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Attorneys for Cross-Defendant,
SHEEP CREEK WATER COMPANY, INC.

SUPERIOR COURT OF THE STATE OF CALIFORNIA

IN AND FOR THE COUNTY OF LOS ANGELES

Coordination Proceeding Special Title (Rule 1550(b)) ANTELOPE VALLEY GROUNDWATER CASES Including Actions: Los Angeles County Waterworks District No. 40 v. Diamond Farming Co. Superior Court of California, County of Los Angeles, Case No. BC 325 201 Los Angeles County Waterworks District No. 40 v. Diamond Farming Co. Superior Court of California, County of Kern, Case No. S-1500-CV-254-348 Wm. Bolthouse Farms, Inc. v. City of Lancaster Diamond Farming Co. v. City of Lancaster Diamond Farming Co. v. Palmdale Water Dist. Superior Court of California, County of Riverside, consolidated actions, Case Nos. RIC 353 840, RIC 344 436, RIC 344 668 AND RELATED CROSS-ACTIONS.	Judicial Council Coordination Proceeding No. 4408 Santa Clara Case No. 1-05-CV-049053 Assigned to the Honorable Jack Komar **DECLARATION OF DR. RAM ARORA, HYDROGEOLOGIST, IN SUPPORT OF SHEEP CREEK WATER COMPANY'S MOTION TO BE EXCLUDED FROM THE ANTELOPE VALLEY GROUNDWATER ADJUDICATION, OR, IN THE ALTERNATIVE, FOR RECOGNITION OF ITS PRIOR RIGHTS TO THE WATERS OF SHEEP CREEK** DATE: October 3, 2008 TIME: 9:00 a.m. DEPT: 17 [Filed Concurrently with Notice of Motion, Memorandum of Points and Authorities, Request for Judicial Notice, Declarations of Michael Duane Davis and Chris Cummings, and Proposed Order]

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I, RAM ARORA, PhD, declare as follows:

1. I am a registered Professional Geologist in the State of Georgia. I received my license in March 1984 and have over thirty (30) years of practical experience in the field of hydrogeology. A copy of my *Curriculum Vitae* is attached to this Declaration as ***Exhibit 1.*** I have personal knowledge of the matters set forth in this declaration. If called as a witness, I could, and would, competently testify to all matters set forth in this declaration.

2. I have reviewed and am familiar with the Notice of Motion and Motion, the Memorandum of Points and Authorities in Support of Sheep Creek Water Company's Motion to be Excluded from the Antelope Valley Groundwater Adjudication, or, in the Alternative, for Recognition of its Prior Rights to the Waters of Sheep Creek (including all of the attached Exhibits), the Request for Judicial Notice, and the Declarations of Michael Duane Davis and Chris Cummings (collectively the "Motion"), in support of which I give this Declaration.

3. I have reviewed and am familiar with the following United States Geological Survey ("U.S. Geological Survey") publications, respecting the hydrology of the western Mojave Desert, including Sheep Creek: W. B. Langbein & Kathleen T. Iseri, U.S. Geological Survey, General *Introduction and Hydrologic Definitions*, Water-Supply Paper 1541-A (1983); John A. Izbicki & Robert L. Michel, U.S. Geological Survey, *Movement and Age of Ground Water in the Western Part of the Mojave Desert, Southern California, USA*, Water-Resources Investigations Report 2003-4314 (2004); John A. Izbicki et al., U.S. Geological Survey, *Data From a Thick Unsaturated Zone Underlying Oro Grande and Sheep Creek Washes in the Western Part of the Mojave Desert, near Victorville, San Bernardino County, California*, Open-File Report 2000-262 (2000); John A. Izbicki, U.S. Geological Survey, *Source and Movement of Ground Water in the Western Part of the Mojave Desert, Southern California, USA*, Water-Resources Investigations Report 2003-4313 (2004); Carl S. Carlson & Steven P. Phillips, U.S. Geological Survey, Water-level Changes (1975-1998) in the Antelope Valley Ground-Water Basin, California, Open-File Report 98-561 (1998); and David A. Leighton & Steven P. Phillips, U.S. Geological Survey, *Simulation of Ground-Water Flow and Land Subsidence, Antelope Valley Ground Water Basin, California*, Water-Resources Investigations Report 2003-4016 (2003).

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4. I have also reviewed and am familiar with the following documents: California Department of Water Resources, Bulletin 118, *California's Groundwater* (2003); California Regional Water Quality Control Board, *Water Quality Control Plan for the Lahontan Region*, fig. Plate 1B; Joseph C. Scalmanini et al., *Technical Memorandum Ground-Water Basin and Subbasin Boundaries Antelope Valley Ground-Water Basin* (2002), fig. Plate 1; County of San Bernardino, *Phelan/Pinon Hills Community Plan*, February 2007, p. 35, ¶ 3; Map of Sheep Creek Water Company's Well Field; *USGS Geological map Data for El Mirage Area, San Bernardino and Los Angeles Counties, California.*

5. I have also reviewed the composite of six (6) USGS / National Geographic 1:30,750 scale maps that is appended to the Motion as ***Exhibit H.*** The map depicts that portion of the Counties of San Bernardino and Los Angeles from south of Swarthout Creek (Wrightwood) / Sheep Creek Canyon on the south to approximately 34°31'N on the north, and from approximately 117°45'W on the west to approximately 117°29'W on the east. The Los Angeles / San Bernardino County line is printed on the map and highlighted in "red" at approximately one-third (⅓) of the way from the left side. Sheep Creek Water Company's service area is plotted and marked in orange at the middle right center of the map. Sheep Creek Water Company's Sheep Creek Canyon (San Bernardino County) well field is plotted and marked in orange in the lower center of the map, and the "shaft" described in the 1931 Judgment is printed on the map and highlighted in yellow about one inch (1") below the well field. Sheep Creek Water Company's Los Angeles County well site is plotted and marked in orange in the upper center left of the map, just below the highlighting of the County line. The plotted Antelope Valley Groundwater Basin boundary lines are from Bloyd, 1967 (red), Carlson, et al, 1998 (dashed black) and Carlson & Phillips, 1998 (blue), as depicted on Plate 1 from Luhdorff & Scalmanini's Technical Memorandum "Ground-Water Basin and Subbasin Boundaries, Antelope Valley Ground-Water Basin" January 2002. The Sub-Basin boundary line between the Pearland and Buttes Sub-Basins, is also from Bloyd, 1967 (green), and is also as depicted on Plate 1 from Luhdorff & Scalmanini's Technical Memorandum "Ground-Water Basin and Subbasin Boundaries, Antelope Valley Ground-Water Basin" January 2002.

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6. I have also received information from Chris Cummings, Sheep Creek Water Company's General Manager, with regard to the location, characteristics and conditions of Sheep Creek Water Company's water supply, well fields, service area and wells.

7. Based on my professional knowledge, experience, and understanding of the relevant issues, it is my professional opinion that:

a. A watershed is an area of land that drains all the streams and precipitation to a common outlet. A groundwater basin is defined as a "volume" underlain by permeable materials capable of furnishing a significant supply of groundwater to wells or storing a significant amount of water [modified from Bulletin 118]. The current groundwater basin map depicts a surface expression (area) of groundwater basin boundaries and it should not be construed to imply that these boundaries extend downward in a third dimension [Bulletin 118]. Watershed represents the surface water drainage, and basin represents groundwater storage and flow.

b. Surface drainage (watershed) are the boundary lines separating two adjacent surface water drainage systems, which mark the points on the surface of the land where a drop of water will run down one side or the other. A groundwater divide generally forms a barrier to groundwater movement. Groundwater divides have noticeably divergent groundwater flow directions on either side of the divide with the water table sloping away from the divide [Bulletin 118].

c. Among others [Bulletin 118], groundwater flow directions can be used to define the groundwater basin boundaries. To determine the direction of groundwater flow directions, hydrogeologists plot and contour water level (potential energy) data on a base map. Groundwater flow lines are then drawn at right angles to the water – level elevation contours (potentiometric surface) in the direction of decreasing elevation. When more than one aquifer exists, each has its own direction of groundwater flow. The three-dimensional closed system that contains the entire flow paths followed by all water recharging the groundwater system has been termed a groundwater basin.

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d. Alluvial fans are formed by the deposition of sediments carried by streams that flow from mountain fronts onto broad, open areas. Consequently, alluvial fans tend to be coarse-grained, especially at their mouths. At their edges, however, they can be relatively fine-grained. Alluvial fans influence hydrogeologic characteristics both within individual fans and at a broader, stream segment scale. Hydrologic characteristics of alluvial fans are important determinants of riparian vegetation community composition [Miller et al. 2001, Chambers et al. 2003] and comprise the link between geomorphic phenomena within a stream system and riparian plant ecological processes and dynamics. They provide a subsurface conduit for groundwater input, influence groundwater depths and hence groundwater availability, and govern groundwater input to the stream.

e. Pumping a well in an unconfined aquifer causes actual dewatering of the material within an inverted, roughly cone-shaped volume, called the "cone of depression" or the "cone of influence." Dewatering occurs by simple gravity drainage toward the lowest point at the apex of the cone, the well. The widest part of the cone, at the top, is called the "area of influence." The ratio of the volume of water that drains from this cone under the influence of gravity to the volume of the cone is called the "specific yield," and is generally expressed as a percentage or decimal fraction. In most unconfined aquifers, the specific yield ranges from ten percent (10%) to thirty percent (30%). In other words, of the water held by an aquifer, ten percent (10%) to thirty percent (30%) can be given up to pumping or other discharge. A coarse-grained aquifer will have a higher specific yield than a fine-grained one. Specific yield is not to be confused with maximum yield, which is affected by the size of the aquifer.

f. The shape of the cone and the rate at which it expands across the top depend on the coefficients of transmissivity and storage of the aquifer and on the rate of pumping. The general rule is that the cone will continue to grow until it intercepts sufficient base area to satisfy the demands of the pumped well at the prevailing rates of ground water recharge. Occasionally, two (2) or more wells will have developed their cones of influence in such a way that they interfere with one another. The amount and areal extent of the interference is directly related to the rate of pumping of each well.

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g. The sources of recharge to a groundwater system include both natural and human-induced phenomena. Natural sources include recharge from precipitation, lakes, ponds, and rivers (including perennial, seasonal, and ephemeral flows), floodplains, stream wash, alluvial fan, and from other aquifers. Human-induced sources of recharge include irrigation losses from canals and fields, leaking water mains, sewers, septic tanks, and over-irrigation of parks, gardens, and other public amenities.

h. A portion of the infiltrated water enters the groundwater or aquifer system by passing through the vadose or unsaturated zone, and it exits to the atmosphere, surface water, or to plants. The groundwater flows from the highlands towards the valleys, or from the recharge areas to the discharge areas. In a recharge area, there is a component to the direction of groundwater flow that is downward. Groundwater recharge is the entry to the saturated zone of water made available at the water table surface. Conversely, in a discharge area, there is a component to the direction of groundwater flow that is upward. Groundwater discharge is the removal of water from the saturated zone across the water table surface. The patterns of groundwater flow from the recharge to the discharge areas form groundwater flow systems, which constitute the framework for understanding recharge processes.

i. Percolation to the water table from streambeds takes two forms, depending on whether there is a saturated connection between the stream and the water table. Where no connection exists, a situation where water tables are generally deep, water moves downward from the streambed to the water table, forming a groundwater mound which then dissipates laterally away from the stream.

j. The route which groundwater takes to a discharge point is known as a flow path. A set of flow paths with common recharge and discharge areas is termed a groundwater flow system. As mentioned above, the three-dimensional closed system that contains the entire flow paths followed by all water recharging the groundwater system has been termed a groundwater basin. Groundwater possesses potential energy mainly by virtue of its elevation (elevation or gravitational head) and its pressure (pressure head). To determine the direction of groundwater flow directions, hydrologists plot and contour water level (potential

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energy) data on a base map. Groundwater flow lines are then drawn at right angles to the water-level elevation contours (potentiometric surface) in the direction of decreasing elevation. When more than one aquifer exists, each has its own potentiometric surface map and direction of groundwater flow directions.

8. From these aforedescribed and other professional publications and information respecting the hydrology of the Western Mojave Desert including Sheep Creek, and based on my professional knowledge, experience, and understanding of the relevant issues, it is my professional opinion that:

a. The source of natural recharge water to the aquifer beneath the Sheep Creek Water Company properties include: precipitation, Sheep Creek and Sheep Creek Wash, alluvial fans, and other surface and subsurface sources. Sheep Creek Wash flows as a result of runoff from the higher altitudes in the San Gabriel Mountains and from precipitation that falls on the desert floor. Annual average precipitation ranges from about four inches (4") to six inches (6") in the vicinity of El Mirage Lake and increases to about twenty-eight inches (28") to thirty-two inches (32") in the Swarthout Valley over the southern part of the El Mirage Basin [Bulletin 118]. Recharge is greater near the San Gabriel mountain front in Sheep Creek where surface flows are more frequent and recharge is less far away from the mountains.

b. The average flow in Sheep Creek Wash is estimated to be about twenty-two hundred acre feet per year (2,200 ac-ft/yr) [Lines, 1966].

c. The southeastern boundary of the Antelope Valley Groundwater Basin was modified by Carlson & Phillips (1998) and Bloyd (1968). The revised boundary shows that Sheep Creek Water Company's Los Angeles County property lies outside the Antelope Valley Groundwater Basin (6-44) boundary. The waters of Swarthout Creek and Sheep Creek are contained in the El Mirage Valley Basin (6-43) which is a hydrogeologically distinct and separate basin from the Antelope Valley Groundwater Basin. The original El Mirage Valley Groundwater Basin boundaries are defined in Bulletin 118.

d. The El Mirage Valley Basin (6-43) is not integral to either the Antelope Valley (6-44) or Mojave River Basins (6-43).

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e. The Sheep Creek fan of sediments in the geologic record shows the historic patterns in the Sheep Creek Wash. Alluvial fan sediments are composed of materials weathered from the San Gabriel Mountains. At the mouth, alluvial fans tend to be coarse-grained and, at the edges, the alluvial fans can be relatively fine-grained. They are part of Sheep Creek Wash. Alluvial fans may be a source of natural recharge to the aquifers.

f. Percolation to the water table aquifer from Sheep Creek is via an unsaturated zone. Water moves downward from the streambed to the water table, forming a groundwater mound [***Figure 1***] which then dissipates groundwater laterally away from the stream. Groundwater from the recharge mound flows in the direction of low potential energy areas. These groundwater flow directions include: (a) north, (b) northeast [USGS Water Resources Investigations Report 03-43-4314; Flow Path 3 includes Sheep Creek area], and (c) northwest (in the direction of Sheep Creek Water Company's Los Angeles County property). The faults in the area may impede movement of groundwater water flow and its direction.

g. Mountain front recharge typically involves complex processes of unsaturated and saturated flow, as well as percolation along Sheep Creek channels, flowing across alluvial fans to the valley. On a large scale, mountain front recharge through Sheep Creek mouth from mountain streams is considered a localized recharge process that creates a high potential energy recharge zone [***Figure 2***]. The surface waters in Sheep Creek flow toward the north, and groundwater flows north toward El Mirage Lake, east toward the Mojave River Basin and west toward the Antelope Valley Basin.

h. By analyzing maps containing USGS groundwater contours and the geographic location of Sheep Creek Water Company's Los Angeles County Property, I was able to determine that the basin underlying Sheep Creek Water Company's Sheep Creek (San Bernardino County) well field and its Phelan service area, also underlies its Property in Los Angeles County. Further, the Los Angeles County property is not within the hydrogeologic unit of the Antelope Valley Basin.

i. The drilling company (Farm Pump and Irrigation, Co; Inc.) for Sheep Creek Water Company's Los Angeles County well has provided the well test data for the

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following parameters:

i. Static water level = 352 feet;

ii. Pumping rate, water elevation and drawdown information:

Pumping Rate (gpm)	Water Elevation in the Well (feet)	Drawdown (feet)
1774	560	560-352=208
1526	532	532-352=180
1353	510	510-352=158

iii. Based on this data, calculations were made for Specific Capacity, Transmissivity, Hydraulic Conductivity, and Radius of Influence. These calculations are as follows:

Pumping Rate (gpm)	Drawdown (feet)	Specific Capacity (gal/min/ft)	Transmissivity (gal/day/ft)	Hydraulic Conductivity (gal/day/ft^2)
1774	208	8.52	12,780	25.6
1526	180	8.47	12,705	25.5
1353	158	8.56	12,840	25.7

iv. Calculations of Transmissivity were based on Driscoll's (1986) formula for an unconfined aquifer, where T = 1500 (Q/s); T is Transmissivity (gal/d/ft); Q is Constant Discharge (gal/min); and, S is Drawdown in feet.

v. Hydraulic Conductivity = Transmissivity / Saturated Thickness; Saturated Thickness = 498 feet.

vi. Calculation of Radius of Influence for unconfined aquifer (Sichardt's equation) = 3000 x drawdown (meters) x square root of Hydraulic Conductivity (meter /second) = 3000 x 48 x √ of 1.2 x 10^{-5} = 1,641 feet. This radius of influence was calculated for pumping rate of 1,353 gpm and a drawdown of 158 feet.

j. The driller is recommending groundwater withdrawal at the rate of 1,200 gpm. The production rate of 1,200 gpm will reduce radius of influence. The nearest distance from Sheep Creek Water Company's Los Angeles County property / well field to the eastern boundary of the Antelope Valley Groundwater Basin [Carlson & Phillips, 1998] is 4000 feet. Therefore, the extraction of water from the Sheep Creek Water Company's Los Angeles County

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property / well field in the El Mirage Basin would not adversely impact the water supply in Antelope Valley Groundwater Basin.

k. Sheep Creek Water Company's producing wells in Los Angeles County and San Bernardino County were completed in the unconfined aquifer. In unconfined aquifers, specific yield ranges from 0.1 to 0.3. A coarse-grained aquifer in San Bernardino County will represent higher specific yield than a fine-grained aquifer in Los Angeles County. However, the size (saturated thickness) of the aquifer in Los Angeles County is higher and, therefore, produces a higher amount of yield than San Bernardino County.

l. The shape of the drawdown cone and the rate at which it expands across the top depend on the coefficients of transmissivity and storage of the aquifer, and on the rate of pumping. The general rule is that the cone will continue to grow until it intercepts a recharge or impermeable boundary. Occasionally, two or more wells will have developed their cones of influence in such a way that they interfere with one another. The amount and areal extent of the interference is directly related to the rate of pumping of each well. The specific yield of an unconfined aquifer is higher than of a confined aquifer. For the same hydraulic parameters, unconfined aquifers produce a smaller radius of influence than a confined aquifer. At a producing rate of 1,353 gpm, the calculated radius of influence for Sheep Creek Water Company's Los Angeles County well field is 1,641 feet. Preliminary inquiry shows that there are no other significant producing wells located in close proximity to the Sheep Creek Water Company's Los Angeles County well field.

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

Executed on September 9, 2008 at Dallas, Texas.

RAM ARORA, PhD

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