FEE EXEMPT

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Attorney for APPROPRIATIVE POOL

SUPERIOR COURT OF THE STATE OF CALIFORNIA

FOR THE COUNTY OF SAN BERNARDINO

CHINO BASIN MUNICIPAL WATER DISTRICT,

Plaintiff,

v.

CITY OF CHINO et al,

Defendants,

Case No. RCVRS 51010

[Assigned for All Purposes to the Honorable Stanford E. Reichert]

DECLARATION OF THOMAS E. HARDER IN SUPPORT OF APPROPRIATIVE POOL REPLY TO AGRICULTURAL POOL'S OPPOSITION TO WATERMASTER MOTION REGARDING 2020 SAFE YIELD RESET, AMENDMENT OF RESTATED JUDGMENT, PARAGRAPH 6

Date: June 26, 2020
Time: 1:30 p.m.
Dept. S-35

Filed concurrently herewith: Appropriative Pool Reply To Agricultural Pool's Opposition To Watermaster Motion Regarding 2020 Safe Yield Reset, Amendment of Restated Judgment, Paragraph 6

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DECLARATION OF THOMAS E. HARDER

I, Thomas E. Harder, declare as follows:

1. I have personal knowledge of the following facts, and if called upon to testify regarding such facts, I could and would competently testify thereto.

2. I am a California registered Professional Geologist and California Certified Hydrogeologist with more than 30 years of experience in hydrogeology and groundwater resource management. I am the President of Thomas Harder & Company, a groundwater consulting company that specializes in perennial yield (i.e. safe yield), groundwater basin analysis, groundwater models, artificial recharge, groundwater resource development, groundwater management, water well design, stratigraphic analysis, groundwater quality and contaminant hydrogeology. I hold a bachelor's degree in geology from California State Polytechnic University, Pomona and a master's degree in geology (hydrogeology emphasis) from California State University, Los Angeles. I have specific expertise on the geology, hydrogeology and water resource management of the Chino Basin through almost 20 years conducting studies for and providing technical support to Chino Basin Watermaster (Watermaster) stakeholders. This technical support has included land subsidence technical studies, siting and design of more than 20 high capacity production wells including eleven Chino Basin Desalter wells, development of a groundwater flow model for the Chino Basin Desalter, participation on various Watermaster committees including the Recharge Masterplan Steering Committee, and peer review of the 2010 and 2020 Safe Yield reset models. I provided technical input for the 2015 Safe Yield Reset Methodology. A copy of my resume, which accurately states my education and experience, is attached to this Declaration.

3. I was asked to review and opine on the "Agricultural Pool's Opposition to Watermaster's Motion Regarding the 2020 Safe Yield Reset, Amendment of Restated Judgment, Paragraph 6, Declaration of Tracy J. Egoscue," dated June 15, 2020.

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4. The Agricultural Pool asserts that the proposed Safe Yield reset "will indeed result in undesirable result or MPI because it does not account for the overallocation of Safe Yield by approximately 100,000 acre-ft (AF) from 2011 to 2020" (Opposition 4:1-3).

5. Despite the Agricultural Pool's assertion that the reset Safe Yield will cause an undesirable result or Material Physical Injury (MPI), they have provided no detail on the nature of the MPI caused by the revised Safe Yield, who is, or would be, harmed and how. Potential examples of MPI would include inducement of land subsidence or excessive drawdown resulting in the need to lower pumps or deepen wells. No specific cases have been cited. Further, they have provided no analysis demonstrating that MPI has occurred or is imminent. They have only provided a vague statement that not accounting for the apparent overallocation of Safe Yield will result in MPI.

6. I am not aware of any current claims of MPI from any of the Watermaster Parties. If the alleged overallocation of Safe Yield has resulted in MPI, specific claims would have been made that would have been factored into the 2020 SYR process.

7. In contrast, Watermaster's engineer has conducted an analysis of MPI based on output from a calibrated groundwater flow model of the Chino Basin. The basis for determination of MPI was the same future projection scenario, analyzed with the model, that was used to reset Safe Yield. Watermaster's engineer determined that no MPI is predicted into the future under the currently revised Safe Yield of 131,000 acre-ft/yr. Unlike the Agricultural Pool's unsupported claim of MPI, the Watermaster's determination is based on model analysis.

8. The model used by Watermaster's engineer to revise the Safe Yield and determine MPI was calibrated through 2018 with measured or estimated input specific to the time period. This included actual hydrology, actual managed recharge, and actual pumping and accrual of water in storage accounts through 2018. In addition, the forward projection incorporates an estimate of how stakeholders will utilize their storage accounts into the future. Any overallocation of Safe Yield for the period 2010 through 2020 would have been accounted for in the estimate of Safe Yield and the determination of no MPI.

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9. There is no provision in the 2015 Safe Yield Rest Methodology that requires adjustments to account for overestimated Safe Yield in the prior 10 years. In accordance with Element 5 of the 2015 Safe Yield Methodology, no adjustments were necessary because no MPI was evident from the forward projection.

I declare under penalty of perjury pursuant to the laws of the State of California that the foregoing is true and correct.

Executed this 18th day of June 2020 in Anaheim, California .

Thomas Harder

THOMAS E. HARDER

JOHN SCHATZ
Attorney at Law
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ATTACHMENT

THOMAS E. HARDER

Hydrogeologist

EDUCATION

B.S., Geology. California State Polytechnic University - Pomona, 1990

M.S., Geology with Honors. Emphasis in Hydrogeology, California State University – Los Angeles, 1995

PROFESSIONAL REGISTRATIONS

California Professional Geologist (No. 6512)

Certified California Hydrogeologist (No. 588)

PROFESSIONAL AFFILIATIONS

National Ground Water Association

Groundwater Resource Association of California

Watereuse Association

During his 30 years of professional experience, Mr. Harder has provided technical direction and management for some of the largest water resource projects in southern California, including the Chino Desalter Well Field Design and Construction, the Kern Water Bank, and the Mojave Water Agency's Regional Recharge and Recovery Project. His expertise spans a wide range of hydrogeological disciplines, including regional groundwater basin analysis, perennial yield (i.e. safe yield), artificial recharge, groundwater management, groundwater models, contaminant hydrogeology, and water wells.

PROFESSIONAL EXPERIENCE

2008 to Present: *Principal Hydrogeologist*, Thomas Harder & Co.; Anaheim, California

1998 to 2008: *Senior Geohydrologist*, Geoscience Support Services, Inc.; Claremont, California

1997 to 1998: *Principal Hydrogeologist, Geosciences Department Manager*, Parsons Engineering Science; Pasadena, California

1989 to 1997: *Senior Geologist*, Harding Lawson Associates; Irvine, California

TECHNICAL COMMITTEE PARTICIPATION

2016 - Present: Metropolitan Water District of Southern California Regional Recycled Water Recharge Scientific Advisory Panel

2011 to 2016: Kern Fan Monitoring Committee – Groundwater Model Technical Advisory Subcommittee

2010 to 2013: Chino Basin Recharge Master Plan Steering Committee

2009 to 2012: Chino Basin Watermaster Appropriative Pool and Advisory Committee

2003 to Present: Big Bear Lake Department of Water Groundwater Management Technical Review Team

2002: Chino Basin Subsidence Technical Committee

PROJECT EXPERIENCE – GROUNDWATER MANAGEMENT

Chino Basin Environmental Water Storage/Exchange Project – Chino Basin, CA

Client: Inland Empire Utilities Agency. 2018 - Present.

Mr. Harder provided a preliminary analysis of various recharge and recovery alternatives associated with a regional recharge and recovery project. The project entails an advanced water treatment facility that would provide up to 15,000 acre-ft/yr of advanced treated recycled water which would be used to recharge the Chino Groundwater Basin using injection wells or recharge basins. This water would be stored solely for ecosystem benefits in the Sacramento-San Joaquin Delta. In-lieu of imported water deliveries, the stored water could be pumped out at a rate up to 50,000 acre-ft/yr and delivered to an imported water pipeline.

Tule Subbasin Sustainable Groundwater Management Act Compliance – Tulare County, CA

Client: Tule Subbasin TAC. 2017 - Present.

Currently providing technical direction to the Tule Subbasin Technical Advisory Committee for compliance with the Sustainable Groundwater Management Act (SGMA). This has included development of a basin-wide monitoring plan and technical sections of the subbasin Coordination Agreement.

Kaweah Subbasin Sustainable Groundwater Management Act Compliance – Tulare County, CA

Client: City of Visalia. 2018 - Present.

Currently serving as a technical representative for the City of Visalia on the Kaweah Subbasin Technical Advisory Committee for compliance with SGMA. This has included technical review of hydrogeological reports and a model prepared by another consultant.

Beaumont Basin Watermaster

Client: Beaumont Basin Watermaster. 2012 to Present.

Provides groundwater management planning services to the Beaumont Watermaster. This includes assistance with annual reports, analysis of operating safe yield, and basin condition assessments. Mr. Harder also provides analysis of various proposed projects and management actions using a calibrated groundwater flow model.

Chino Basin Watermaster Recharge Master Plan Update

Client: Jurupa Community Services District. 2009 to 2013.

Mr. Harder served on the technical steering committee for development of the Chino Basin Recharge Master Plan Update, published in 2013.

Chino Basin Watermaster

Client: Jurupa Community Services District. 2009 to 2012.

Representative for the JCSD on the Appropriative Pool and Advisory Committees. Provides input and direction on policy issues that affect the JCSD.

PROJECT EXPERIENCE – GROUNDWATER MANAGEMENT

Kern Water Bank Joint Operating Committee

Client: Rosedale-Rio Bravo Water Storage District. 2012 to Present.

Mr. Harder provides technical direction to the Joint Operating Committee for evaluating the impacts of projected pumping and/or recharge within the Kern Water Bank on area private wells. Analysis is informed through the annual update of Thomas Harder & Co.'s calibrated numerical groundwater flow model of the Kern Water Bank and area.

City of Pomona Integrated Water Supply Plan

Client: RMC Water/City of Pomona. 2010.
Provided an analysis of groundwater supply issues related to an overall water supply strategy for the City. Included an analysis of groundwater production in the Chino, Six Basins area, and Spadra Basin.

Santa Ana Watershed Cooperative Agreement

Client: San Gorgonio Pass Water Agency. 2009.
Provided technical support to the Agency in meeting the requirements of the Regional Water Quality Control Board's Cooperative Agreement for total dissolved solids and nitrate management associated with the artificial recharge of imported water within the Santa Ana River Watershed.

Adelanto Water Development Strategy – Adelanto, CA

Client: Confidential. 2007 to 2008.
Developed a strategy to meet anticipated water supply demands for a proposed 5,000 unit residential development near Adelanto, CA. Included a planning-level assessment of imported water, groundwater, recycled water and conservation options as part of an integrated water supply plan.

Gillibrand/Tapo Canyon AB3030 Groundwater Management Plan – Simi Valley, CA

Client: Ventura County Waterworks District No. 8 City of Simi Valley. 2006 to 2007.
Developed a groundwater monitoring and management plan in accordance with AB3030 as a cooperative program for the City of Simi Valley and the P.W. Gillibrand Mining Corporation.

Chino Desalter System Projects Groundwater Monitoring and Mitigation Plan – Chino, CA

Client: Chino Basin Desalter Authority. 2002 to 2004.

Developed a comprehensive groundwater monitoring and mitigation plan for the Chino Desalter well field. The purpose of the plan was to address potential impacts from lowering the groundwater level on private agricultural wells in the vicinity of the well field.

Big Bear Valley Groundwater Monitoring and Management Plan – Big Bear Lake, CA

Client: City of Big Bear Lake Department of Water & Power. 2002 to 2005.

Developed a comprehensive groundwater monitoring and management plan for the Big Bear Lake area of the San Bernardino Mountains. Currently serving as a member of a technical review team to periodically review monitoring data and provide input for basin management decisions.

PROJECT EXPERIENCE – GROUNDWATER MANAGEMENT

Lake Arrowhead Integrated Surface and Groundwater Management Plan – Lake Arrowhead, CA

Client: Lake Arrowhead Community Services District. 2004 to 2007.

Developed a groundwater monitoring and management strategy for the Lake Arrowhead area. Included identifying monitoring features and potential locations for the features to improve the existing database for the area's water resources.

Cadiz Groundwater Storage and Dry-Year Supply Program – Cadiz, CA

Client: Metropolitan Water District of Southern California. 1998 to 2002.

Provided technical assistance for the development of an EIR/EIS for the project that included a detailed and comprehensive groundwater monitoring and management plan. The plan covered an area of approximately 1,500 square miles of the eastern Mojave Desert and included implementation of cluster monitoring wells, soil moisture instrumentation, stream gages, evapotranspiration stations, and other weather stations. Participated in meetings with the U.S. Geological Survey, U.S. Bureau of Land Management, U.S. Parks Department, and the County of San Bernardino to adjust and finalize the monitoring and management plan.

Robinson Ranch Golf Course – Santa Clarita, CA

Client: Robinson Development Corporation. 2000.

Developed a comprehensive groundwater monitoring and management plan for groundwater pumping related to irrigation for a golf course. The plan outlined a monitoring well network and detailed monitoring and sampling protocol. The plan was prepared in cooperation with the State of California Water Resources Control Board.

PROJECT EXPERIENCE – WATERSHED / GROUNDWATER BASIN EVALUATIONS

Tule Subbasin Water Balance Analysis/SGMA Compliance – Tulare County, CA

Client: Tule Subbasin MOU Group. 2015 to present.
Prepared detailed surface water and groundwater budgets for the Tule Subbasin and surrounding watershed. The analysis resulted in change in groundwater storage estimates using multiple methods for the period between 1987 and 2014. The work was originally used in support of a legal case for which Mr. Harder served as an expert witness. The water budgets were later refined for use in support of Sustainable Groundwater Management Act (SGMA) compliance for the Tule Subbasin MOU Group.

Aliso Creek Groundwater Supply Evaluation – Laguna Niguel, CA

Client: Moulton Niguel Water District. 2017 - Present.
Conducted a feasibility study for the development of groundwater resources in the Aliso Creek Canyon. The study included the drilling and testing of three monitoring wells and two test wells.

Cummings Valley Safe Yield Evaluation – Tehachapi Mountains, CA

Client: SunSelect Produce. 2015.
Conducted a peer review of a safe yield evaluation of the Cummings Valley Groundwater Basin near Tehachapi, California.

South Fork Kern River Valley Surface and Groundwater Analysis – Kern County, CA

Client: Spaletta Law/Rosedale-Rio Bravo Water Storage District. 2015 to present.
Prepared a detailed hydrogeological conceptual model, surface water budget, groundwater budget for an analysis of groundwater resources in the South Fork Kern River valley. The analysis included development of a three-dimensional numerical surface and groundwater flow model.

Lee Lake Groundwater Basin Water Balance Analysis – Riverside County, CA

Client: VA Consulting/Summit Partners, LLC. 2014 - 2015.
Conducted a surface and groundwater water balance for the Lee Lake Groundwater Basin near Corona, California.

Chino Basin Reevaluation of Safe Yield – San Bernardino County, CA

Client: Chino Basin Watermaster Appropriative Pool. 2013 - 2015.
Conducted a peer review of safe yield methodology and results for the Chino Groundwater Basin in southwestern San Bernardino County, California.

Beaumont Basin Reevaluation of Safe Yield – Riverside County, CA

Client: Beaumont Basin Watermaster. 2012 - 2014.
Conducted a reevaluation of the safe yield of the Beaumont Basin adjudicated area as required by the Judgment for the Beaumont Basin Watermaster. Included the development of a numerical groundwater flow model of the basin for use in the reevaluation.

PROJECT EXPERIENCE – WATERSHED / GROUNDWATER BASIN EVALUATIONS

San Bernardino Liquefaction Mitigation Project – San Bernardino, CA

Client: PACE/Inland Valley Development Agency. 2009 to 2010.

Conducted an evaluation of potential pumping necessary to lower groundwater levels in the downtown San Bernardino area to levels that are preventative of liquefaction in the event of an earthquake.

Arrastre Creek Water Resource Evaluation – San Bernardino Mountains, CA

Client: City of Big Bear Lake Department of Water and Power. 2010.

Conducted a perennial yield evaluation of the Arrastre Creek Watershed, located east of the community of Lake William in the San Bernardino Mountains, California. Perennial yield was evaluated using a simplified water balance approach as a basis for developing the groundwater resource as a water supply for the nearby community. Provided an analysis and recommendations for potential well sites to develop the resource.

Peer Review of USGS Scientific Investigations Report – Big Bear and Baldwin Lakes Watershed, CA

Client: City of Big Bear Lake Department of Water and Power. 2007.

Prepared peer review comments for the United States Geological Survey's draft report entitled "Geohydrology of the Big Bear Groundwater Basin, California." Coordinated revisions to the report with USGS scientists.

Murrieta Valley Perennial Yield Evaluation – Murrieta, CA

Client: Western Municipal Water District. 2006.

Technical advisor for a perennial yield evaluation of the Murrieta Valley in Riverside County, California. Provided an analysis and recommendations for potential artificial recharge sites to supplement natural recharge in the area.

Tapo Canyon Perennial Yield Evaluation – Simi Valley, CA

Client: Ventura County Waterworks District No. 8 City of Simi Valley. 2005 to 2006.

Project manager and technical advisor for the development of a detailed hydrogeologic analysis of the watershed surrounding Tapo Canyon for the purpose of developing estimates of maximum perennial yield (i.e. safe yield). Included the development of a detailed watershed hydrologic model (using EPA HSPF), which was calibrated to stream flow. Provided recommendations for future production wells based on study results.

Lake Arrowhead Perennial Yield Evaluation – Lake Arrowhead, CA

Client: Lake Arrowhead Community Services District. 2004 to 2005.

Project manager and technical advisor for the development of a detailed hydrogeologic analysis of the watersheds surrounding Lake Arrowhead for the purpose of developing estimates of maximum perennial yield (i.e. safe yield). Included the development of a detailed watershed hydrologic model (using EPA HSPF), which was calibrated to historical lake levels.

PROJECT EXPERIENCE – WATERSHED / GROUNDWATER BASIN EVALUATIONS

Big Bear Lake Area Groundwater Exploration Program – Big Bear Lake Watershed, CA

Client: City of Big Bear Lake Department of Water and Power. 2002 to 2005.

Project manager and technical advisor for an ongoing test drilling program in the Big Bear Lake Watershed to evaluate the groundwater production potential of areas identified as potential well sites. Eleven test drilling sites have been explored. The testing program includes detailed stratigraphic analysis, depth-specific production and water quality testing, supervision and interpretation of geophysical logs, and design and construction of monitoring wells at key locations.

Perennial Yield – Lake Williams Tributary Subarea, Baldwin Lake Watershed, CA

Client: City of Big Bear Lake Department of Water and Power. 2004.

Developed a detailed hydrogeologic analysis of the tributary subarea surrounding Lake Williams in the Baldwin Lake Watershed of the San Bernardino Mountains for the purpose of developing estimates of maximum perennial yield (i.e. safe yield). Included the development of a detailed watershed hydrologic model (using EPA HSPF).

Hydrogeologic Evaluation of Gypsum Canyon – Northern Santa Ana Mountains, CA

Client: Confidential. 2004.

Performed a study to assess the groundwater resources of the Gypsum Canyon Area of the Northern Santa Ana Mountains. Included an evaluation of potential natural groundwater recharge and an impact analysis for use in support of an EIR for a future housing development.

Hydrogeologic Evaluation of Rattlesnake Canyon – Northern Santa Ana Mountains, CA

Client: Confidential. 2003 to 2004.

Performed a study to assess the groundwater resources of the Rattlesnake Canyon Area of the Northern Santa Ana Mountains. Included an evaluation of potential natural groundwater recharge and an impact analysis for use in support of an EIR for a future housing development.

Baldwin Lake Area Groundwater Exploration Program – Big Bear City, CA

Client: Big Bear City Community Services District. 2003.

Designed and supervised a test drilling program to evaluate the groundwater production potential of three sites within the Baldwin Lake watershed. The testing program included detailed stratigraphic analysis, depth-specific production and water quality testing, supervision and interpretation of geophysical logs.

Hydrogeologic Evaluation of Irvine Lake Area – East Orange, CA

Client: Confidential. 2003.

Performed a study to assess the groundwater resources of the Irvine Lake Area of the Northern Santa Ana Mountains. Included an evaluation of potential natural groundwater recharge, groundwater quality and an impact analysis for use in support of an EIR for a future housing development.

PROJECT EXPERIENCE – WATERSHED / GROUNDWATER BASIN EVALUATIONS

Perennial Yield Evaluation – North Shore and Grout Creek Subunits, Big Bear Lake, CA

Client: City of Big Bear Lake Department of Water and Power. 2003.

Developed a detailed hydrogeologic analysis of the North Shore and Grout Creek Hydrologic Subunits on the north side of Big Bear Lake in the San Bernardino Mountains of southern California for the purpose of refining previous estimates of maximum perennial yield (i.e. safe yield). Included delineation of tributary subareas and a detailed analysis of the geology, aquifer systems, groundwater levels, groundwater production, groundwater quality, precipitation, evapotranspiration, and surface water runoff for each subarea. Included the development of a detailed watershed hydrologic model (using EPA HSPF).

Raymond Basin Baseline Hydrogeologic Study – Pasadena, CA

Client: Raymond Basin Management Board. 2003.

Performed a study to assess Raymond Basin Management Board's long-term groundwater storage program through a detailed hydrogeologic evaluation of the Raymond Basin. The study included development of a relational database of existing data, display and manipulation of data using a geographic information system (GIS), development of a groundwater monitoring and management plan, and development of a 3-dimensional groundwater flow model for use in future basin management and planning.

Hydrogeologic Analysis of Subsidence in the Western Chino Basin – Chino, CA

Client: City of Chino Hills. 2002 to 2003.

Prepared a hydrogeologic analysis of land surface subsidence associated with groundwater withdrawal in the western portion of the Chino Basin. The study included a detailed stratigraphic and structural analysis of the western Chino Basin along with an evaluation of groundwater levels and groundwater pumping between 1900 and 2001.

Hydrogeologic Evaluation of the Northwestern Portion of the Chino Basin – Upland, CA

Client: Chino Basin Water Conservation District. 2001 to 2003.

Conducted an evaluation of the effects of the San Jose fault on groundwater flow between the Claremont and Chino Groundwater Basins. Included a detailed analysis to locate the trace of the fault using satellite data (Interferometric Synthetic Aperture Radar – InSAR) and seismic reflection geophysics, analysis of groundwater levels in wells on either side of the fault, and stratigraphic analysis.

Chino Groundwater Basin Study – Western San Bernardino and Riverside Counties, CA

Client: Santa Ana Watershed Project Authority. 2001.

Conducted a detailed hydrogeologic analysis of the Chino Groundwater Basin for the purpose of evaluating the potential impacts of developing a 13-well wellfield in the southern portion of the basin. The hydrogeologic analysis served as a conceptual model for the development of a groundwater flow model that encompassed approximately two-thirds of the basin.

PROJECT EXPERIENCE – WATERSHED / GROUNDWATER BASIN EVALUATIONS

Hydrogeologic Analysis of the Northern Portion of the Irvine Subbasin – Irvine, CA

Client: Confidential. 2002.

Prepared a detailed hydrogeologic analysis of the Irvine Subbasin, with specific reference to the area north and west of the former El Toro Marine Corps Air Station. The analysis included an evaluation of potential impacts of a proposed development plan on natural groundwater recharge and groundwater quality. The report was used in support of an Environmental Impact Report for the proposed development.

Re-evaluation of Maximum Perennial Yield – Big Bear Lake Watershed, CA

Client: City of Big Bear Lake Department of Water and Power. 2001.

Developed a detailed hydrogeologic analysis of the Big Bear Lake watershed for the purpose of refining previous estimates of maximum perennial yield (i.e. safe yield). Included a detailed analysis of the geology, aquifer systems, groundwater levels, groundwater production, groundwater quality, precipitation, evapotranspiration, and surface water runoff for the watershed. Included the development of a detailed watershed hydrologic model (using EPA HSPF), flownet analysis, and evaluation of maximum perennial yield using the 0-net draft method.

Evaluation of Average Annual Recharge to the Klinefelter/Sacramento Springs Area, Eastern San Bernardino County, CA

Client: City of Needles. 2001.

Developed a detailed hydrogeologic analysis of the lower Piute Valley in the Eastern Mohave Desert to assess the average annual recharge to the Klinefelter/Sacramento Springs. The study was conducted to assess potential for utilization of the springs as a drinking water source.

Hydrogeologic Investigation of Spring Water Occurrence – Northern Owens Valley, CA

Client: Confidential. 1999 to 2001.

Performed field reconnaissance and investigation of springs within the northern Owens Valley, for the purpose of developing the springs as a drinking water source. Provided field supervision of exploratory borings, pumping tests, and water quality sampling and analysis.

Evaluation of Potential Water Resources – Victorville, CA

Client: City of Victorville. 2000.

Conducted a comprehensive evaluation of the average annual recharge to the aquifers in the transition zone of the Alto Sub-basin of the Mojave River watershed. Included a detailed analysis of stream/aquifer relationships in the area downgradient of the Lower Narrows area of the Mojave River.

PROJECT EXPERIENCE – WATERSHED / GROUNDWATER BASIN EVALUATIONS

Maximum Perennial Yield Study – Baldwin Lake Watershed – Big Bear Area, CA

Client: Big Bear City Community Services District. 1999.

Developed a detailed hydrogeologic analysis of the Baldwin Lake watershed for the purpose of refining previous estimates of maximum perennial yield in the area and locating potential areas for additional groundwater development.

Stream Gauge Assessment – Victorville, CA

Client: Baldy Mesa Water District/Victor Valley Water District. 1998.

Project manager for a stream gauge assessment to evaluate the physical condition of three gauges located along the Mojave River near Victorville. Provided an evaluation of the quality of data and estimates of storm flow/base flow separation.

Hydrogeologic Analysis of the Western Irvine Groundwater Subbasin – Tustin, CA

Client: Orange County Water District. 1995.

Performed a hydrogeologic assessment of the groundwater basin beneath the Tustin area of the Irvine Subbasin. Assessed the source, fate, and transport of nitrate detected in drinking water wells of the area using the hydrogeological assessment combined with isotopic tracking methods.

PROJECT EXPERIENCE – GROUNDWATER MODELS

Groundwater Flow Model of the Tule Subbasin – Tulare County, CA

Client: Tule Subbasin MOU Group. 2017 - Present.
Currently developing a numerical groundwater flow model of the Tule Subbasin for use in support of Sustainable Groundwater Management Act (SGMA) compliance. The model is being prepared using the USGS code OWHM (MODFLOW) and covers an area of approximately 1,100 square miles. The model analysis will be used to refine the Sustainable Yield estimate of the subbasin and enable planning analyses using basin management scenarios. The model analysis is also being used to inform the development of six Groundwater Sustainability Plans (GSPs) for the six individual Groundwater Sustainability Agencies (GSAs) in the subbasin.

Groundwater Flow Model of the South Fork Kern River Area – Lake Isabella, CA

Client: Rosedale-Rio Bravo Water Storage District. 2011 to Present.

Developed a numerical surface water and groundwater flow model of the South Fork Kern River Valley east of Lake Isabella, California. The model was developed to assess potential project benefits associated with water diversions from the river and impacts on a riparian habitat. The model was developed using MODFLOW and encompasses approximately 173 square miles.

Groundwater Flow Model of the Erwin Subunit – Erwin Lake Area, CA

Client: California Department of Fish and Wildlife. 2016 to 2017.

Technical lead for development of a numerical groundwater flow model of the Erwin Subunit near Erwin, California in the San Bernardino Mountains. The model was developed to assess the impact of groundwater pumping on a natural spring pond that supports the Stickleback Fish and to develop options for sustaining the pond. The model was developed using MODFLOW.

Groundwater Flow Model of the Kern Fan Area – Bakersfield, CA

Client: Rosedale-Rio Bravo Water Storage District. 2011 to Present.

Developed a numerical groundwater flow model of the Kern Fan Area west of Bakersfield, California. Included development of both conceptual and numerical models (MODFLOW). The model encompasses approximately 160 square miles and is constructed with three layers, 268 rows and 417 columns (200-ft grid cells). The model includes 243 non-agricultural production wells, 181 agricultural production wells, and 89 individual recharge zones, most of which are associated with the Kern Water Bank and Pioneer Projects. The model has been successfully calibrated for the transient period from 1988 through 2016. The model is currently being used to evaluate potential groundwater level changes associated with various recharge and recovery scenarios within the model area.

PROJECT EXPERIENCE – GROUNDWATER MODELS

Groundwater Flow Model of the Beaumont Basin – Riverside County, CA

Client: Beaumont Basin Watermaster. 2012 to 2014.

Developed a numerical groundwater flow model of the Beaumont Basin for the purpose of groundwater management and reevaluating the safe yield of the basin. The model was developed using MODFLOW and encompasses approximately 42 square miles. The model is currently being updated and recalibrated on an annual basis for the purpose of evaluating groundwater resources and planning scenarios.

Groundwater Dewatering Evaluation for Cow Camp Road Waterlines – Rancho Mission Viejo, CA

Client: GMU Geotechnical/Rancho Mission Viejo. 2012 to 2015.

Developed a numerical groundwater flow model (MODFLOW) of the Chiquita Canyon area for the purpose of evaluating optimum well locations and expected discharge rates for extraction wells to dewater a planned pipeline jack-and-bore excavation beneath Chiquita Creek. The model was calibrated to steady state conditions based on groundwater levels measured in area wells. Aquifer parameters were developed based on pumping tests that TH&Co conducted in new wells constructed near the dewatering site.

Park Place Parking Structure Subdrain Design – Irvine, CA

Client: The Irvine Company. 2011 to 2012.

Conducted a hydrogeological analysis of historical groundwater levels in the vicinity of a proposed parking structure. Developed a groundwater flow model for assessing the effectiveness of a proposed subdrain design at maintaining groundwater levels below the bottom of the parking structure.

Portola Hills Drainage Levee Certification – Irvine, CA

Client: NMG Geotechnical/The Irvine Company. 2010.

Developed a coupled unsaturated/saturated flow groundwater model to assess potential seepage through the levee from a 100 year flood. Included the collection and analysis of borehole lithologic data and surface water flow measurements in the drainage channel. The model was used to simulate seepage through the levee under both steady state and transient flow conditions within the channel. Results of the model were used to obtain certification of the levee with the Federal Emergency Management Agency (FEMA).

Chino Desalter Groundwater Flow Model Update – Chino Basin, CA

Client: Chino Basin Desalter Authority. 2007 to 2008.

Updated a previously established MODFLOW groundwater flow model of the Chino Basin to assess potential future regional drawdown from desalter groundwater pumping operations. The model was updated using data obtained from pumping tests of the Chino I expansion and Chino II wells as well as information from local subsidence investigations. Predictive scenarios included the addition of a proposed Chino Creek Well Field and five Chino II expansion wells.

PROJECT EXPERIENCE – GROUNDWATER MODELS

Groundwater Flow Model of the Murrieta Valley – Murrieta, CA

Client: Western Municipal Water District. 2007 to 2008.

Developed a groundwater flow model of the watershed encompassing the Murrieta Valley to assess potential future conjunctive use options for the District. Included development of both conceptual and numerical models (MODFLOW). Developed four conjunctive use scenarios for evaluation with the model, all involving aquifer storage and recovery wells.

Fashion Island Parking Structure Subdrain Design – Newport Beach, CA

Client: The Irvine Company. 2006 to 2007.

Developed and implemented a work plan to drill boreholes and construct monitoring wells in a parking lot to assess hydrogeologic properties for designing a subdrain system for high groundwater. Included developing a groundwater flow model for assessing potential groundwater flow to the subdrain beneath the proposed parking structure.

Pole Creek Debris Basin Subdrain Design – Fillmore, CA

Client: Griffin Industries. 2006.

Modified an existing MODFLOW model to assess the amount of groundwater flow that could be expected in order to maintain groundwater levels a satisfactory depth below a proposed debris basin. Results of the model effort were used in support of a subdrain design.

Chino Basin Water Quality Evaluation – Chino Basin, CA

Client: Jurupa Community Services District. 2002 to 2003.

Updated a previously established groundwater flow model of the Chino Basin to include a solute fate and transport package (using MT3D) to assess the impact of artificial recharge operations planned by the Chino Basin Watermaster on Nitrate and TDS concentrations in the southern Chino Basin.

USGS Model of the Beaumont and Banning Groundwater Storage Units – San Gorgonio Pass, CA

Client: Beaumont Cherry Valley Water District. 2005.

Provided a peer review of the USGS report. This included a MODFLOW model of the Beaumont and Banning Storage Units and a rainfall runoff model of the surrounding watershed (Infil v.3).

San Luis Rey River Groundwater Storage and Recovery Study – Oceanside, CA

Client: San Diego County Water Authority. 2004.

Provided peer review oversight of a MODFLOW groundwater flow model of the Mission and Bonsall Basins prepared as part of a large scale conjunctive use study.

PROJECT EXPERIENCE – GROUNDWATER MODELS

Arrowhead East Tunnel – San Bernardino County, CA

Client: Metropolitan Water District of Southern California. 1999 to 2003.

Technical advisory role in the oversight of the development of a discreet fracture groundwater flow model (FracMan) by the United States Geological Survey. Included participation at periodic update meetings and preparation of response letters to provide input for the development of the model.

Hayfield Groundwater Storage Program – Riverside County, CA

Client: Metropolitan Water District of Southern California. 2003.

Provided peer review oversight of a MODFLOW groundwater flow model of the Hayfield Valley prepared as part of the Hayfield Groundwater Storage Program.

I-105 Groundwater Beneficial Use Study – Downey, CA

Client: Black & Veatch / City of Downey. 2002.

Modified and expanded an existing groundwater flow model (the US Geological Survey's code MODFLOW) to include updated groundwater levels and production data to assess optimum pumping rates to maintain water levels below the freeway surface. Capture zones from 5 proposed wells were assessed using EPA's Wellhead Protection Area (WHPA) model for use in a Department of Health Services DWSAP Permit.

Fate and Transport Model of MCAS El Toro TCE Plume – Irvine, CA

Client: Confidential. 2002.

Prepared a detailed hydrogeologic analysis of the potential impacts of historical volatile organic compound (VOC) releases from the El Toro Marine Corps Air Station on a proposed future development. The analysis included a detailed assessment of the current extent of the VOC plume and development of a 2-dimensional groundwater fate and transport model to assess the potential future extent of the plume. The report was used in support of an Environmental Impact Report for the proposed development.

Cadiz Groundwater Storage and Dry-Year Supply Program – Cadiz, CA

Client: Metropolitan Water District of Southern California. 1998 to 2002.

Provided technical assistance for the development of a comprehensive watershed hydrologic model and groundwater flow model (MODFLOW) that encompassed the Bristol, Fenner and Cadiz watersheds of the eastern Mojave Desert, San Bernardino County. Results of the modeling effort were used to assess average annual recharge to the area and provide a planning tool to evaluate potential operational scenarios for a conjunctive use program using surface spreading basins.

Surface Water/Groundwater Model - Santa Margarita River Watershed – Temecula, CA

Client: Rancho California Water District. 1998 to 2002.

Technical assistant for the development of a conceptual hydrogeologic model of the Upper Santa Margarita River watershed for the purpose of quantifying the relationship between surface water and groundwater within the watershed.

PROJECT EXPERIENCE – GROUNDWATER MODELS

Chino Desalter System Projects – Chino, CA

Client: Santa Ana Watershed Project Authority / Chino Basin Desalter Authority. 2001.

Developed a groundwater flow model of a large portion of the Chino Basin using MODFLOW to evaluate potential groundwater level changes associated with a proposed desalter well field.

PROJECT EXPERIENCE – WELLS AND WELL FIELD DESIGN

Construction and Testing of Municipal Production Wells – California, Arizona and Mexico

Client: Multiple Water Districts and Cities. 1998 to Present.

Provided technical direction and field oversight for the drilling, design and construction of more than 100 high capacity municipal water supply wells throughout Southern California. Included development of technical specifications, field inspection of the drilling process including borehole logging, inspection of geophysical logging, aquifer zone testing, well construction, well development, pumping tests, water quality sampling, and flowmeter surveys. Provided technical direction for the design of wells including the evaluation of field borehole logs, cuttings samples, sieve analyses, geophysical logs and zone-specific water quality analyses. Prepared and coordinated the preparation of numerous well completion reports. Wells have included:

- *Arizona Water Company* (Wells 7 and 9)
- *Baldy Mesa Water District* (1 Production Well - No. 9)
- *Beaumont Cherry Valley Water District* (5 Production Wells - 23, 24, 25, 26, SunnyCal No. 4)
- *Big Bear City Community Services District* (4 Production Wells - 3B, 8, 9 and 10)
- *California Department of Forestry and Fire Protection* (1 Production Well – Owens Valley)
- *California Water Service Company* (1 Production Well - Bakersfield Station 214-01)
- *Chino Basin Desalter Authority* (9 Chino II Desalter Wells - II-1, II-2, II-3, II-4, II-6, II-7, II-8, II-9, II-9a), (3 Chino I Expansion Wells - I-13, I-14, I-15)
- *City of Big Bear Lake Dept. of Water and Power* (9 Production Wells - Canvasback, McAlister, Moonridge, Sheephorn, Magnolia, Sawmill, Seminole, Cherokee, and Arrastre Creek)
- *City of Blythe* (1 Production Well)
- *City of Ontario* (2 Production Wells - 40 and 41)
- *Coachella Valley Water District* (Design Only - 10 Production Wells)
- *Eastern Municipal Water District* (Perris II Desalter Wells 93, 94, 95 and 96; Well 38)
- *Golden State Water Company* (Kiowa Well No. 1)
- *Hacienda Resort Mexico (*One Seawater Desalination Well)
- *High Valleys Water District* (1 Production Well – McMullen Flat)
- *Highland Fairview Development* (2 Production Wells)
- *Jurupa Community Services District* (3 Production Wells - 22, 23, and 25)
- *Lake Arrowhead Community Services District* (2 Production Wells - 6 and 8)
- *M.D.J. Development Company* (1 Production Well - Alta Vista Country Club Well)
- *Metropolitan Water District of Southern California – (Cadiz)* (1 Production Well -PW-1)
- *Rancho Mission Viejo* (1 Production Well – Well 5)
- *Rosedale-Rio Bravo Water Storage District* (8 Drought Relief Project Production Wells – WB-1 through WB-3; SUP-1, SUP-2, SUP-4 through SUP-6); (3 Onyx Ranch Wells)
- *San Diego County Water Authority / City of Oceanside* (3 Production Wells - PW-9, PW-10 and PW-11)
- *Santa Margarita Water District* (2 Production Wells)

PROJECT EXPERIENCE – WELLS AND WELL FIELD DESIGN

Construction and Testing of Municipal Production Wells – California, Arizona and Mexico (Cont.)

- *Three Valleys Municipal Water District* (Grand Avenue Well)
- *Vista Serena Mexico* (PW-1b Seawater Desalination Well)

Well Rehabilitation Projects – Southern California

Client: Multiple Water Districts and Cities. 1998 to Present.

Provided technical direction and field oversight for the rehabilitation of high capacity municipal water supply wells throughout Southern California. Included development of technical specifications, bid support, initial testing including sidewall and CITM, field inspection of the rehabilitation process, and follow-up pumping tests and water quality testing. Rehabilitation processes have included brushing, bailing, swabbing, combination airlift/swab, and chemical rehabilitation. Wells have included:

- *Chino Basin Desalter Authority* (13 Wells)
- *City of Big Bear Lake Department of Water* (Mooncamp Well)
- *City of Fullerton* (Well 5)
- *City of Murrieta* (Adams/Juniper Well)
- *City of Santa Barbara* (5 Wells)
- *Golden State Water Company* (Yeager Well No. 3)
- *Irvine Ranch Water District* (Wells 5, 21, 22, 110, and Stockdale West Agricultural Well)
- *Summit Partners, LLC* (Elliott Well)
- *Western Municipal Water District* (5 Arlington Desalter Wells)

Depth-Specific Well Testing, Helendale Community Services District Well No. 9 – Helendale, CA

Client: Helendale Community Services District. 2010.

Designed a depth-specific water quality sampling program for Well No. 9 in order to assess the potential for packing off portions of the well with high total dissolved solids concentrations.

Perris II Desalter Wells Test Drilling and Well Design – Perris, CA

Client: Eastern Municipal Water District. 2009 to 2010.

Conducted a comprehensive well siting and test drilling program that including identification of seven potential well sites and test drilling at six sites. Data collected from the test drilling program was used to develop preliminary designs and technical specifications for high capacity desalter production wells at four of the sites.

PROJECT EXPERIENCE – WELLS AND WELL FIELD DESIGN

Seawater Injection Barrier Well Evaluation – West and Central Basins, CA

Client: West Basin Municipal Water District. 2007 to 2008.

Evaluated injection well barrier performance for the Alamitos, Dominguez Gap and West Coast Basin Seawater Injection Barriers. Specific injection decline in wells was correlated with water quality criteria for injection water in the context of increasing the percentage of recycled water for injection. Provided recommendations for future rehabilitation methods and frequency.

Seawater Supply Well and Brine Injection Well Design – Cabo San Lucas, Mexico

Client: Confidential. 2006 to 2008.

Provided management oversight of a test drilling program to obtain design parameters for a seawater supply well for a desalination system in southern Baja California, Mexico. The supply well was designed with 8-inch diameter AL6XN steel. Two injection wells were also designed for the purpose of discharging brine waste from the desalination process.

Depth-Specific Well Testing, WMWD New Clay Well – Murrieta, CA

Client: Western Municipal Water District. 2008.

Designed a depth-specific water quality sampling program for the New Clay Well in order to assess changes in arsenic concentrations at various screened intervals within the well. The results of the testing will be used to provide recommendations for installing a packer to lower the arsenic concentrations in the discharge water.

Depth-Specific Well Testing, City of Ontario Well 50 – Ontario, CA

Client: City of Ontario. 2008.

Designed a depth-specific water quality sampling program for Well 50 in order to characterize the vertical distribution of perchlorate, color, and total dissolved solids within the well. The results of the testing were used to recommend a setting depth for an inflatable packer to limit production from the impacted aquifers.

Well Destruction, IRWD Well 14 – Tustin, CA

Client: RBF Consulting/Irvine Ranch Water District. 2008.

Developed detailed technical specifications for the destruction of one well. The specifications were developed in accordance with Department of Water Resources and local requirements.

Seawater Production Well Feasibility Study – Oceanside, California

Client: Tetra Tech/City of Oceanside. 2007 to 2008.

Developed a near-shore drilling and testing investigation program to assess the feasibility of producing seawater from wells in near-shore aquifers for the purpose of desalination. The testing program followed recommendations made to the City of Oceanside for seawater production as an alternative water supply. The program included drilling and testing one nested monitoring well and design of one test well.

PROJECT EXPERIENCE – WELLS AND WELL FIELD DESIGN

Preliminary Design Report for Three ASR Wells – Pasadena, CA

Client: RMC Water/City of Pasadena. 2006 to 2007.

Provided technical direction and quality control for development of a preliminary design for three aquifer storage and recovery wells in the City of Pasadena (MacDonald Park, Victory Park and Craig Well). The design followed a well siting analysis and included a description of the hydrogeologic setting, recommended well design, a recommended operation and maintenance program, and planning costs for the drilling and construction of the wells.

Lake Arrowhead Well Site Evaluation – Lake Arrowhead, CA

Client: RMC Water/Lake Arrowhead Community Services District. 2006 to 2007.

Evaluated and ranked 18 potential well sites in the Lake Arrowhead area for possible future production wells. The sites were evaluated with respect to hydrogeology, property ownership, drilling access, proximity to existing infrastructure, and environmental issues. Three sites were selected for new wells.

Victorville City-Wide Well Site Evaluation – Victorville, CA

Client: City of Victorville. 2006 to 2007.

Conducted a comprehensive well site evaluation for wells to supply water for the Southern California Logistics Airport in Victorville. Considerations included production yield potential, groundwater quality (both regional and point source contamination), potential for excessive drawdown in areas with other wells, environmental concerns, and proximity to the City's existing pipeline distribution system. Developed well site potential zones for use by the City in locating future well sites.

Murrieta Valley Well Site Evaluation – Murrieta, CA

Client: Western Municipal Water District. 2007.

Identified and evaluated six potential well sites within the Murrieta Valley. As a result of the study, one well site is being pursued for construction of a production well.

Beach Well Feasibility Study – Cabo San Lucas, Mexico

Client: Confidential. 2006 to 2008.

Provided field oversight and management of a test drilling program on two beaches in southern Baja California, Mexico. The program included the drilling and testing of boreholes, a monitoring well and an 8-inch diameter test well for the purpose of evaluating the feasibility of beach wells as water supply for seawater desalination systems.

PROJECT EXPERIENCE – WELLS AND WELL FIELD DESIGN

Gobernadora Multi-Use Basins Well Field Design Study – Rancho Mission Viejo, CA

Client: Santa Margarita Water District. 2005 to 2006.

Project manager and lead technical advisor for a wellfield design alternatives analysis for a surface water diversion/artificial recharge facility in southern Orange County. The evaluation included development of a MODFLOW model of the proposed spreading basins and selection of potential well sites. Developed a drilling and testing protocol for construction of the wells.

Well Rehabilitation Evaluation – Chino, CA

Client: Chino Basin Desalter Authority. 2005 to 2006.

Conducted an evaluation of declining production capacity in eleven Chino I Desalter wells. Included evaluation of video logs, water chemistry data, Southern California Edison pumping test data, groundwater levels and production. Based on the evaluation, provided specific rehabilitation recommendations for each of the eleven wells.

Well Sites Evaluation – High Valleys, CA

Client: High Valleys Water District. 2003 to 2005.

Conducted a reconnaissance level well site evaluation within the High Valleys Water District area, located between Idyllwild and Banning in southern California.

Private Well Evaluation – Fawnskin, CA

Client: City of Big Bear Lake Department of Water and Power. 2004.

Developed and implemented a well evaluation protocol for determining the suitability of four existing private wells in the Fawnskin area north of Big Bear Lake for incorporation into the City's distribution system. Included onsite inspection of downhole video logs of each well, redevelopment, pumping tests, water quality analyses and reporting.

Jurupa Community Services District District-Wide Well Site Evaluation – Mira Loma, CA

Client: Jurupa Community Services District. 2003.

Conducted a comprehensive well site evaluation within the JCSD boundaries. Considerations included production yield potential, groundwater quality (both regional and point source contamination), potential for excessive drawdown in areas with other wells, and potential to exacerbate existing environmental problems (i.e. subsidence). Developed well site potential zones for use by the District in locating future well sites.

City of Ontario City-Wide Well Site Evaluation – Ontario, CA

Client: City of Ontario. 2002.

Conducted a comprehensive well site evaluation within the City boundaries. Considerations included production yield potential, groundwater quality (both regional and point source contamination), potential for excessive drawdown in areas with other wells, potential to exacerbate existing environmental problems (i.e. subsidence), and proximity to the City's existing pipeline distribution system. Developed well site potential zones for use by the City in locating future well sites.

PROJECT EXPERIENCE – WELLS AND WELL FIELD DESIGN

Chino Desalter System Projects Well Field Design – Chino, CA

Client: Santa Ana Watershed Project Authority. 2001 to 2002.

Project manager and senior technical lead for the design of a 13-well well field in the southern Chino Basin. Included development of a comprehensive well field design protocol that considered property access, environmental concerns, Chino Basin Watermaster goals, potential interference with existing pumpers, and pipeline costs.

City of Arcadia Infrastructure Restoration and Design – Arcadia, CA

Client: Cities of Arcadia and Sierra Madre. 1998 to 1999.

Developed a detailed hydrogeologic analysis of the Raymond Basin to evaluate potential sites for new production wells. The analysis included development of a watershed hydrologic model and a groundwater flow model. The model was used to assess potential pumping interference from proposed well sites with existing production wells. As a result of the project, three sites were recommended based on a priority system that considered location with respect to existing wells, location with respect to faults, available groundwater resources, water quality, and proximity to existing City facilities.

PROJECT EXPERIENCE – ARTIFICIAL RECHARGE / CONJUNCTIVE USE

Regional Recycled Water Program Feasibility Study – Southern California

Client: Metropolitan Water District of Southern California. 2016 - Present.

Mr. Harder served on an advisory panel for Metropolitan Water District to provide input and guidance for the development of a regional recycled water program that would treat water from the Los Angeles County Sanitation District's Joint Water Pollution Control Plant in Carson, California and deliver it to recharge facilities in the West Basin, Central Basin, Orange County Basin, and Main San Gabriel Basin. The proposed program would ultimately produce up to 150 million gallons per day of advanced treated water for recharge in the basins. Mr. Harder provided input primarily on the hydrogeological aspects of the project.

Groundwater Recharge Analysis – Orange County, CA

Client: Irvine Ranch Water District. 2016 (ongoing).

Mr. Harder served as the technical lead to evaluate potential groundwater quality impacts from the proposed use of desalinated seawater in the Talbert Injection Barrier. The analysis was conducted using the existing Orange County Water District numerical model of the Orange County Groundwater Basin, coupled with a solute transport model code. Modeled constituents of concern included, total dissolved solids, chloride, and boron.

East Declez Recharge Basin Evaluation – Mira Loma, CA

Client: Inland Empire Utilities Agency. 2015.

Conducted a field investigation of artificial recharge potential using CPT and boreholes. Data collected during the investigation were used to assess subsurface permeability, liquefaction potential, subsurface storage potential and recharge capacity.

Recycled Water Recharge Feasibility Study – Montclair, CA

Client: Carollo Engineers/Inland Empire Utilities Agency. 2015.

Conducted analyses to assess potential impacts of spreading recycled water in the Montclair Basins on groundwater levels, groundwater flow, and existing contaminant plumes. Included development of a 2 dimensional groundwater flow model for use in assessing potential travel times for regulatory compliance.

Stockdale Integrated Banking Project – Bakersfield, CA

Client: Rosedale-Rio Bravo Water Storage District/Irvine Ranch Water District. 2012 to 2015.

Conducted an analysis of potential groundwater level impacts associated with a proposed recharge and recovery project in support of an Environmental Impact Report. The analysis was conducted using a calibrated numerical groundwater flow model developed by TH&Co.

PROJECT EXPERIENCE – ARTIFICIAL RECHARGE / CONJUNCTIVE USE

James Canal Integrated Banking Project – Bakersfield, CA

Client: Rosedale-Rio Bravo Water Storage District/Buena Vista Water Storage District. 2012 to present.

Conducted an analysis of potential groundwater level impacts associated with a proposed recharge and recovery project in support of an Environmental Impact Report. The analysis was conducted using a calibrated numerical groundwater flow model developed by TH&Co.

Recycled Water Recharge Evaluation – Indio, CA

Client: Carollo Engineers/Indio Water Authority. 2009 to 2011.

Conducted analyses to assess potential groundwater level and quality impacts from proposed recycled water recharge facilities, including both spreading grounds and injection wells, in the Indio area.

Recycled Water Recharge Basin Monitoring – Rancho Cucamonga, CA

Client: Inland Empire Utilities Agency. 2008 to 2011.

Prepared technical specifications for the construction of two lysimeter clusters and three deep monitoring wells as part of a groundwater monitoring system for future recycled water recharge in the Victoria and San Sevaine recharge basins in Rancho Cucamonga, California. Provided field inspection oversight of the construction of the monitoring features.

Artificial Recharge Basin Evaluation – Ontario, CA

Client: Confidential. 2009.

Prepared a reconnaissance-level evaluation of a potential artificial recharge basin located in the central Chino Basin. The evaluation included development of a basin evaluation protocol for considering the site for artificial recharge.

Regional Recharge and Recovery Project – Hesperia, CA

Client: Mojave Water Agency. 2007 to 2008.

Lead technical director for a 40,000 acre-ft/yr artificial recharge and extraction project along the Mojave River near Hesperia, California. Included preliminary design work for artificial recharge facilities and a 22-well well field. Also provided peer review of a regional groundwater flow model for use in evaluating conjunctive use scenarios.

Chuckwalla Groundwater Recharge Project – Chuckwalla, CA

Client: Metropolitan Water District of Southern California. 2002.

Technical advisor for an artificial recharge pilot test located near the Colorado River Aqueduct in Upper Chuckwalla Valley, Riverside County. Included peer review oversight of pilot basin siting, monitoring well locations and construction, groundwater sampling and analysis, and soil infiltration instrumentation.

PROJECT EXPERIENCE – ARTIFICIAL RECHARGE / CONJUNCTIVE USE

Smith Creek Artificial Recharge Evaluation – Banning, CA

Client: Pardee Homes/City of Banning. 2006 to 2008.

Evaluated the feasibility of artificial recharge along Smith Creek in the City of Banning. Preliminary analysis included locating potential recharge basins, determining potential recharge area within a large proposed residential development, and developing a drilling and pilot testing program. Potential sources of recharge include imported water, recycled water and captured storm flow.

Noble Creek Artificial Recharge Program – Beaumont, CA

Client: Beaumont-Cherry Valley Water District. 2001 to 2008.

Project manager and lead technical advisor for an artificial recharge evaluation located near Beaumont. The evaluation included a drilling and testing program, including a pilot recharge test. Provided input for engineering design of full-scale artificial recharge basins. Provided design and construction oversight of cluster monitoring wells for full-scale facility. Provided groundwater monitoring and reporting for the facility, which began operation in September 2006. ***This project received the National Ground Water Association's 2008 Outstanding Groundwater Project Award.***

Big Bear Valley Groundwater Replenishment Study – Big Bear Lake, CA

Client: Big Bear Area Regional Wastewater Agency. 2001 to 2006.

Conducted a comprehensive artificial recharge study for the Big Bear Valley area of the San Bernardino Mountains. The study involved the identification of potential artificial recharge sites and a comprehensive drilling and pilot testing program utilizing surface recharge basins. The ultimate project would include the use of recycled wastewater as a water source so detailed tracer studies, water quality analysis, and groundwater migration rate analyses were conducted as part of the study. ***This project won the California Water Environment Association – Desert and Mountain Section 2005 Research and Development Award.***

Discharge Basin Expansion Project – Victorville, CA

Client: Victor Valley Wastewater Reclamation Authority. 2004 to 2005.

Conducted an evaluation of the percolation potential of ten surface spreading basins used for the discharge of secondary effluent from a wastewater treatment plant. Currently evaluating additional areas in the vicinity of the plant for potential future percolation basins. Included coordination with the Regional Water Quality Control Board – Lahontan Region for the permitting of the basins.

Hayfield Groundwater Storage Program – Chuckwalla, CA

Client: Metropolitan Water District of Southern California. 2003.

Technical advisor and peer review oversight of field investigations to design project spreading basins and extraction wells for a conjunctive use program in Hayfield Valley, Riverside County. Includes design of a relational database and geographic information system for the project.

PROJECT EXPERIENCE – ARTIFICIAL RECHARGE / CONJUNCTIVE USE

Mission and Bonsall Basins Artificial Recharge Program – Oceanside, CA

Client: San Diego County Water Authority. 2002 to 2004.

Project Manager and lead technical advisor for a groundwater/surface water conjunctive use feasibility study in the Mission and Bonsall Basins of the San Luis Rey River Watershed, San Diego County. Included development and oversight of a comprehensive field drilling and data collection program (borehole drilling, sample collection and analysis; monitoring well construction, development and sampling; test well drilling, construction and testing).

Cadiz Groundwater Storage and Dry-Year Supply Program – Cadiz, CA

Client: Metropolitan Water District of Southern California. 1998 to 2002.

Project and task manager for the development and implementation of a field program designed to assess the water resources and hydrogeologic characteristics of the Fenner Gap portion of the Fenner Watershed of the Eastern Mojave Desert near Cadiz, California. Developed and implemented an 8-month pilot recharge test to assess the permeability of unsaturated zone sediments in the project area and the mounding characteristics of the groundwater.

Rapid Infiltration Design (RIX) Project – San Bernardino, CA

Client: City of San Bernardino. 1998.

Project Geohydrologist for a preliminary design of spreading basins for tertiary treated wastewater along the Santa Ana River near San Bernardino. Designed a field program to evaluate permeability characteristics of native sediments for use in designing an extraction system to control groundwater mounding from spreading activities and prevent offsite migration of untreated wastewater.

PROJECT EXPERIENCE – ENVIRONMENTAL HYDROGEOLOGY

Helendale Wastewater Treatment Plant Antidegradation Study – Helendale, CA

Client: RBF Consulting/Helendale Community Services District. 2009 to 2010.

Prepared an antidegradation study for tertiary treated wastewater discharge in the vicinity of Helendale CSD's Wastewater Treatment Plant. Included coordination with the RWQCB-Lahonton Region for obtaining a National Pollution Discharge Elimination System (NPDES) permit.

Grass Valley Antidegradation Study – Lake Arrowhead, CA

Client: Lake Arrowhead Community Services District. 2008.

Prepared an antidegradation study for emergency discharges to Grass Valley Creek from LACSD's Grass Valley Wastewater Treatment Plant. Included coordination with the RWQCB-Lahonton Region for obtaining a National Pollution Discharge Elimination System (NPDES) permit.

Evaluation of Nitrate in Groundwater from Septic Systems – Lake William, CA

Client: City of Big Bear Lake Department of Water & Power. 2006.

Conducted an evaluation of the source, extent and potential migration of nitrate in groundwater resulting from septic system drains in the Lake William area of the Big Bear Valley, San Bernardino County, California.

Evaluation of MTBE Release – City of Big Bear Lake, CA

Client: City of Big Bear Lake Department of Water & Power. 2002 to 2004.

Technical advisor for the evaluation of data related to a methyl tert butyl ether (MTBE) release from a gasoline station in the City of Big Bear Lake. The release directly threatens the water quality of a municipal supply well field, located downgradient from the gas station.

Hexavalent Chromium Evaluation – Montebello Forebay – Bell, CA

Client: Confidential. 2000 to 2001.

Performed a fate and transport evaluation of hexavalent chromium in soil and groundwater beneath a former chromium plating facility. Included development of both vadose zone (VS2DT), groundwater flow (MODFLOW) and solute transport (MT3D) models. Work was performed in support of expert witness work for attorneys representing the former facility.

Defense Fuel Supply Point MTBE Release Technical Review – Norwalk, CA

Client: City of Norwalk. 2000 to 2001.

Technical advisor for the evaluation of data related to a methyl tert butyl ether (MTBE) release from a tank farm and fuel distribution facility.

PROJECT EXPERIENCE – ENVIRONMENTAL HYDROGEOLOGY

Navy/Marine Corps Bases – Southern California and Arizona

Client: Navy Southwest Division. 1997 to 1998.

Project manager responsible for hydrogeologic and geochemical evaluations of remediation by natural attenuation of both petroleum hydrocarbons and chlorinated solvents in groundwater at five bases. Analyzed geochemical indicators of physical and biological processes that degrade contaminants.

Former Aerospace Facility – Torrance, CA.

Client: Confidential. 1997 to 1998.

Conducted a site assessment/feasibility study of soil and groundwater impacted by petroleum hydrocarbons and chlorinated solvents. Geochemical data were collected and evaluated to assess the potential for remediation by natural attenuation of both chlorinated solvents and petroleum hydrocarbons. Provided support for negotiations with the LA Regional Water Quality Control Board regarding the most cost-effective remedial option. Successfully negotiated closure of soil issues at the site based on natural attenuation of chlorinated solvents.

Property Transaction – Los Angeles, CA.

Client: Confidential. 1996.

Project manager for a hydrogeological investigation in the Los Angeles Narrows. Prepared design plans for both monitoring wells and groundwater extraction wells. Developed a soil and groundwater sampling and analysis plan and supervised the collection of field data. Prepared both conceptual and numerical models (using MODFLOW) based on the data collected in the field investigation to help predict the groundwater pumping rates and number of wells necessary to capture the dissolved PCE plume.

Jet Fuel Storage Facility – Los Angeles, CA.

Client: Confidential. 1989 to 1995.

Performed a full range of field investigation tasks including soil logging and sampling during drilling, monitoring well installation, well development, and groundwater sampling from wells. Performed free hydrocarbon product bailout tests on four monitoring wells to assess formation production thickness and to determine recovery pump design. Performed step-drawdown and constant rate pumping tests on two wells to assess formation hydraulic conductivity. Designed and installed large-diameter (8 and 12-inch) groundwater recovery wells. Managed the design and installation of a free hydrocarbon product recovery system.

Tequesquite Landfill – Riverside, CA.

Client: City of Riverside. 1992 to 1994.

Installed a clustered monitoring well network using mud-rotary drilling techniques. Installed Well-Sentinel data collection devices in the well network to assess seasonal rainfall effects on contaminant transport from the landfill into the Santa Ana River.

PROJECT EXPERIENCE – ENVIRONMENTAL HYDROGEOLOGY

Semiconductor Manufacturing Facility – Puyallup, WA.

Client: Confidential. 1994.

Performed step drawdown and constant rate groundwater pumping tests from wells screened in glacial till, using a Grundfos pumping system and Hermit data loggers. Calculated hydraulic characteristics of the aquifer (hydraulic conductivity, transmissivity, etc.) from the results of the test to assess remedial alternatives for a diesel fuel release at the site.

Crude-Oil/Gasoline Terminal – Port of Los Angeles, CA.

Client: Confidential. 1990 to 1992.

Installed five groundwater observation wells to assess the extent of petroleum hydrocarbon releases from pipes and tanks. Conducted aquifer tests on selected wells to assess formation hydraulic conductivity and formation product thickness, product recovery rates, and well performance. Conducted weekly monitoring of wells to assess tidal influence on free hydrocarbon thickness in wells.

Drinking Water Distribution Facility – San Diego, CA.

Client: Confidential. 1992.

Installed, developed and sampled monitoring wells, many of which were completed as cluster wells screened in shallow and deep alluvial aquifers, to assess the migration of petroleum hydrocarbons in groundwater from leaking underground fuel tanks. Performed step drawdown and constant rate groundwater pumping tests from the wells to assess well yield and aquifer characteristics.

California State Superfund Site – Santa Fe Springs, CA.

Client: Confidential. 1990 to 1992.

Supervised the drilling and construction of 12 monitoring wells to assess chlorinated solvent contamination beneath the site. Conducted slug and pumping tests for selected wells to assess hydraulic properties of the subsurface across the site. Conducted a step-out groundwater investigation using CPT/Hydropunch groundwater sampling techniques.

California State Superfund Site – Los Angeles, CA.

Client: Confidential. 1990.

Supervised a petroleum hydrocarbon plume characterization at a former ceramics manufacturing facility. Involved excavation oversight, drilling and sampling of soil borings, and observation well installation. Developed and sampled wells downgradient of the site contamination source. Prepared a report describing the investigation.

PROJECT EXPERIENCE – ENVIRONMENTAL HYDROGEOLOGY

City of Orange TCE Investigation – Orange, CA.

Client: Orange County Water District. 1989 to 1990.

Drilled 10 borings to depths ranging from 120 to 250 feet using rotary, drill-and-drive drilling methods. Logged cuttings and collected groundwater samples to assess trichloroethene concentrations in the subsurface. Included post-installation perforation of the casing and installation of pre-pack casing. Some wells were completed as cluster wells.

PROJECT EXPERIENCE – GEOCHEMISTRY STUDIES

Geochemical Evaluation of Nitrate and Selenium in Groundwater – Irvine, CA

Client: Confidential. 2004 to 2005.

Evaluated the source and fate of selenium and nitrate in groundwater in the northern Irvine Subbasin.

Geochemical Mixing Evaluation – Lower San Luis Rey River Conjunctive Use Study – Oceanside, CA

Client: San Diego County Water Authority. 2004.

Conducted a detailed geochemical evaluation of potential adverse chemical reactions that could occur as a result of mixing imported Colorado River Water with native groundwater via injection wells or surface spreading basins. The evaluation was conducted with the assistance of the USGS geochemical model PHREEQC.

Well Screen Corrosion Evaluation Using Metal Coupons – Ontario, CA

Client: City of Ontario. 2003.

Evaluated the corrosion potential of groundwater in the Ontario, California area through a metal coupon test. The test includes lowering an apparatus with pre-weighed coupons representing five different metal types (mild steel, copper-bearing steel, corten steel, 304 stainless steel and 316L stainless steel) into a non-pumping well. After a period of 6 to 12 months, the coupons are cleaned, reweighed and the amount of metal loss recorded, thus indicating the corrosion potential of the water.

Well Screen Corrosion Evaluation of Desert Groundwater – Cadiz, CA

Client: Metropolitan Water District of Southern California. 1998 to 2002.

Performed a metal coupon test for wells in the Fenner Gap area of the eastern Mojave Desert to assess the corrosion potential of the water. Results of the test indicated highly corrosive conditions and recommendations were made for corrosion-resistant (i.e. stainless steel) well materials for future wells.

Cadiz Groundwater Storage and Dry-Year Supply Program – Cadiz, CA

Client: Metropolitan Water District of Southern California. 1998 to 2002.

As part of the Cadiz conjunctive use feasibility study, developed detailed protocols for the evaluation of mixing Colorado River Water with native groundwater. The protocol was implemented through the development of a laboratory physical model, glass coupon studies, and computer modeling of equilibrium reactions (using the USGS code PHREEQC).

Diamond Valley Lake Injection Wells Geochemistry Evaluation – Hemet, CA

Client: Metropolitan Water District of Southern California. 2000.

Prepared a computer model simulation of mixing injected Colorado River water in injection wells near Diamond Valley Lake. Injection wells had been clogging excessively and the analysis was meant to assess an appropriate well rehabilitation program.

PROJECT EXPERIENCE – EXPERT WITNESS

Lower Tule River Irrigation District v. Sandridge Partners LP – Tulare County Superior Court Case No. 253401

Client: Spaletta Law PC/Lower Tule River Irrigation District. 2013 to 2015.

Provided hydrogeological analysis and expert witness services. This case settled out of court.

Rosedale-Rio Bravo v. Kern County Water Agency – Ventura County Superior Court Case No. 56-2010-00379084-CU-WA-VTA

Client: McMurtrey Hartsock & Worth/Rosedale-Rio Bravo Water Storage District. 2010 to 2015.

Provided a hydrogeological analysis of groundwater level impacts associated with recharge and recovery operations of the Kern Water Bank and Pioneer Project near Bakersfield, California. Mr. Harder was designated as an expert for trial. This case settled out of court.

Antelope Valley Groundwater Cases, JCCP 4408

Client: Smith Trager LLP/Aleshire & Wynder LLP/Phelan Pinon Hills Community Services District. 2010 to present.

Provided a hydrogeological analysis of the characteristics and conditions of the groundwater system in the southeast portion of the Antelope Valley Groundwater Basin. Mr. Harder was designated and qualified as an expert for the Phase III portion of the trial. This case is ongoing.

Agri-Empire Inc., v. Osborne Development, Inc. et al. – Riverside County Superior Court Case No. RIC 488628

Client: Davis & Wojcik. 2009.

Provided a well condition analysis for a municipal well altered during construction for a housing development. Mr. Harder conducted the analysis and was the designated expert for trial. The case was settled out of court.

PUBLICATIONS

Harder, Thomas E., 1995. *A Hydrogeochemical Assessment of the Fate and Transport of Nitrate in Groundwaters Beneath the Tustin Area of Orange County, California.* Masters Thesis.

Williams, D.E. and Harder, T.E., 2003. *Pilot Study to Determine the Feasibility of Artificial Recharge of Recycled Water in Surface Spreading Basins*. Prepared paper for the 11th Biennial Symposium on Groundwater Recharge, Arizona Hydrological Society, Salt River Project, U.S. Water Conservation Laboratory, and Arizona Department of Water Resources, Tempe Arizona. June 5-7, 2003.

Diehr, D., Harder, T., and Jamison, D., 2006. *Lower San Luis Rey River Valley Groundwater Storage and Recovery Feasibility Study*. Prepared for the 15th Annual Groundwater Resource Association Conference. September 21-22, 2006.

Williams, D.E. and Harder, T.E., 2006. *The Use of Wells to Provide Water for Seawater Desalination Systems*. Prepared for the 15th Annual Groundwater Resource Association Conference. September 21-22, 2006.

Harder, T.E., 2007. *Pilot Study to Determine the Feasibility of Artificial Recharge in the San Bernardino Mountains, Southern California.* Prepared for the National Groundwater Association 2007 Groundwater Summit. May 1-3, 2007.

Harder, T.E., 2008. *The Hydrogeology of the Big Bear Valley, San Bernardino County, California*; in Geology and Hydrogeology of the Big Bear Valley and San Bernardino Mountains, Transverse Ranges, California; South Coast Geological Society Annual Field Trip Guidebook, No. 35.

CHINO BASIN WATERMASTER
Case No. RCVRS 51010
Chino Basin Municipal Water District v. City of Chino, et al.

PROOF OF SERVICE

I declare that:

I am employed in the County of San Bernardino, California. I am over the age of 18 years and not a party to the within action. My business address is Chino Basin Watermaster, 9641 San Bernardino Road, Rancho Cucamonga, California 91730; telephone (909) 484-3888.

On June 19, 2020 I served the following:

1. DECLARATION OF THOMAS E. HARDER IN SUPPORT OF APPROPRIATIVE POOL REPLY TO AGRICULTURAL POOL'S OPPOSITION TO WATERMASTER MOTION REGARDING 2020 SAFE YIELD RESET, AMENDMENT OF RESTATED JUDGMENT, PARAGRAPH 6

/ X / BY MAIL: in said cause, by placing a true copy thereof enclosed with postage thereon fully prepaid, for delivery by United States Postal Service mail at Rancho Cucamonga, California, addresses as follows:
See attached service list: Mailing List 1

/___/ BY PERSONAL SERVICE: I caused such envelope to be delivered by hand to the addressee.

/___/ BY FACSIMILE: I transmitted said document by fax transmission from (909) 484-3890 to the fax number(s) indicated. The transmission was reported as complete on the transmission report, which was properly issued by the transmitting fax machine.

/ X / BY ELECTRONIC MAIL: I transmitted notice of availability of electronic documents by electronic transmission to the email address indicated. The transmission was reported as complete on the transmission report, which was properly issued by the transmitting electronic mail device.

I declare under penalty of perjury under the laws of the State of California that the above is true and correct.

Executed on June 19, 2020 in Rancho Cucamonga, California.

Janine Wilson

By: Janine Wilson
Chino Basin Watermaster

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