rechannelization on the hydraulics of Little Chariton River.

Civil Engineer/Staff Hydrologist, Law Engineering Testing Company, Englewood, Colorado, 1982–1983. While working for Law Engineering, I was responsible for technical execution of a variety of hydraulics and hydrology projects, including analysis of flood plain hydraulics, design of a construction dewatering wellpoint field, and forensic review of an off-stream earth dam with a serious underseepage

problem.

EDUCATION

Ph.D. in Civil Engineering (Hydraulics and Hydrology, Mathematics minor), University of Missouri–Rolla¹, May 1989. Dissertation title: *Determining Parameters for a Continuous Simulation Model by Estimation, Calibration Using Measured Data, or Calibration Using Regional Regression Equations*. Chancellor’s Fellow.

Master of Science in Civil Engineering (Hydraulics and Hydrology), University of Missouri–Rolla¹, May 1983. Thesis title: *A Method for Simulating Hydrologic Budgets Using Meteorological Data and the SCS Curve Number Procedure*. Chancellor’s Fellow.

Bachelor of Science in Civil Engineering University of Missouri–Rolla¹, December 1980. Honors Scholar in Engineering. Honors report title: *A Finite Element Ground-Water Model*, Magna Cum Laude, Tau Beta Pi, Chi Epsilon, Kappa Mu Epsilon, Phi Kappa Phi, Order of the Engineer.

PROFESSIONAL ORGANIZATIONS AND REGISTRATION

Registered Professional Engineer: Missouri (1989), Texas (2006), and Nevada (2008).

Diplomate, Water Resources Engineering (2008).

Certified Floodplain Manager (2007).

Professional Hydrologist, Surface Water (2012).

Member, American Geophysical Union.

Past Member, American Society of Civil Engineers (Chair, Texas section hydraulics technical committee, 1995–2002; chair, Mississippi section technical committee on computers in civil engineering, 1991–1992; branch secretary, Mississippi section 1990).

Past Member, Transportation Research Board Advisory Committee A2A03 on research in hydraulics, hydrology, and environmental concerns (1996–2005; now AFB60). Currently serving as a “friend of the committee” of AFB60 as a member of the subcommittee on hydrology.

RESEARCH

My research interest is the modeling of surface-water and ground-water hydrologic processes. In particular, I am interested in studying problems associated with transport of water and water-borne constituents through the land-based part of the hydrologic cycle. The principal means of investigation are numerical models coupled with physical models and measurements of field processes. For some situations application of statistical analyses and stochastic models is required.

Recent research comprises projects for the Texas Department of Transportation (TxDOT), National Co-

¹The University of Missouri–Rolla is now the Missouri University of Science and Technology.

operative Highway Research Program (NCHRP), and Texas Water Development Board (TWDB). A set of important basic hydrologic studies are underway with cooperation from researchers working for U.S. Geological Survey (USGS), Texas District, Auburn University, and Texas Tech University (TTU). A review of applicable hydrologic technology for application by TxDOT analysts has been ongoing for nearly a decade. In addition, methods for estimating the joint probability of concurrent flooding at stream confluences is a topic of interest for NCHRP. Finally, a project for TWDB recently began to examine the suite of generally available general (GCM) circulation models to determine which model or models is appropriate for estimating climate change for Texas and to determine appropriate mechanics for downscaling GCM results to the regional scale.

PRACTICE

My practical experience is varied and substantial. My focus is on the application of hydrologic and hydraulic models to the solution of engineering problems. I have substantial experience with the hydrologic and hydraulic components of dam safety studies, having worked on more than 30 such studies, mostly in Missouri. I also executed a number of hydraulic modeling studies to address the impact of proposed projects on the floodplain boundaries of FEMA-regulated floodplains. I served as an expert witness involving both surface- and ground-water litigation, for both plaintiffs and defendants.

REFEREED PUBLICATIONS

Dhakal, N., Fang, X., Asquith, W.H., Cleveland, T.G., Thompson, D.B., in preparation. "Rate-based and probabilistic estimation of the rational runoff coefficients," *Journal of Irrigation and Drainage Engineering*, ASCE.

Dhakal, N., Fang, X., Cleveland, T.G., Thompson, D.B., Asquith, W.H., and Marzen, L.J., in review. "Estimation of volumetric runoff coefficients for Texas watersheds using land-use and rainfall-runoff data," *Journal of Irrigation and Drainage Engineering*, ASCE, IRENG-5913.

Cleveland, Theodore G., Thompson, David B., Fang, Xing, and He, Xin, accepted. "Synthesis of unit hydrographs from a digital elevation model." Accepted for publication in *Journal of Hydrologic Engineering*, ASCE.

Asquith, William H. and Thompson, David B., 2008. "Alternative regression equations for estimation of annual peak-streamflow frequency for undeveloped watershed in Texas using PRESS minimization," Scientific Investigations Report 2008-5084, Austin, Texas 40pp.²

Fang, Xing, Thompson, David B., Cleveland, Theodore G., Pradhan, Pratistha, and Malla, Ranjit, 2008. "Time of Concentration Estimated Using Watershed Parameters Determined by Automated and Manual Methods." *Journal of Irrigation and Drainage Engineering* ASCE, Vol. 134, No. 2, 202-211.

Fang, Xing, Thompson, David B., Cleveland, Theodore G., Pradhan, Pratistha, and Malla, Ranjit, 2008. "Variations of time of concentration estimates using NRCS velocity method." *Journal of Irrigation and*

²The U.S. Geological Survey has a formal peer-review process. Publications that are subject to USGS review are read at the local level plus at least two colleague reviewers read every document.

Drainage Engineering ASCE, Vol. 133, No. 4, 314–322.

Cleveland, Theodore G., He, Xin, Asquith, William H., Fang, Xing, and Thompson, David B., 2006. “Instantaneous unit hydrograph evaluation for rainfall-runoff of small watersheds in North and South Central Texas,” *Journal of Irrigation and Drainage Engineering*, ASCE, Vol. 132, No. 5, pp. 479–485.

Asquith, William H., Roussel, Meghan C., Cleveland, Theodore G., Fang, Xing, and Thompson, David B., 2006. “Statistical characteristics of storm interevent time, depth, and duration for Eastern New Mexico, Oklahoma, and Texas,” U.S. Geological Survey Professional Paper 1725, Austin, Texas 299pp.¹³

Asquith, William H. and Thompson, David B., 2005. “Alternative regression equations for estimation of annual peak-streamflow frequency for undeveloped watershed in Texas using PRESS minimization,” TxDOT Research Report 0–4405–2, TechMRT 27pp.¹

Rainwater, K.A., Jackson, W.A., Ingram, W., Lee, C.Y., Thompson, D.B., Mollhagen, T.R., Ramsey, R.H., and Urban, L.V., 2005. “Field Demonstration of the Combined Effects of Absorption and Evapotranspiration on Septic System Drainfield Capacity,” *Water Environment Research*, Vol. 77, No. 2, pp. 150–161.

Fang, X., Cleveland, T., Garcia, C.A., Thompson, D., and Malla, R., 2005. “Literature review on timing parameters for hydrographs,” TxDOT Research Report 0–4696–1, Lamar University, Beaumont, Texas, 77710, 72pp.¹

Asquith, William H. Meghan C. Roussel, Ted Cleveland, Xing Fang, and David B. Thompson, 2004. “Atlas of Storm Arrival Rate, Statistics of Storm Depth and Duration, and Dimensionless Rainfall Hyetographs for Eastern New Mexico, Oklahoma, and Texas.” U.S. Geological Survey Water-Resources Investigations Report, Austin, Texas 78754-4733.¹

Williams-Sether, T., Asquith, W.A., Thompson, D.B., Cleveland, T.G., and Fang, X., 2004. “Empirical, dimensionless, cumulative-rainfall hyetographs developed from 1959–86 storm data for selected small watersheds in Texas,” U.S. Geological Survey Scientific Investigations Report 2004–5075, Austin, Texas, 131pp.¹

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Rainwater, K.A., Ramsey, R.H., and Thompson, D.B., 1999. “A Master’s of Environmental Engineering Curriculum,” *Journal of Professional Issues in Engineering*, 125(2) ASCE, pp. 40–46.

Westphal, J. A., Thompson, D. B., Stevens, Jr., G. T., Strauser, C. N., 1999. “Stage-Discharge Relations on the Middle Mississippi River,” *Journal of Water Resources Planning and Management*, 125(1) ASCE, pp 48–53.

Wood, Warren W., Rainwater, Ken A., and Thompson, David B., 1997. “Quantifying Macropore Recharge: Examples from a Semi-Arid Area,” *Ground Water*, NGWA, Volume 35, Number 6, pp 1097–1106.

³The U.S. Geological Survey Professional Paper series is the most prestigious product of the U.S. Geological Survey.

DeLong, Lewis L., Thompson, David B., and Lee, Jonathan K., 1997. "The Computer Program FOURPT (Version 95.01) — A Model for Simulating One-Dimensional, Unsteady, Open-Channel Flow," Water Resources Investigations Report 97-4016, U.S. Geological Survey, Bay St. Louis, Mississippi, 69pp.¹

Thompson, D.B., DeLong, L.L., and Fulford, J.M., 1992, "Data Encapsulation Using Fortran 77 Modules—A First Step Toward Object-Oriented Programming in Water Resources," Water Resources Investigations Report 92-4123, U.S. Geological Survey.¹

Thompson, D.B. and Rogers, T.D., 1993. "Water Surface Profile Computations—How Many Sections Do I Need?" *Hydraulic Engineering '93: Proceedings of the 1993 National Conference on Hydraulic Engineering*, American Society of Civil Engineers, San Francisco, California, July 26–30, 1993, pp 791–796.

Thompson, D.B., Westphal, J.A., and Kopsky, R.J., Jr., 1993. "Smith's Infiltration Equation and Flooding Infiltrimeters," *Engineering Hydrology: Proceedings of the 1993 National Conference on Hydraulic Engineering*, American Society of Civil Engineers, San Francisco, California, July 26–30, 1993, pp. 25–30.¹

DeLong, L.L., Thompson, D.B., and Fulford, J.M., 1992, "Data Encapsulation Using Fortran 77 Modules," *Fortran Forum* Volume 11, Number 3, ACM, New York, pp. 11–19.¹

Thompson, D.B., 1992, "Numerical Methods 101—Convergence of Hydrodynamic Models in Space and Time," *Proceedings of the Hydraulic Engineering sessions at Water Forum 1992*, American Society of Civil Engineers, Baltimore, Maryland, August 1–5, 1992, pp. 398–403.¹

PRESENTATIONS:

Thompson, David B., 2011. "Site-specific estimates of potential evapotranspiration," presentation to Nevada Mining Association Environmental Committee, Reno, Nevada, December 8, 2011.

Thompson, David B., 2011. "Hydrologic routing — Applied hydrology for engineers and planners," presentation at Minden, Inn, Nevada, January 13, 2011.

Thompson, David B., 2010. "Hydrograph convolution — Applied hydrology for engineers and planners," presentation at Minden, Inn, Nevada, December 9, 2010.

Thompson, David B., 2010. "Design Hyetographs — Applied hydrology for engineers and planners," presentation at Minden, Inn, Nevada, November 18, 2010.

Thompson, David B., 2010. "The Clark Unit Hydrograph Method — Applied hydrology for engineers and planners," presentation at Minden, Inn, Nevada, October 21, 2010.

Thompson, David B., 2010. "The NRCS synthetic unit hydrograph method — Applied hydrology for engineers and planners," presentation at Minden, Inn, Nevada, September 8, 2010.

Kilgore, Roger and Thompson, David B., 2010. "The joint probability of flooding at stream confluences — Results from the NCHRP 15–36 project," presentation at the National Hydraulic Engineer's Conference, Park City, Utah, September 2, 2010.

Thompson, David B., 2010. "Loss-rate functions for select Texas watersheds," presentation at the National Hydraulic Engineer's Conference, Park City, Utah, September 2, 2010.

Thompson, David B., 2010. "Unitgraph Introduction, Part II — Sixth in a series of applied hydrology seminars," presentation at Minden Inn, Minden, Nevada, August 12, 2010.

Thompson, David B., 2010. "Introduction to unit hydrographs — Fifth in a series of applied hydrology seminars," presentation at Minden Inn, Minden, Nevada, July 8, 2010.

Thompson, David B., 2010. "NRCS TR-55 — Fourth in a series of applied hydrology seminars," presentation at Minden Inn, Minden, Nevada, June 10, 2010.

Thompson, David B., 2010. "Regional regression equations — Third in a series of applied hydrology seminars," presentation at Minden Inn, Minden, Nevada, May 13, 2010.

Thompson, David B., 2010. "Joint probability of flooding at stream confluences," presentation to U.S. Army Corps of Engineers, Hydrologic Engineering Center, Davis, California, April 16, 2010.

Thompson, David B., 2010. "The rational method — Second in a series of applied hydrology seminars," presentation at Minden Inn, Minden, Nevada, April 8, 2010

Thompson, David B., 2010. "Introduction to seminar series — Applied hydrology for engineers and planners," presentation at Minden Inn, Minden, Nevada, March 11, 2010.

Thompson, David B., 2010. "Concurrent flooding — drainage area analysis," presentation to California Water Environmental Modeling Federation, Asilomar Conference Center, February 22, 2010.

Thompson, David B., 2009. "LiDAR for topographic measurements," invited presentation to Carson River Coalition, December 15, 2009, Carson City, Nevada.

Thompson, David B., 2009. "A simplified look at concurrent flooding," seminar for California Water Science Center, U.S. Geological Survey, October 20, 2009, Sacramento, California.

Thompson, David B., 2009. "A simplified look at concurrent flooding," paper for AIH/AHS annual conference, August 30–September 2, 2009, Scottsdale, Arizona.

Thompson, David B., Dorman, Troy D., and Tummuri, Spandana, 2009. "Downscaling general circulation models for regional hydrologic studies," Nevada Water Resources Association annual conference, February 4–5, 2009, Reno, Nevada.

Thompson, David B., 2009. "Loss-rate functions for Texas," seminar for David Ford Consulting Engineers and guests, Sacramento, California, January 23, 2009.

Thompson, David B., 2008. "Watersheds, hydrographs, and timing parameters," seminar for R.O. Anderson Engineering, Inc. staff and guests. Minden, Nevada, November 13, 2008.

Thompson, David B., 2008. "Results from application of bivariate distributions and copulas to a prototyping dataset," presentation to NCHRP Panel 15–36, Washington, D.C., September 17, 2008.

Thompson, David B., 2008. "The Texas hydrologic method," seminar for Nevada Department of Transportation hydraulic engineers, Carson City, Nevada, April 10, 2008.

Thompson, D.B. and Al-Saadi, R., 2008. "Comparison of hyetographs from runoff-producing events for

San Antonio,” invited presentation to Transportation Research Board annual conference, Session 305, Hydrology, Washington, D.C., January 14, 2008.

Thompson, D.B., 2006. “Texas flood hydrology,” presented at the Texas section ASCE meeting in Beaumont, Texas, April 19–21, 2006.

Thompson, D.B. and Herrmann, G., 2004. “Texas Hydrology and TxDOT Research,” invited presentation to FHWA Hydraulic Conference, Asheville, North Carolina, September 1, 2004.

Thompson, D.B. and West, E., 1998. “Hydrology of urban playa lakes,” presented at the Texas section ASCE meeting in Ft. Worth, Texas, September 10–11, 1998.

Thompson, D. B., 1997. “Convergence and Gradually-Varied Flow Models,” presented at the Texas section ASCE meeting in Arlington, Texas, October 3–4, 1997.

Thompson, D. B. and Zartman, R. E., 1997. “Soil Erosion Along Highway 20 Near Longview, Texas,” poster presentation, International Erosion Control Association Annual Conference, Nashville, Tennessee, February 25–28, 1997.

Thompson, D. B. and West, E., 1996. “Selection of Cross Sections for Water-Surface Profile Computations,” presented at Texas section ASCE meeting in Beaumont, Texas, April 10–13, 1996.

Thompson, D. B. and Rainwater, K. A., 1995. “A Model of Playa Bottom Infiltration at the Pantex Plant,” presented at the Water for Texas Conference in Austin, Texas, January 26–27, 1995, pp 635–639.

Thompson, D. B. and Medellin, M., 1994. “Comparison of Infiltration Equations Using Flooding Infiltration Data,” presented at the national hydraulics conference on hydraulic engineering, ASCE, Buffalo, New York, August 1–5, 1994.

CONFERENCE PROCEEDINGS:

Dhakal, Nirajan, Fang, Xing, Cleveland, Theodore G., and Thompson, David B., 2011. “Revisiting modified rational method,” *Proceedings of the 2011 World Environmental and Water Resources Congress*, May 22–26, 2011, Palm Springs, California, digital publication (CD-ROM).

Kilgore, Roger and Thompson, David B., 2011. “Estimating joint flow probabilities at stream confluences using copulas,” Transportation Research Board 90th Annual Meeting (January 23–27, 2011), Washington, DC, digital publication.

Dhakal, Nirajan, Fang, Xing, Cleveland, Theodore G., and Thompson, David B., 2010. “Estimation of rational runoff coefficients for Texas watersheds,” *Proceedings of the 2010 World Environmental and Water Resources Conference*, Providence, Rhode Island, May 16–21, 2010, digital publication (CD-ROM).

Thompson, D.B., 2009. “A simplified look at concurrent flooding,” AIH/AHS annual conference, August 30–September 2, 2009, Scottsdale, Arizona, digital publication.

Thompson, D.B. and Al-Saadi, R., 2008. “Comparison of hyetographs from runoff-producing events for San Antonio,” Transportation Research Board annual conference, Washington, D.C., January 14, 2008, digital publication.

- Thompson, D.B., 2007. "Loss-rate parameters for selected Texas watersheds," presented at the American Institute of Hydrology Integrated Watershed Management conference, Reno, Nevada, 22–25 April 2007.
- Cleveland, T.G., Thompson, D.B., Fang, X., and He, X., 2007. "Synthesis of unit hydrographs from a digital elevation model," in *Proceedings of the Texas Section American Society of Civil Engineers, Spring Conference*, April 12–14, Tyler, Texas, digital publication.
- Thompson, D.B., 2006. "Texas flood hydrology," in *Proceedings of the Texas Section American Society of Civil Engineers, Spring Conference*, April 19–21, Beaumont, Texas, digital publication.
- Tummuri, S. and Thompson, D.B., 2006. "Methodology of regional climate impact studies for west Texas and its importance," in *Proceedings of the Texas Section American Society of Civil Engineers, Spring Conference*, April 19–21, Beaumont, Texas, digital publication.
- Fang, X., Qiu, J., Shrestha, G., Cleveland, T., Thompson, D., and Wang, K.H., 2006. "Analysis of Gravel Transport over Low-Water Stream Crossings," in *Proceedings of the Texas Section American Society of Civil Engineers, Spring Conference*, April 19–21, Beaumont, Texas, digital publication.
- Fang, X., Pradhan, P., Malla, R., Cleveland, T., and Thompson, D., 2006. "Estimating time of concentration for Texas watersheds," American Institute of Hydrology Annual Meeting, May 21–24, 2006 Baton Rouge, Louisiana.
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- Cleveland, T.G., He, X., Fang, X., Thompson, D.B. 2006. "Regressions Relating Watershed Physical Characteristics to Unit Hydrograph Parameters for Rainfall-Runoff Modeling in Central Texas" in *Coastal Hydrology and Processes*, Singh, V.P., and Xu, Y.J. eds., Water Resources Publications, Highlands Ranch, CO. pp 465–478.
- Fang, X., Pradhan, P., Malla, R., Cleveland, T.G., and Thompson, D.B. 2006. "Estimating Time of Concentration for Texas Watersheds" in *Coastal Hydrology and Processes*, Singh, V.P., and Xu, Y.J. eds., Water Resources Publications, Highlands Ranch, CO. pp 465–478.
- Cleveland, T.G., Garcia, C.A., He, X., Fang, X., Thompson, D.B., 2005. "Comparison of physical characteristics for selected small watersheds in Texas as determined by automated and manual methods," in *Proceedings of the Texas Section American Society of Civil Engineers, Fall Conference* October 13–15, El Paso, Texas, digital publication.
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- Fang, X., Jianhua Fu, David Thompson, Theodore Cleveland, and William Asquith. "Unit Hydrograph Development for Texas Watershed Using Linear Programming." *Proceedings of the ASCE Texas Section Spring Meeting in Corpus Christi*, April 2–5, 2003.
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Texas." *Proceedings of the ASCE Texas Section Spring Meeting in Corpus Christi*, April 2–5, 2003.

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Resources Center (and others), May 19–20, 1994, pp. 153–160.

Thompson, D. B. and Westphal, J. A., 1990, “Synthetic Calibration of a Rainfall-Runoff Model,” *Proceedings of the 1990 National Conference on Hydraulic Engineering*, American Society of Civil Engineers, San Diego, California, July 30–August 3, 1990, pp. 169–174.

Thompson, D. B. and Westphal, J. A., 1989, “A Tilt at the Wheel of Runoff Simulation,” *Proceedings of the International Conference on Channel Flow and Catchment Runoff: Centennial of Manning’s Formula and Kuichling’s Rational Formula*, cosponsored by the International Association for Hydraulic Research, International Water Resources Association, American Society of Civil Engineers and the American Geophysical Union, Charlottesville, Virginia, May 22–26, 1989, pp. 176–183.

Westphal, J. A. and D. B. Thompson, 1987, “Improving NWS Simplified Dam Breach Analysis,” *Proceedings of the 1987 Water Resources Symposium*, cosponsored by American Society of Civil Engineers, Illinois Association of Environmental Professionals, Illinois Ground-Water Association, and Illinois Association for Floodplain and Stormwater Management, Rosemont Illinois, October 21-22, 1987, pp. 1–11.

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TECHNICAL REPORTS:

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Thompson, David B., 2010. “Simplified dam breach analysis, NRCS Site 14,” engineer’s report submitted to Texas Council on Environmental Quality, R.O. Anderson Engineering, Inc., Minden, Nevada, 15pp.

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Thompson, David B., 2010. “Simplified dam breach analysis, NRCS Site 17,” engineer’s report submitted to Texas Council on Environmental Quality, R.O. Anderson Engineering, Inc., Minden, Nevada, 15pp.

Cleveland, T.G., Fang, X., and Thompson, D.B., 2010. “Use of the rational and modified rational method

for TxDOT hydraulic design,” TechMRT Report 0-6070-1, Lubbock, Texas, in-review.

Thompson, David B., Neddenriep, Kent R., and McReavy, Susan, 2010. “Hydrologic and hydraulic analyses to support application for a LOMR, James Canyon, Douglas County, Nevada,” Engineer’s report, R.O. Anderson, Inc., Minden, Nevada, 51pp.

Thompson, David B. and Bernard, Matt, 2010. “Validation of 2004 BAE Systems LiDAR topography for the Carson Valley portion of the dataset, Phase II,” Engineer’s report, R.O. Anderson Engineering, Inc., Minden, Nevada 20pp.

Thompson, David B., Morse, Audra M., and Acker, Jenna, 2010 (in review). “Analysis of the occurrence and statistics of hazardous materials spill incidents along Texas highways and suggestions for mitigation of transport-related spills to receiving waters,” Texas Tech University, TechMRT Report 0-5200-1, Lubbock, Texas, 149pp.

Thompson, David B. and Bernard, Matt, 2009. “Validation of 2004 BAE Systems LiDAR topography for the Carson Valley portion of the dataset,” Engineer’s report, R.O. Anderson Engineering, Inc., Minden, Nevada, 10pp.

Thompson, David B., 2009. “Flood hydraulics study of Martin Slough,” Engineer’s Report, R.O. Anderson Engineering, Inc., Minden, Nevada, 156pp.

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RESEARCH PROJECTS

Since 1993, Dr. Thompson directed research projects with budgets totaling about \$4.65M. In addition to the projects Dr. Thompson directed, he participated in other research projects with a total funding exceeding \$1.5M.

Assessment of global climate models for water resources planning applications, budget \$90K, funded by Texas Water Development Board. Project objective is to determine the general circulation model or models most appropriate for assessing climate change in Texas and to examine mechanics for downscaling results from the selected model or models. Co-PI with Ken Rainwater (Texas Tech) and Spandana Tummuri (CDMSmith).

Evaluation of hydrologic techniques for areas with low topographic slope, budget \$300K, funded by Texas Department of Transportation. Project objective is to evaluate current hydrologic technology for estimating watershed response time for watersheds with low topographic slope. If (as expected) those methods produce poor estimates, then develop technology appropriate for providing reasonable estimates to be used to develop design discharges for drainage and other hydraulic design activities. Co-PI with Ted Cleveland (research supervisor, TTU), William Asquith (USGS), and Ming-Han Li (Texas A&M).

Subdivision of watersheds for modeling, budget \$325K, funded by Texas Department of Transportation. Intent of the project is to develop a protocol for appropriate subdivision of watersheds into sub-watersheds. Research supervisor with co-PI's William Asquith (USGS) and Ted Cleveland (UH).

Develop statewide regression equations for improved flood peak estimation, budget \$326K, funded by Texas Department of Transportation. Intent of the project is to extend work done on TxDOT Project 0-4405 with regional regression equations using updated methods for flood frequency estimation and regression analysis. Research supervisor with co-PI's with William Asquith (USGS) and Lucia Barbato.

Transport spill containment for Texas highways, budget \$290K, funded by Texas Department of Transportation. Intent of the project is to review and/or develop structures for mitigating hazardous materials spills along highways in sensitive areas. Applied results of other TxDOT research projects to develop mechanics for analyzing capacity of detention ponds to dual-serve as hazardous materials traps. Research supervisor with co-PI Audra Morse.

Estimating joint probabilities of design coincident flows at stream confluences, budget \$350K, funded by National Cooperative Highway Research Program, Washington D.C. Purpose of research is to develop a method for estimating design discharges at locations where there are confluent flows. Co-PI with David Ford and Roger Kilgore as lead.

Timing parameter for unitgraphs, budget \$119K, funded by Texas Dept. of Transportation. Study to examine current procedures for estimating time of concentration (travel time) and compare with other measures to develop a timing parameter for unit hydrograph deployment. Co-PI with Xing Fang (Lamar).

Mitigation of bed-load mobility, budget \$860K, funded by Texas Dept. of Transportation. Study to examine procedures for mitigation of deposition of large bed materials (cobbles and boulders) on, and damage to, low-water crossings in the hill country of Texas. Research supervisor with Co-PI's Will Asquith (USGS), Ted Cleveland and K.H. Wang (UH), and Xing Fang (Lamar).

Hydrologic scale and design procedures budget \$140K, funded by Texas Dept. of Transportation. Study to examine the relation between scale, as represented by drainage area, and design methodology. Research supervisor with Co-PI's Tony Cahill and Ming-Han Li (TAMU), and Will Asquith (USGS).

Review of drainage design methods, budget \$36K, funded by Texas Dept. of Transportation. Study to examine discrepancy between inlet design procedure and drainage network design procedure. Co-PI with Xing Fang (Lamar).

Unit Hydrographs for Texas, budget \$1.04M, funded by Texas Dept. of Transportation. Study to complete literature review of methods for developing and regionalizing unit hydrographs, then compile a data base of streamflow and precipitation measurements and develop a synthetic unit hydrograph for TxDOT design applications. Research supervisor with co-PI's Will Asquith (USGS), Xing Fang (Lamar), and Ted Cleveland (University of Houston).

Design Hyetographs for Texas, budget \$648K, funded by Texas Dept. of Transportation. Study to complete literature review of design hyetographs for development of drainage designs, then apply methods to develop hyetographs specifically for Texas meteorology. TxDOT will use the resulting design procedures for development of highway drainage designs. Research supervisory with co-PI's Will Asquith (USGS), Xing Fang (Lamar), and Ted Cleveland (University of Houston).

Interactions Between Precipitation, Evapotranspiration, Streamflow, and Groundwater, budget \$35K, funded by Texas Water Development Board through the Llano Estacado Regional Water Planning Group. Study to examine statistical correlation and trends between hydrologic variables. Co-directed with Lloyd Urban and Ken Rainwater, Texas Tech University Water Resources Center.

Role of Playa Lakes in the South High Plains Hydrology, budget \$12K, funded by Texas Water Development Board through the Llano Estacado Regional Water Planning Group. Study to synthesize current knowl-

edge of playa lake recharge for the South High Plains region of Texas. Co-directed with Lloyd Urban and Ken Rainwater, Texas Tech University Water Resources Center.

Climatic Adjustment of NRCS Curve Numbers, budget \$370K, funded by Texas Department of Transportation. Study to compute runoff curve numbers from selected watersheds geographically distributed across the state, then examine relations between curve number, aridity, and geographic location. Co-directed with Will Asquith, U.S. Geological Survey.

Updated Topographic Surveys of the Pantex Plant, budget \$58K, funded by Department of Energy through Mason & Hanger Corporation. Study to provide GPS surveys of plant facilities for development of new topographic maps. Ultimately, the mapping will be used to develop hydrologic models for stormwater management. Co-directed with Ken Rainwater.

Effects of Combined Absorbic and Evaporative Disposal Methods on Drainfield Sizing in Arid and Semiarid Areas, budget \$294K, funded by Texas Natural Resource Conservation Commission. Study to evaluate design parameters for septic tank systems installed in arid and semiarid regions of the state. Co-directed with Heyward Ramsey, Ken Rainwater, Tony Mollhagen, and Richard Zartman.

Effectiveness of Low-Cost Stormwater Control Measures, budget \$26K, funded by Texas Department of Transportation. Study to evaluate effectiveness of low-cost stormwater best management practices as applied to highway environments. Co-directed with Harlow Landphair, Texas Transportation Institute, Texas A&M University.

Interactions Between Precipitation, Evapotranspiration, Streamflow, and Ground Water, budget \$25K, funded by Water Resources Center, Texas Tech University and Texas Water Development Board. Study to determine a hydrologic budget for several watersheds along the South High Plains region of Texas and examine for correlation between precipitation, streamflow, and ground water. Co-directed with Ken Rainwater and Lloyd Urban.

Large Scale Injection of Carbon Dioxide for Removal of Carbonate Scale, budget \$10K, funded by Canadian River Municipal Water Authority. Studied effects of injecting carbon dioxide into central system pipeline for removal of carbonate scale (see central system pipeline project below). Co-directed with Ken Rainwater.

Design Guidelines for Channel Modifications, budget \$210K, funded by Texas Department of Transportation. Project called for research and development of design guidelines for stream crossings that incorporate good hydraulic design practices, concern for environmental factors, and fit the aesthetics of the locale. Co-directed with Tony Mollhagen, Heyward Ramsey (Civil Engineering), and Tom Lehman (Geosciences).

Field Study to Determine Feasibility of Using Carbon Dioxide as a Scale Removal Technology, budget \$10K, funded by Canadian River Municipal Water Authority. Project involved assisting Canadian River Municipal Water Authority in testing the efficacy of carbon dioxide injection into the central system pipeline for reducing the pH of the flow such that the water is not saturated with respect to calcium carbonate. Co-directed with Ken Rainwater.

Use of GCM Predictions of Climate Change to Assess Impacts on Water Resources Systems, budget \$270K, funded by National Institute for Global Environmental Change. Project objective was to develop method-

ology to apply GCM outputs to assess potential impact of climate change on river basin hydrology through the flow-duration curve. Required development of river basin model, calibration of model to actual watershed data, development of climate models from regional meteorology, transfer of GCM predictions of changes in mean and variance of climate variables to climate models, and use of resulting climate models to drive the calibrated hydrologic model. Co-directed with Richard Peterson, atmospheric sciences.

Water Budgets of Playa Lakes, budget \$41K, funded by Texas Tech University Water Resources Center. Project was designed to establish and use a database of stage-volume relations and continuous recordings of playa stage to estimate volume of evaporation and infiltration through playa bed sediments.

Mensuration of Playa Lake Bathymetry, budget \$11K, funded by the City of Lubbock, Texas. Project required field surveys of playa lake bathymetry, surface surveys for vertical and horizontal control, and generation of bathymetric (topographic) maps. Co-directed with Tony Mollhagen.

Erosion Control Measures Along Interstate 20 Near Tyler, Texas, budget \$67K, funded by Texas Department of Transportation. Project required selection, recommendation, and testing of erosion control measures for an approximate 100 acre site along Interstate 20. Co-directed with Richard Zartman (Plant and Soil Sciences).

Feasibility Study of Scale Removal Techniques for the Central System Pipeline, budget \$50K, funded by Canadian River Municipal Water Authority. Project involved analysis of hydraulics of a 120-mile long pipeline carrying raw water for Plainview, Lubbock, and other municipal supplies. Further work required analysis of water quality data and chemical modeling to determine the source of carbonate scale which has reduced carrying capacity of the pipeline about 12 percent. Study recommended field-scale testing of carbon dioxide injection to reduce water pH below the saturation level of the carbonate scale. Subsequent dissolution and softening of the scale should result in regaining at least part of the capacity of the pipeline. Co-directed with Ken Rainwater.

Geologic and Hydrologic Site Characterization of the Pantex Plant, budget \$1.1M, funded by U. S. Department of Energy. Supervised application of *STORM* to construct hydrologic budgets for playa lakes on the Pantex site. Project involved monitoring several weirs and raingages, collecting data from data loggers, and checking recorded data for accuracy. *STORM* was calibrated using measured data, and then used to extend meteorological records for estimating the long-term infiltration of water through playa lake sediments. Developed a water-budget model, *WaterBalance*, for computation of water budget of playa lakes and estimation of total infiltration during period of record from 1952–1991. Developed codes to read and use meteorologic data from several sources for computation of evapotranspiration using the FAO-24 Penman method. Co-director ed with Ken Rainwater, Heyward Ramsey, Tony Mollhagen, and Lloyd Urban.

Review of Selected Army Installations for Stormwater Runoff and Nonpoint Source Pollution, budget \$25K, funded by Construction Engineering Research Laboratory, U.S. Army Corps of Engineers. Object was to determine stormwater research needs for Army installations. The project included a literature review to identify innovative and emerging technologies for control and mitigation of stormwater runoff and nonpoint source pollution. Additional work included travel to selected installations and review of best management practices as related to prevention of stormwater-generated pollution. The project focused on industrial areas of Army installations. Co-directed with Lloyd Urban.

Development of One-Dimensional Streamflow Model FOURPT, funded from U.S. Geological Survey project funds. Assisted development of the one-dimensional gradually varied streamflow model FOURPT, a portable finite difference code for solving the one-dimensional flow equations in river and estuarine environments. The model is intended for use both as a training tool for USGS personnel and as a production tool for district and public use. Design of the code emphasized portability and re-usability of program elements, and included use of utilities and database routines developed in the project described below. Co-developer was Lewis DeLong, USGS.

Development of Database Software for Hydraulic and Hydrologic Modeling, funded from USGS project funds. Designed and implemented a database for use in hydrologic and hydraulic models for storage and retrieval of time-series and space-series data. The system was designed using the principle of data encapsulation and completely implemented in standard FORTRAN, resulting in a very portable and robust utility. During the development process, a number of useful utility subprograms were developed and are available for use in many modeling codes.

Determining Parameters for a Continuous Simulation Model by Estimation, Calibration Using Measured Data, or Calibration Using Regional Regression Equations, (dissertation project), budget \$14K, funded by USGS. This project was funded by the United States Geological Survey. It involved a modeling analysis of ungaged watersheds. Objective was twofold: to determine if models of ungaged watersheds can be used based on parameters estimated during site visits; to examine how well models of ungaged watershed perform using parameters estimated from calibration using regional regression equations as data base. Comparison of the results of the two procedures were made against each other as well as against results using measured data to optimize model parameters.

A Method for Simulating Hydrologic Budgets Using Meteorological Data and the SCS Curve Number Procedure, (M.S.C.E. thesis project), unfunded. Problem was to devise a method for estimating water budgets for small, ungaged watersheds which reflects soil moisture storage dynamics during the yearly period. Procedure developed used Monte Carlo simulation of daily rainfall, evapotranspiration estimates from Thornthwaite method, and runoff estimates using SCS curve number scheme to compute a consistent (in the sense that soil moisture storage was considered) water budget.

SURFACE-WATER HYDROLOGY PROJECTS

Flood hydrology of the upper Carson River. Tasked with developing estimates of 100- and 500-year flood events for use in flooding potential of the upper reach of the Carson River. The work was performed for Carson Water Subconservancy District under subcontract to HDR Engineering.

Hydrology of the Dayton Valley reach of the Carson River. Tasked with developing a hydrograph for the 100- and 500-year flood events for a 15-mile reach of the Carson River in Dayton Valley, Nevada. The work was performed for Carson Water Conservancy District under subcontract to HDR Engineering.

Field measurement of soil hydraulic properties for the alluvial fan watersheds in the Pine Nut Mountains, Carson Valley, Douglas County, Nevada. Used tension infiltrometers to make measurements of soil hydraulic properties for the alluvial fan watersheds along the east side of Carson Valley, Nevada. The purpose of the project was to develop scientific data to confirm saturated hydraulic conductivity of watershed soils for use in the Green-Ampt infiltration equation. Work performed for Douglas County, Nevada, and

Carson Water Subconservancy District.

Simplified dam breach analyses of five NRCS flood-control structures in Brown County, Texas. Executed hydraulic modeling to complete simplified dam breach analyses of five small structures in Brown County, Texas. Performed as subcontractor for TRC, who acted as the prime contractor.

Flood hydraulics study of a portion of Buckbrush Wash alluvial fan. Conducted two-dimensional hydraulic modeling using FLO-2D of a portion of the alluvial fan downstream from the fan apex of Buckbrush Wash, Douglas County, Nevada after FEMA revision of base flood hydrology. A CLOMR application was prepared and approved on completion of the floodplain analyses.

Flood study of James Canyon, in Douglas County, Nevada. Conducted hydrologic and hydraulic analysis for a four square mile watershed to determine extent of flooding post-project after construction of a lined channel.

Investigation of flooding for a client in Reno, Nevada. Recent construction adjacent to the affected site might have impacted the historical flow path for flood flows from a portion of Thomas Creek in Reno, Nevada.

Review of Flood Insurance Study (FIS) and Digital Flood Insurance Rate Maps (FIRMs) in Douglas County, Nevada. Technical review of hydrology and hydraulics for the 2008 revision to the Douglas County, Nevada FIS. Reviewed hydrologic modeling and assumptions, mapping revisions to the FIRMs for compliance with digital-FIRM mapping standards, and generated a report to document findings.

Flood study of Martin Slough from Stockyard Road to Toler Avenue, Towns of Minden and Gardnerville, Nevada. Flood hydraulics study using HEC-RAS and approximate methods to determine changes to base flood elevations and floodplain extent for most of Martin Slough, culminating with a report and a LOMR application submitted on behalf of Douglas County, Nevada.

Flood study of a reach of Martin Slough in Minden and Gardnerville, Nevada. Executed HEC-RAS models of Martin Slough to review Douglas County Flood Insurance Study. Determined impact of post-FIRM projects in study reach, assessed impact of proposed floodplain-fringe fill on base flood elevations, generated a project report, and prepared application for a CLOMR.

Expert for plaintiff: Reviewed drainage and flooding problem for a client in Reno, Nevada. Case settled in favor of plaintiff.

Hydrologist for water-rights applications in Carson Valley, Nevada. Analyzed 60 years of Carson River flow data to determine changes in flow conditions. Analysis in opposition to protests against the applications.

Flood study of Cottonwood Slough in Gardnerville, Nevada. Executed HEC-RAS model of Cottonwood Slough to review Flood Insurance Study and determine impact of fill on client's property. Prepared detailed report and application for a CLOMR.

Expert for defendant: Reviewed ground-water associated with foundation failure of homes in Laredo, Texas. Case settled.

Expert for plaintiff: Reviewed drainage design for a public school system in Las Cruces, New Mexico. Case settled in favor of plaintiff.

Multi-dimensional hydrodynamic model of Guadalupe River delta. Developed a two-dimensional flow model (RMA2) of lower Guadalupe River delta, analyzed low-flow patterns, and developed data collection plan to support further modeling. Project ended with preparation of engineer's report.

Expert for plaintiff: analyzed impact of gravel pack on groundwater well hydraulics. Case found in favor of defendant.

Designed detention pond and wrote drainage report for two-acre development in Abilene, Texas.

Expert for defendant: Analyzed flood patterns on development site using FESWMS two-dimensional hydrodynamic model. Case terminated.

Expert for defendant: Analyzed impact of bridge structure on river flow regime using FESWMS two-dimensional model. Case terminated.

Expert for plaintiff: Reviewed drainage conditions and impacts of changes by county government on plaintiff's property. Case terminated.

Expert for plaintiff: Conducted hydrologic and hydraulic analyses of flooding of homes in Timberlakes and Timberridge subdivisions in Montgomery County, Texas. Case terminated.

Expert for plaintiff: Conducted hydrologic analysis of flooding of house and out-buildings near Knott, Texas. Case terminated.

Conducted Phase II dam safety analyses for 20 Missouri Department of Conservation dams. Participated in site reconnaissance of dams, watersheds, and downstream environmental zones. Conducted surface-water analyses to determine adequacy of existing spillway structures. Performed simplified breach analyses to investigate downstream environmental classification. Reported results of investigations for inclusion in Phase II inspection reports.

Completed detailed dam breach analyses of four Missouri Department of Conservation dams. Conducted detailed analyses of results of rapid and complete breach of two earth embankments using National Weather Service Dam Break Flood Forecasting Model. Assisted with analysis of breach of two other dams. Wrote reports presenting results of analysis for two of the four embankments.

Prepared the hydrologic report for 1985 mining permit for NEMO Coal Company, Moberly, Missouri. Supervised preparation of hyetographs, infiltration capacity curves, and synthetic unitgraphs to assess relative impact of mining on the surface-water regime. Project culminated with the preparation of a written report.

Executed hydrologic and hydraulic studies in support of relocation of Middle Fork of the Little Chariton River for Associated Electric Cooperative, Moberly, Missouri. Conducted field surveys to determine river cross sections. Conducted modeling effort using HEC-1 and DAMBRK to determine existing conditions and the intermediate and long-term effects of relocating a one-half mile reach of the Middle Fork Little Chariton River.

Completed detailed dam breach analysis of Holiday Acres Lake near Moberly, Missouri. Developed inflow hydrographs and conducted HEC-1 dam breach modeling to reduce downstream hazard classification for the reservoir.

Completed detailed dam breach analysis of Raintree Plantation Dam. Developed inflow hydrographs and conducted HEC-1 dam breach analysis to reduce downstream hazard classification of the reservoir.

Executed dam safety analysis of Mineral Point No. 1 and No. 2 dams. Developed inflow hydrographs and designed broad-crested weir spillways for two barite tailings dams for Pfizer Chemical Company.

Completed feasibility-level design and cost estimate for a channelization study for Cherry Creek near Denver, Colorado. Conducted hydraulic analyses to determine channel geometry so that a cost estimate could be made. Developed cost estimate for earthwork, rip rap, and site fill activities to reduce the extent of the 100-year flood plain for an estimated flow rate of 50,000 cubic feet per second.

Executed hydrologic analyses and spillway design for Pond Creek mine tailings dam. Developed design flood and designed broad-crested weir spillways for a three-stage barite tailings dam. Estimated downstream flooding potential for catastrophic failure of existing tailings dam and sequential failure of existing and proposed dams for IMCO Mining Company, Potosi, Missouri.

Designed spillways for Tiff No. 1 and Tiff No. 2 mine tailings dams. Developed design flood and designed broad-crested weir spillways for IMCO Mining Company.

Prepared hydrologic report for mining permit for NEMO Coal Company, Moberly, Missouri. Developed hydrographs, infiltration capacity curves, synthetic unitgraphs, and runoff hydrographs for HEC-1 applications to examine effects of surface mining on peak flow and runoff volume for various return intervals.

Prepared hydrologic report for mining permit for Missouri Mining and Reclamation Company, Fort Scott, Kansas. Developed hydrographs and unitgraphs for HEC-1 applications to ascertain the effects of surface mining on peak discharge and runoff volume for various return periods.

Prepared hydrologic report for mining permit for Howard County Coal Company, Moberly, Missouri. Developed hydrographs, synthetic unitgraphs, and infiltration capacity curves for HEC-1 applications to evaluate the effects of mining on peak discharge and runoff volume for various return periods.

CIVIL ENGINEERING DESIGN PROJECTS

Project Engineer for Ashbrooke Executive Park, a 200-acre office and light industrial subdivision in Arapahoe County, Colorado. Responsible for layout of one-acre lots and design of streets, sanitary sewers, and storm sewers, and supervision of compilation of construction drawings. This project involved several hydraulic analyses to determine location and extent of 100-year flood plain for two streams.

Project Engineer for Country Club Executive Park, a commercial subdivision in Arapahoe County, Colorado. Responsible for layout of lots and streets, flood plain encroachment study and initial designs of facilities for proposed development.

Project Engineer for land development projects. Responsible for initial layouts and flood plain analyses for feasibility level designs for 250 and 150 acres sites in Arapahoe County, Colorado.

Designer of Hunter's Ridge subdivision in Overland Park, Kansas. Designed streets, sanitary sewers, and storm drainage facilities, and developed construction documents.

Designer of Gatewood subdivision in Overland Park, Kansas. Designed streets, sanitary sewers, and storm drainage facilities, and developed construction documents.

Designer of sewage collection and interceptor system. Performed analysis of existing and projected sewage flows, conducted route surveys for engineering purposes, developed legal descriptions for easements, designed and prepared construction drawings, quantity estimates, and cost estimates for modifications to the sewage system of the City of St. James, Missouri.

Designer of sewage interceptor system. Conducted preliminary route location, surveys, easement descriptions, designs, construction drawings, quantity estimates, and cost estimates for sewage interceptors for the City of Richland, Missouri.

Designer of street improvements for the City of Cuba, Missouri. Crew chief for engineering surveys, reviewed property surveys, designed street improvements which included curb and gutter, asphalt paving, and drainage improvements, prepared construction drawings, quantity estimates and cost estimates, and completed field staking for construction of project.

Designer of Line Barnitz First Addition. Performed land and engineering surveys, designed lot layout, streets and drainage facilities for subdivision.

Designer of Pine Tree Road. Conducted engineering surveys, prepared design of major arterial street, including horizontal and vertical geometry, intersections, drainage, construction documents, and field staking for City of Rolla, Missouri.

Designer of Soest Road improvements. Conducted engineering survey, reviewed existing property descriptions, designed new street geometry and drainage facilities and developed construction documents for the City of Rolla, Missouri.

GROUND-WATER PROJECTS

Analyzed well hydraulics to support a water rights application for City of Gardnerville, Nevada.

Expert witness: analyzed impact of local groundwater on homeowner's foundation.

Analyzed high water table near surface-water impoundments in Thompson Park, Amarillo. Conducted field investigations, supervised drilling operation, conducted slug tests to determine aquifer properties, constructed a cross-sectional groundwater model, and designed french drain to reduce water table.

Well field analysis and design. Reduced data from pump tests and operated numerical ground-water model to analyze effects of various pumpage rates on potential surface of Missouri River alluvial aquifer.

Review of recommended remedial actions and analysis of underseepage beneath an off-stream peaking water supply reservoir. Reviewed reports and recommendations of previous consultants, supervised field investigations including soil boring and rock coring, packer testing, bailer tests, and monitoring well installation. Analyzed underseepage using flow net procedures and prepared a report summarizing findings.

Hydrologic analysis for mining permit for a coal mining company. Characterized, interpreted, and reported the expected impact of surface mining on the ground-water and surface-water flow system.

Design of excavation dewatering system. Designed a well point dewatering system for a coal storage pit excavation. Developed a computer model to determine pumping rates and the time required to dewater the excavation.

Impact analysis of coal strip mine on three-tier ground-water flow system. Reduced slug test data to estimate transmissivity and modeled each tier separately as an areal flow system. Operated a cross-sectional model to examine vertical potential distribution after mining for Associated Electric Cooperative, Moberly, Missouri.