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SUPERIOR COURT OF THE STATE OF CALIFORNIA

COUNTY OF LOS ANGELES – CENTRAL DISTRICT

ANTELOPE VALLEY GROUNDWATER CASES Included Actions: Los Angeles County Waterworks District No. 40 v. Diamond Farming Co., Superior Court of California, County of Los Angeles, Case No. BC 325201; 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, Case Nos. RIC 353 840, RIC 344 436, RIC 344 668	Judicial Council Coordination No. 4408 CLASS ACTION Santa Clara Case No. 1-05-CV-049053 Assigned to The Honorable Jack Komar **PHASE 3 TRIAL BRIEF SUBMITTED BY THE CITY OF LOS ANGELES, LOS ANGELES COUNTY WATERWORKS DISTRICT NO. 40, CITY OF PALMDALE, LITTLEROCK CREEK IRRIGATION DISTRICT, PALM RANCH IRRIGATION DISTRICT, PALMDALE WATER DISTRICT, QUARTZ HILL WATER DISTRICT, AND CALIFORNIA WATER SERVICE COMPANY**

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I. INTRODUCTION

The Antelope Valley Groundwater Adjudication Area ("Basin") is in overdraft. As a result, there are at least three undesirable effects in the Basin - any one of which is sufficient for a court finding of overdraft and implementing a physical solution:

> Groundwater pumping exceeds the safe yield of the Basin and has exceeded the safe yield of the Basin, by approximately 50,000 acre-feet a year ("afy") over the last decade.
>
> As a result of groundwater pumping in excess of safe yield, groundwater in storage has been significantly depleted, *by more than five million acre-feet since 1951*; ongoing pumping in excess of safe yield has resulted in ongoing declining groundwater levels and associated ongoing depletion of groundwater in storage, by an average annual loss of approximately 40,000 to 50,000 acre-feet over the last ten years.
>
> Currently, up to about six feet of land subsidence has resulted and continues from the lowering of groundwater levels and the associated depletion of groundwater in storage in the central part of the Basin.

The safe yield of the Basin is 110,000 afy. The safe yield is based on the best scientific data and analysis available. Total groundwater extractions, however, have been in the range of about 150,000 to 170,000 afy from 2000 to 2009. Thus, the Basin is in overdraft as average groundwater pumping has exceeded the Basin's safe yield by approximately 50,000 acre-feet each year from 2000 to 2009.

As a result of the present and historical pumping in excess of the safe yield, total groundwater in storage has been chronically depleted, by about 5,600,000 acre feet since 1951. Although the magnitude of groundwater decline is not uniform throughout the Basin because geologic conditions vary, it is beyond reasonable dispute that, as a result of the chronic decline in

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groundwater in storage, subsidence has been occurring in the Basin for decades, and has continued to the present time. The most visible effects of land subsidence are the occurrence of ground fissures in and near Edwards Air Force Base.[1]

II. WHY THE GROUNDWATER BASIN CANNOT BE EVENTUALLY DEPLETED AND WHY THERE CANNOT BE ANY FURTHER PERMANENT LOSS OF GROUNDWATER IN STORAGE

The Public Water Suppliers[2], together with the United States, City of Los Angeles, and other parties, created an expert's group that was the most experienced group of groundwater experts ever to analyze a California groundwater basin. Their task was straightforward: to determine the Basin's safe yield and the extent of the overdraft using the best scientific data available.

For more than four years, the key members of the Technical Committee worked together in an intensive analysis of decades of data. Ultimately, they issued their report, today known as the "The Summary Expert Report, Phase 3 Trial on Safe Yield and Overdraft, Antelope Valley Area of Adjudication" consisting of several hundred pages of analysis and findings.

The Summary Expert Report is believed to be the most extensive analysis ever done on the Basin – or on any adjudicated groundwater basin in California.[3] No private landowner party or expert produced a timely report on the date designated for an exchange of expert witness reports under Code of Civil Procedure section 2034. Stated simply, the Summary Report's analysis estimating the native safe yield at 82,300 afy and total safe yield at 110,000 afy, and analysis of decades of chronic overdraft conditions are the best scientific analysis of the Basin.

A. The Adjudication Area

The Antelope Valley encompasses over 1,000 square miles of desert. One of the most arid areas in the United States, it receives only a few inches of rain annually. Historically, there has been little residential development. In the last few decades, however, the Palmdale and

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[1] Exhibit "1" contains a photograph of the effects of land subsidence near Edwards Air Force Base.

[2] The Public Water Suppliers are: California Water Service Company; City of Palmdale; Littlerock Creek Irrigation District; Los Angeles County Waterworks District No. 40; Palmdale Water District; Palm Ranch Irrigation District; and Quartz Hill Water District

[3] A copy of the Summary Expert Report was posted on the court's website on July 15, 2010.

Lancaster areas were among the fastest growing regions in California. Although residential development has slowed recently due to the severe recession, there will be significant new urban development in the foreseeable future, including thousands of new homes in the proposed Tejon Ranch project. Together with the hundreds of thousands of existing residents and businesses, new development projects must have a reliable supply of water.

The Antelope Valley has virtually no lakes, rivers or natural reservoirs. Groundwater is the only reliable natural water supply. As agriculture expanded significantly in recent years, it put increasing demands on the Basin's water, the same water which the Public Water Suppliers have depended upon for decades for a public water supply.

The Public Water Suppliers are legally obligated to provide water to their existing customers, and must provide water for new development. Without continued access to groundwater, they would have to rely upon less reliable and increasingly scarce imported water from Northern California and they might be unable to serve their existing customers or support new development.

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B. Edwards Air Force Base

Edwards Air Force Base covers 470 square miles and is the largest property owner in the Basin. The Federal Government conducted military and NASA operations at Edwards before agriculture or urban development began their relatively recent expansion within the Valley. Edwards AFB exists in the Antelope Valley because it is the only place in the United States with long, dry lake beds for space shuttle landings and for supersonic test flights.

Edwards AFB is vital to the local economy and to national security. Aerospace and high-tech companies employ thousands of Valley residents who work with military and NASA personnel at Edwards AFB.

There is land subsidence at Edwards AFB and elsewhere in the Antelope Valley. The United States Geologic Survey ("USGS") has studied the subsidence and reports it occurs from the City of Lancaster up to and including Edwards AFB.[4] The subsidence is caused by too much groundwater pumping. Subsidence causes the Basin's clay and alluvial soils to permanently compact.

In the 1990's, land subsidence stopped space shuttle landings at Edwards AFB when fissures and cracks opened on the Edwards runways. Edwards Air Force Base officials first believed they could stop subsidence by purchasing imported water from Northern California, thereby decreasing Edwards' reliance upon groundwater. Although Edwards AFB has stopped much of its own pumping and relies upon some imported water, subsidence continues due to overdraft pumping many miles away from Edwards AFB that causes groundwater to flow away rather than into the region as it had for millions of years under natural conditions.

Subsidence cannot be curtailed until overdraft pumping stops. Overdraft pumping will not stop until the court determines a safe yield number and implements a physical solution.

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C. <u>The Basin Is The Most Reliable Supply Of Drinking Water For Hundreds of Thousands Of Residents And Businesses</u>

Before the 1970's, the Basin was the only source of water for the hundreds of thousands of residents and businesses who depend upon the Public Water Suppliers for a safe and secure water supply. In the 1970's, the Public Water Suppliers began purchasing imported water from the Antelope Valley East Kern Water Agency ("AVEK"), Palmdale Water District and Littlerock Creek Irrigation District which contract for and deliver imported State Water Project ("Project") water from northern California. The Public Water Suppliers receive imported water deliveries via the Project – a several hundred-mile water distribution system operated by the California Department of Water Resources.

The Public Water Suppliers use the imported water to serve homes and businesses within the Antelope Valley. A portion of this imported water seeps into the ground and eventually ends up in the Basin. This water is known as "return flow."

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[4] Exhibit "2" is a copy of the U.S. Geologic Survey publication "Measuring Human-Induced Land Subsidence From Space (December 2003).

Although the Public Water Suppliers take Project water when available, they must depend upon Basin water for three reasons. First, the Public Water Suppliers must depend upon native groundwater for a large portion of their water supply in the Antelope Valley because the imported Project supply is widely variable. As an example, in 2008, some Public Water Suppliers received less than 25 percent of their expected amount of imported water. Second, the Public Water Suppliers have significant groundwater rights to recover the return flows from their Project purchases. Third, the Public Water Suppliers must continue to use groundwater during drought conditions or when the Project deliveries diminish due to drought, environmental regulations, earthquake, terrorism or other interruptions to the Project's pipeline distribution system. When there are inadequate imported water deliveries, the Public Water Suppliers must use additional groundwater to meet the public's water needs.

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III. THE BASIN'S SAFE YIELD IS A SCIENTIFICALLY-ESTIMATED NUMBER DETERMINED BY ALL AVAILABLE DATA

A. Why The Court Must Determine A Safe Yield Number

In the context of a surface stream system adjudication, the California Supreme Court emphasized the need for certainty in the amount of water available for allocating water rights in adjudications: "Uncertainty concerning the rights of water users has pernicious effects. Initially, it inhibits long range planning and investment for the development and user of waters in a stream system." (*In re Water of Long Valley Creek Stream System* (1979) 25 Cal.3d 339, 354.) The reasoning of *Long Valley* is equally applicable to groundwater adjudications because they are to make certain each party's groundwater production rights and apply a physical solution protecting the basin as a perpetually available water resource. (See Cal. Const., Art. X, § 2; *City of Barstow v. Mojave Water Agency* (2000) 23 Cal.4th 1224, 1249, fn. 13 [court should have discretion "to reduce to a reasonable level the amount the overlying user takes from an overdrafted basin."])

The United States, City of Los Angeles, and the Public Water Suppliers have spent millions of dollars to secure the Basin's safe yield determination as a crucial step in achieving a comprehensive groundwater rights adjudication, and for a physical solution to the Basin's water supply problems. Because the United States is the largest landowner party, these efforts include a costly, multi-year process of certifying two large classes of landowners as well as service of process upon thousands of individual parties to satisfy the McCarran Amendment's comprehensiveness requirement.

It is important to note that, out of thousands of landowner parties, there are only a relatively few large agricultural parties who refuse to accept the safe yield number as determined by the best presently-available scientific evidence. Instead, they would have the court not determine a safe yield number but merely a range of numbers. To do so, however, would put the public and the Basin at risk of greater harm from chronic overdraft conditions. Thus, this trial should determine a safe yield number based upon all of the presently available scientific data.

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B. The Parties And The Public Will Not Have A Physical Solution Until There Is A Safe Yield Established For The Basin

The Public Water Suppliers are responsible for providing a safe and reliable public water supply to over 200,000 homes and businesses. Although Project water is available in the Basin, Project deliveries depend upon uncertain annual Sierra Nevada mountain precipitation, changing environmental laws, regulations and court decisions, and upon limited delivery and distribution facilities. Thus, the Basin's viability is a vital concern to the Public Water Suppliers whose customers depend upon the Basin for more than 40,000 acre feet of water annually.

Over the last 15 years, the Basin has seen a sharp increase in agricultural groundwater demand.[5] Two large carrot farming operations moved into the Basin and began pumping tens of thousands of acre-feet annually thereby putting the Basin's long-term water supply at an increased risk.[6] Additionally, they filed lawsuits against the Public Water Suppliers which would prevent the Public Water Suppliers use of groundwater during chronic water shortage conditions.

Until a physical solution is implemented under the court's ongoing jurisdiction and supervision, overdraft conditions will continue with increased land subsidence, loss of groundwater in storage, and lower groundwater levels within the Basin. As almost all parties

[5] See Los Angeles Times article dated June 15, 2004 attached hereto as Exhibit "3."
[6] The two large carrot farmers are Bolthouse Farms and Diamond Farming.

acknowledge the need for a physical solution, they also agree or have to concede the Basin is in overdraft.

IV. A COURT DOES NOT NEED TO WAIT TO FIND OVERDRAFT UNTIL AN IMMEDIATE INJURY OCCURS BUT FINDS OVERDRAFT WHEN A CONTINUING USE OF GROUNDWATER WOULD RESULT IN A CHRONIC LOSS OF GROUNDWATER IN STORAGE OR WOULD LEAD TO AN EVENTUAL DEPLETION OF THE GROUNDWATER SUPPLY

The determination of groundwater rights must be based on a proper judicial determination of both safe yield and overdraft. The necessary certainty required in a water rights determination can only be achieved by a court determination of the best estimated safe yield number based on all presently-available scientific evidence.

A. Definitions of Safe Yield and Overdraft

The California Supreme Court defined "safe yield" and "overdraft" in *City of Pasadena v. City of Alhambra* (1949) 33 Cal.2d 908 and *Los Angeles v. San Fernando* (1975) 14 Cal.3d 199, 278.

In *San Fernando*, the California Supreme Court defined "overdraft" in terms of "safe yield:" Safe yield" is "the maximum quantity of water which can be withdrawn annually from a groundwater supply under a given set of conditions without causing an undesirable result." An "undesirable result" includes, but is not limited to, the "gradual lowering of the ground water levels resulting eventually in depletion of the supply." (*San Fernando* at p. 278 [citing *City of Pasadena v. City of Alhambra* (1949) 33 Cal.2d 908, 929].)

B. Overdraft Exists If There Is Or Will Be A Loss of Groundwater In Storage Or An Eventual Depletion of The Groundwater Supply

The *Pasadena* court explained that overdraft is not necessarily an immediate injury to groundwater users but overdraft exists when the groundwater would be eventually depleted by pumping in excess of the safe yield:

> Each taking of water in excess of the safe yield...was wrongful and was an injury to the then existing owners of water rights, because the overdraft, from its very beginning, operated progressively to reduce the total available supply. Although no owner was immediately prevented from taking the water he needed, the report demonstrates that a continuation of the overdraft would eventually result in such a depletion of the supply stored in the underground basin that it would become inadequate. The injury thus did not

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> involve an immediate disability to obtain water, but, rather, it consisted of the continual lowering of the level and gradual reducing of the total amount of stored water, the accumulated effect of which, after a period of years, would be to render the supply insufficient to meet the needs of the rightful owners.

(*Pasadena, supra,* at pp. 928-929.)

In other words, the *Pasadena* court unequivocally holds overdraft does not require a showing of an immediate injury or harm but overdraft exists if present groundwater extractions would eventually lead to the depletion of the natural groundwater supply or would cause other undesirable results including chronic loss of groundwater in storage and land subsidence.

C. A Court Separates Natural Recharge (Precipitation) From Artificial Recharge (State Water Project Deliveries) In The Safe Yield Determination

The importer of Project water is entitled to the Project water return flows. For that reason, the *San Fernando* court divided the San Fernando Basin's groundwater yield into a native safe yield and a total safe yield. (*San Fernando, supra*, at p. 261; see also *City of Los Angeles v. City of Glendale* (1943) 23 Cal.2d 68 [return flows belong to the importer].) The difference between total natural or native safe yield and total safe yield is the latter included return flows from imported water deliveries. As in *San Fernando*, the court should determine safe yield by separating natural recharge or native safe yield from total safe yield.[7]

D. Overdraft Can Be Determined By Comparing Extractions With Safe Yield From Natural Recharge

The California Supreme Court held that overdraft is determined by comparing the estimated safe yield from natural recharge with groundwater extractions:

> The proper time to act in preserving the supply is when the overdraft commences, and the aid of the court would come too late and be entirely inadequate if, as appellant seems to suggest, those who possess water rights could not commence legal proceedings until the supply was so greatly depleted that it actually became difficult or impossible to obtain water. Where the quantity withdrawn exceeds the average annual amount contributed by rainfall, it is manifest that the underground store will be gradually depleted and eventually exhausted, and accordingly, in order to

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[7] "Safe yield" includes: (1) native precipitation and associated runoff; (2) return flows from delivered imported water; and, (3) return flow from delivered groundwater minus losses incurred through natural groundwater depletions from: (1) subsurface outflow; (2) excessive evaporative losses in high groundwater areas and through vegetation long streams; (3) groundwater infiltration into sewers; and (4) rising water outflow or water emerging from the ground and flowing down the river channel to the sea. (*San Fernando* at pp.278-279.)

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> prevent such a catastrophe, it has been held proper to limit the total use by all consumers to an amount equal, as near as may be, to the average supply and to enjoin takings in such quantities or in such a manner as would destroy or endanger the underground source of water. There is, therefore, no merit to the contention that the owners of water rights were not injured by the additional appropriations made after all surplus waters were taken, and they clearly were entitled to obtain injunctive relief to terminate all takings in excess of the surplus as soon as it became apparent from the lowering of the well levels that the underground basin would be depleted if the excessive pumping were continued. (*Pasadena, supra,* at pp. 928-929.)

E. **<u>The Basin Already Has Undesirable Effects From The Use Of Groundwater That Exceeds The Basin's Safe Yield And There Will Be Further Losses Of Groundwater in Storage And Eventual Depletion Of The Public Water Supply</u>**

Expert witnesses for the United States, the City of Los Angeles, and the Public Water Suppliers will testify that the water withdrawn from the Basin exceeds, and has exceeded, the average annual amount of contributed by rainfall since as early as 1950 and continuing to the present. There has been a permanent loss of groundwater in storage since the early 1950's and that loss continues at the present time. Moreover there is and has been land subsidence in the Basin where large lacustrine deposits (clay soils) are present.

V. **<u>LEADING CALIFORNIA GROUNDWATER EXPERTS HAVE ESTABLISHED THE BASIN'S ESTIMATED SAFE YIELD NUMBER AND BASIN OVERDRAFT IN MULTI-YEAR STUDIES AND ANALYSIS AT COST OF OVER 2 MILLION DOLLARS</u>**

Of the over 20 court-adjudicated basins in California, no other adjudicated California basin is as large as the Antelope Valley Area of Adjudication. Its size and complexity demanded a sophisticated and coordinated study and analysis by leading California groundwater experts. For that reason, six of California's foremost groundwater experts worked together for more than four years to estimate the safe yield number and analyze overdraft in the Basin. They are Mr. Robert Beeby, Mr. Timothy Durbin, Mr. Peter Leffler, Dr. June Oberdorfer, Mr. Joseph Scalmanini, and Mr. Mark Wildermuth.

Together, they have done the most comprehensive analysis to date of the Antelope Valley Adjudication Area, and are believed to have conducted the most detailed analysis of an adjudicated groundwater basin in California history.

These six leading expert witnesses were the primary participants in what was known as the "Technical Committee." It was organized at an earlier stage in the litigation in an effort to attempt simultaneous peer review of opinions relating to the state of groundwater in the Basin, while avoiding unnecessary duplication.

The six experts have prepared a joint Summary Expert Report for the Phase III Trial. The Summary Report was provided to all parties and the court on the date designated for the exchange of expert witness reports. Except for the United States, the City of Los Angeles and the Public Water Suppliers, no other party provided a timely expert witness report under Code of Civil Procedure section 2034.

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Contrary to assertions from a few litigants, the Technical Committee was not solely comprised of public water suppliers. Some participants, such as the City of Palmdale and the Los Angeles County Sanitation Districts, do not pump groundwater nor do they supply groundwater to the public. Other participants, such as the City of Los Angeles, generally utilize groundwater for agricultural purposes. Additionally, the United States, which is not a public water supplier, also participated in the Technical Committee.

All these governmental agencies want to establish a safe yield number based upon the scientific evidence and studies available over the last 60 years. Their expert witnesses have a scientifically-justified estimate of the amount of water contributing to the Basin (i.e., safe yield) and they developed a joint document containing their recommendations on the amount of groundwater pumping that can be sustained under current conditions. The expert witnesses and there analysis are described below.

A. **<u>Public Water Suppliers' Expert Witness Joseph Scalmanini</u>**

Mr. Joseph Scalmanini is widely considered to be one of the leading experts on California groundwater basins. He has decades of experience analyzing California's groundwater basins. His experience and expertise are unequaled. A copy of his resume is attached as Exhibit "4."

Mr. Scalmanini has studied the Basin for more than 8 years. With the possible exception of Mr. Tim Durbin, who will testify in behalf of the City of Los Angeles and who began to analyze the Antelope Valley groundwater basin in the 1970's, no other expert has conducted a more in depth analysis of the Basin.

He will testify as to the geology of the Basin including its land subsidence, as well as its land use conditions and the effects of groundwater production in the Basin including its safe yield and overdraft.

B. Palmdale Water District's Expert Witness Mark Wildermuth

Mr. Mark Wildermuth is widely considered to be one of the leading experts on California groundwater basins. He is a civil engineer with 35 years of experience in groundwater basins in southern California. Mr. Wildermuth has studied the Basin for more than 5 years and will testify as to his determination of natural recharge based on change-in-storage calculations.

Mr. Wildermuth will testify as to the loss of over 5 million acre-feet of groundwater in storage since 1951. He will also testify as to land subsidence in the Basin. A copy of Mr. Wildermuth's resume is attached as Exhibit "5."

C. City of Angeles's Expert Witness Timothy Durbin

Mr. Timothy J. Durbin is one of the leading experts on California groundwater basins. He has decades of experience analyzing California's groundwater basins. His experience in the Antelope Valley is unequaled by any other expert.

Mr. Durbin holds a B.S. from Stanford University in Civil Engineering and a Master's degree from Stanford in Civil Engineering, with an emphasis in Hydrology. No other expert witness has more experience in studying the Basin. Mr. Durbin first professionally studied groundwater in the Antelope Valley when he worked on a project for the California Department of Water Resources (DWR) as an employee of the USGS in the mid-1970's. While working at the USGS from 1972 through 1984, Mr. Durbin eventually served as the head of the California and Nevada offices of the USGS and continued to work on Antelope Valley groundwater issues.

During the Phase III trial, the evidence will show Mr. Durbin gathered evidence relating to precipitation and streamflow in the Antelope Valley representing the period of 1949 through 2009 and conducted three separate analyses to develop an estimate for the natural groundwater recharge for the Antelope Valley. His use of the term "natural groundwater recharge" includes all

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natural water sources that contribute to underground water supply, such as streamflows, groundwater travelling outside of known and definite channels, and soil infiltration from precipitation on so-called "underdeveloped areas," but does not include recharge from water applied to the land surface for agricultural, urban, and industrial purposes.

The evidence will show Mr. Durbin performed field work to supplement hydrologic data available from the USGS, National Weather Service, and California Department of Water Resources, and other agencies. The results of the field work and the data compiled from State and Federal agencies were used to analyze the natural groundwater recharge of the Antelope Valley. He personally visited various creeks in the Antelope Valley and gathered evidence to perform his studies.

The City of Los Angeles will present evidence that Mr. Durbin utilized three different and independent approaches to determine the natural groundwater recharge. He will also testify as to the amount of overdraft in the basin by comparing groundwater production and the Basin's safe yield. A copy of his resume is attached as Exhibit "6."

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D. <u>Public Water Suppliers' Expert Witness Robert Beeby</u>

Mr. Robert Beeby is one of the leading experts on California groundwater basins. He too has decades of experience analyzing California's groundwater basins. He is considered to be one of the most prominent California experts in analyzing the water requirements for crops and native vegetation in California.

Mr. Beeby participated in the Technical Committee and will testify as to the amount of water required for crops and native vegetation in the Basin. A copy of his resume is attached as Exhibit "7."

E. <u>Public Water Suppliers' Expert Witness Peter Leffler</u>

Mr. Peter Leffler is a leading expert on California groundwater basins. He has experience analyzing California's groundwater basins and is an expert witness on the paucity or lack of groundwater flow from mountain areas through subterranean bedrock conditions into the Basin. A copy of his resume is attached as Exhibit "8."

F. The United States' Expert Witness Dr. June Oberdorfer

Dr. June Oberdorfer is a California hydrogeologist. Her work is described in the Trial Brief submitted by the United States ("Federal Defendants").

VI. THE BASIN IS IN OVERDRAFT AND HAS BEEN IN OVERDRAFT FOR DECADES

Based on physical evidence of subsidence and detailed scientific analyses of surface water and groundwater resources, land use and associated water requirements, and water supply availability and utilization, overdraft in the Basin can be summarized in three categories:

Groundwater pumping has long exceeded the sustainable yield of the groundwater basin; and groundwater pumping continues to exceed the current sustainable yield of the basin;

As a result of pumping in excess of sustainable yield, groundwater in storage has been significantly depleted since 1951; ongoing pumping in excess of sustainable yield has resulted in declining groundwater levels and ongoing depletion of groundwater in storage; and

Up to about six feet of land subsidence has resulted from historical lowering of groundwater levels in the central part of the Basin.

A. Change In Groundwater In Storage Shows Over 5 Million Acre-Feet Loss And The Eventual Depletion Of The Basin

The change of storage in a groundwater basin is equal to the inflows of water to the basin minus the outflows of water from the basin. If the change in storage is negative, that means that more water is flowing out of the basin than flowing in. If all the inflows and outflows are known except natural recharge, then the calculated change in storage can be used to determine the natural recharge.

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Mr. Wildermuth calculated two types of changes in storage: change in storage from gravity drainage (pumping) and change in storage from land subsidence. To determine the change of storage from gravity drainage, he used changes in groundwater levels in wells. There are numerous well level measurements in the Antelope Valley during the multi-year study period. Mr. Wildermuth obtained these well measurements from the USGS. and other reliable sources. Based on these measurements and using his professional expertise and experience, Mr. Wildermuth drew groundwater elevation contour maps. The court has already seen some of Mr. Wildermuth's contour maps in the Phase 2 trial.[8]

Mr. Wildermuth constructed a 400-meter grid over his study area,[9] and using the groundwater contours and the individual data points, estimated the groundwater elevation at each grid cell at the beginning and end of each period. By subtracting those two numbers, he obtained the change in groundwater elevation in that cell.[10]

Mr. Wildermuth then multiplied the change in groundwater elevation by the specific yield[11] to obtain change in storage. To estimate the specific yield at each grid cell, he used hundreds of well completion reports furnished by the State of California under protective order. By using the actual reported sediment types, he was able to estimate change in storage more accurately than if he had used an average specific yield for the entire study area.

Mr. Wildermuth then computed the change in storage from subsidence. When groundwater is excessively withdrawn from a basin, it causes saturated fine-grained sediments (aquitards) to compact, causing land subsidence. The compacted sediments cannot hold as much water, and the excess water is discharged. The volume of water discharged is equal to the volume of subsidence. Mr. Wildermuth obtained the volume or amount of subsidence from a published

[8] Experts for a few landowners will likely try to criticize Mr. Wildermuth's contour maps by claiming alleged discrepancies between the location of the contours and the data points. Mr. Wildermuth will show that these alleged discrepancies are based on the landowner experts' misunderstanding of the process used to create contours, and their mistaken assumption that groundwater levels are linear between contours.

[9] The study area is smaller than the area of adjudication as defined by the court, because the study area omits certain outlying areas in which there is insufficient reliable data.

[10] Although the computer calculation of groundwater elevations, specific yields and change of storage is referred to as a model, it is not the type of numerical groundwater model requiring calibration and convergence. It is simply a computer calculation for each cell in a large grid.

[11] Specific yield is a measure of how much water can be held in alluvial sediments. It varies depending on the type of sediment.

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report of the U.S. Geological Survey. This report uses data up to 1992 and Mr. Wildermuth correctly assumed that the subsidence continued at the same rate from 1992 to the present.

Adding change in storage from gravity drainage and change in storage from subsidence provides the total change in storage. The results of this effort show total loss or negative change in storage of 5.6 million acre-feet for the period of 1951 to 2005, and a total loss or negative change in storage of 650,000 acre-feet (over 50,000 acre-feed per year) for the period 1998 to 2009. These results are shown graphically on Figure 4.3-14 attached hereto as Exhibit "9."[12]

The fact that groundwater storage in the basin is currently declining at the rate of about 50,000 acre-feet per year establishes the basin is currently in overdraft and has been in overdraft for many years.

B. Subsidence Evidence of Overdraft

Land subsidence is the sinking of the Earth's surface due to the rearrangement of subsurface materials. Over 80 percent of all documented cases of land subsidence in the United States have been caused by groundwater extractions from underlying aquifer systems. Groundwater extraction is an especially well-documented cause of subsidence in the arid southwestern United States.

Land subsidence in the Antelope Valley is attributed to the lowering of groundwater levels beyond the preconsolidation stress of the underlying materials. Between 1930 and 1992, the ground surface subsided by a maximum of about 6.6 feet. Since 1992, the USGS has continued to monitor land subsidence in the Antelope Valley and reports show uninterrupted, ongoing land subsidence. The most damaging effects of the historical land subsidence have been the occurrence of ground fissures in at Edwards Air Force Base.

It is important to note the groundwater derived from soil compaction is permanent damage to the Basin and water derived from the compaction is a limited, non-renewable source of recharge to the aquifer-system. Mr. Scalmanini, Mr. Wildermuth, Mr. Timothy Durbin and Dr. June Oberdorfer will testify as to land subsidence in the Basin.

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[12] All references to Tables, Figures or Charts are to excerpts from the Experts' Summary Report and are separately attached hereto as exhibits.

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C. Groundwater Extractions Exceed The Basin's Safe Yield

The safe yield of the Basin has been calculated by a team of the leading groundwater experts in California, using the best available data and several independent scientific methodologies. The close level of agreement between the results of these independent methodologies strongly lends considerable support to the conclusion that the native safe yield of the Basin is 82,300 afy, and the total safe yield of the Basin is 110,000 afy. As explained in the detailed analysis of the experts' calculation of the safe yield and its comparison with groundwater extractions, the Basin is in overdraft. Groundwater extractions have ranged from about 150,000 afy to 170,000 afy over the last decade, and have therefore exceeded the safe yield by 40,000 afy to 60,000 afy each year.

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VII. SAFE YIELD: THE CALCULATION OF THE BASIN'S ESTIMATED GROUNDWATER RECHARGE AND EXTRACTIONS

Under generally current cultural conditions related to land and water use in the Basin, the combination of natural recharge and return flow contributions to groundwater recharge from the use of both native and supplemental water supplies will support total groundwater pumping of about 110,000 afy on a sustainable basis (i.e., no chronic depletion of groundwater from aquifer storage). Since the mid-1990's, under a range of cultural conditions that result in that sustainable yield, and without regard to any allocations of sustainable yield among types of pumpers, average groundwater pumping has consistently exceeded the total safe or sustainable yield of the Basin, by about 15,000 to 25,000 afy in the late 1990's, to more than 40,000 acre-feet each year from 2000 through 2009.

The long-term history of groundwater pumping in the Basin is illustrated in Figure 4.2-6 attached hereto as Exhibit "10." Total groundwater pumping for agricultural and municipal-type uses has been in the range between about 150,000 and 175,000 afy for the period of generally stable land and water use conditions since 2000.

For the respective periods used to estimate the safe yield of the Basin under fairly recent cultural conditions in the basin, total pumping has consistently exceeded safe yield. In the late

1990's, immediately prior to the initial filing of the current adjudication, average pumping exceeded safe yield by about 25,000 afy. With increased pumping since then, average pumping over the last decade has exceeded safe yield by about 40,000 afy. For historical reference, over a very short period from the late 1980's through the early 1990's, groundwater pumping was between about 88,000 and about 117,000 afy; however, for several decades prior to that, total pumping was consistently in the range of about 150,000 afy to more than 350,000 afy, all far in excess of any estimate of safe yield.

As shown below, the calculation of safe yield was based upon both independent analysis of the experts which strongly corroborated their respective results, as well as their shared data and analysis which concluded that the native yield of the Basin is 82,300 afy and the overall yield of the Basin is 110,000 afy.

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VIII. CHANGE IN GROUNDWATER STORAGE ANALYSIS AND THE DETERMINATION OF NATURAL RECHARGE

Change of storage can be combined with inflows and outflows to calculate natural recharge. In calculating natural recharge, Mr. Wildermuth used estimates of irrigation return flows and discharge to groundwater from septic tanks provided by other public water supplier experts, together with data on recycled water recharge and imported water recharge.

Return flows from irrigation, both agricultural and urban, can take many years to reach the water table. This length of time is referred to as "lag time" and is an important part of the natural recharge calculation. Mr. Wildermuth initially used estimates of lag time based on his experience in other basins and U.S. Geological Survey work in the Antelope Valley. He calculated natural recharge using a variety of lag times. Lag times of 10 years or less resulted in a negative natural recharge in the period 1951 through 1962, a physical impossibility. Ultimately Mr. Wildermuth selected a lag time of 15 to 20 years for irrigation return flows.

Mr. Wildermuth's calculated natural recharge for the period 1951 through 2005 was about 57,000 acre-feet per year and 55,000 acre-feet per year for the 15- and 20-year lag times, respectively. These estimates of natural recharge are very close to Mr. Durbin's independently developed natural recharge estimate of 55,000 acre-feet per year for the same period. Mr. Durbin's estimate is based on precipitation and the subsequent recharge of runoff from precipitation, and does not depend on any of the information used by Mr. Wildermuth to develop his natural recharge estimates. Also, the change in storage developed by Mr. Wildermuth closely tracks the change in storage developed with Mr. Durbin's natural recharge estimates.

IX. CITY OF LOS ANGELES EXPERT WITNESS TIM DURBIN USED THREE INDEPENDENT METHODOLOGIES TO ESTIMATE THE BASIN'S NATURAL RECHARGE

The City of Los Angeles will present evidence that Mr. Durbin utilized three different and independent approaches to determine the natural groundwater recharge. These three approaches are known as: (1) Evapotranspiration Method or "water-balance" method; (2) Chloride Method; and (3) Precipitation-Yield Method. The Evapotranspiration Method involved estimating the precipitation, evapotranspiration and playa flooding within the Antelope Valley watershed. The resulting estimated annual recharge is 55,000 acre-feet. The Chloride Method involved estimating the amount of chloride in precipitation and groundwater and the annual precipitation volume. The resulting estimated annual recharge is 58,000 acre-feet. The Precipitation-Yield Method involved developing precipitation-runoff and precipitation-groundwater relations. The resulting estimated average annual recharge is 56,400 acre-feet. Mr. Durbin's recent work involved almost 2,000 hours of work effort over a three-year period.

Each of the three methods requires identifying the regions within the Antelope Valley watershed where the infiltration of precipitation produces groundwater recharge. Little recharge occurs where the average annual precipitation is less than some small amount. Mr. Durbin relied upon generally-accepted principles in his profession and, after studying the relevant literature on the topic and based upon his many years of experience analyzing groundwater-related conditions in the Antelope Valley, determined it was reasonable to assume that recharge does not occur within interfluvial areas where the average annual precipitation is less than 8 inches.

A. Evapotranspiration Method

Mr. Durbin's first approach, the Evapotranspiration Method, is a method used by at least

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two other opposing landowner parties' designated experts to estimate the natural recharge of the Basin. Generally, the approach involves a calculation in which the water yield of a watershed equals the precipitation less the evapotranspiration.

The City of Los Angeles will present evidence to show how Mr. Durbin performed this calculation. First, Mr. Durbin assembled and analyzed precipitation data in the form of monthly precipitation for selected gauged sites within or near the Antelope Valley watershed and in the form of a map showing average annual precipitation. The precipitation data for the 57-year period of 1949 to 2005 were used for this analysis. Monthly data for 23 sites were downloaded from the Western Regional Climatic Center (2009).

Second, in order to compile the necessary information to derive his evapotranspiration estimate, Mr. Durbin compiled data showing the temperatures in the area for the 57-year period 1949 through 2005. Potential evaporation data were compiled for the available records, which cover 1995 to 2007 or shorter periods. Satellite images were obtained for water years 1986, 2003, 2005, and 2007. The potential evapotranspiration and temperature data were then used to calculate the potential evapotranspiration for the 57-year period 1949 to 2005. The satellite images were used to estimate vegetation coefficients for water years 1986 and 2005.

Third, once the precipitation and evapotranspiration estimates were determined, Mr. Durbin estimated the portion of the water yield that produces flooding on Rosamond Lake, Rogers Lake, and other playas. The portion of the water yield that produces floodwaters does not produce groundwater recharge. After subtracting the playa flood volume from the overall yield, Mr. Durbin estimated the annual recharge from both the San Gabriel and Tehachapi Mountains to be 55,000 acre-feet.

B. <u>Chloride Method</u>

Mr. Durbin's second independent approach to determining the natural recharge in the Antelope Valley was the Chloride Method, which involves measuring the amount of chloride in the precipitation and compare it to the amount of chloride in the groundwater. Mr. Durbin relied upon data gathered by the USGS to calculate the natural recharge of the Basin's groundwater to be approximately 58,000 afy.

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The City will introduce evidence that Mr. Durbin followed appropriate protocol and that the Chloride Method has been used by other scientists to estimate natural groundwater recharge.

C. Precipitation-Yield Method

The third independent method Mr. Durbin used to estimate natural recharge was the Precipitation-Yield Method. Mr. Durbin created a map showing the precipitation over the Antelope Valley watershed. The map was constructed using two steps. First, Mr. Durbin used the information from precipitation gages to identify a relation between the average annual precipitation and the altitude of a site. Second, the precipitation-altitude relation was used to transform a map representing topographic contours into a map representing precipitation contours.

Next, Mr. Durbin used the precipitation map to identify runoff-precipitation and yield-precipitation relations, where the yield corresponds to the combination of: rainfall and snowmelt runoff, groundwater discharge from mountain blocks as subsurface flow to the Basin, and groundwater discharge to stream channels. The runoff-precipitation relation quantifies the average annual rainfall and snowmelt runoff from a watershed based on the average annual precipitation within the watershed. The yield-precipitation relation quantifies the average annual yield from a watershed based again on the average annual precipitation within the watershed. Mr. Durbin calibrated the relations based on the measured streamflow at gages located within the mountain-block areas. The calibrated relations were used to quantify the yield from all the mountain-block areas adjacent to the Basin. Finally, the natural recharge to the groundwater basin was calculated by subtracting the playa flooding from the yield. The resulting average annual recharge is 56,400 acre-feet.

X. PUBLIC WATER SUPPLIERS' EXPERT WITNESS JOSEPH SCALMANINI CONDUCTED THE BASIN'S MOST DETAILED ANALYSIS OF GEOLOGY, LAND USE CONDITIONS, GROUNDWATER EXTRACTIONS AND GROUNDWATER RECHARGE TO DETERMINE THE SAFE YIELD AND OVERDRAFT

Mr. Scalmanini will testify as follows:

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A. Base Period

In studying groundwater basins in California, the selection of the proper representative period for study is crucial. This is because it is possible to be misled by selecting a period of non-representative conditions.

The appropriate base period is 1950 through 2009. The base period was chosen for the reasons described below.

The challenge in analyzing basin conditions is to be able to interpret whether the observed response in the basin, *i.e.*, groundwater level changes, is a result of true surplus or deficit (overdraft) conditions, or a result of short-term anomalous hydrologic conditions. To minimize that possibility, it has long been recognized that representative periods for study of groundwater basin conditions should be selected in such a way that minimizes bias that might result from a particular set of hydrologic or other conditions.

In order to eliminate the bias that could result from inappropriate selection of a study period, and to report on representative Basin conditions, the study periods discussed herein (generally from about 1950 through 2009) were selected on the basis of several criteria: long-term mean water supply; inclusion of both wet and dry stress periods; antecedent dry conditions; adequate data availability; reflection of cultural conditions in the basin; reflection of water management conditions in the basin; and proximity to present time (near-present end of base period).

B. Basin Geology

The Antelope Valley is located in the southwest portion of the Mojave Desert. Approximately two-thirds of the Valley area is located in northern Los Angeles County and the remainder occupies adjacent southeastern Kern County. The Valley is bounded on the south and west by the San Gabriel and Tehachapi Mountains, respectively; on the north by the Rosamond and Bissell Hills; and on the east by the buttes and alluvial fans of the Hi Vista area.

The Antelope Valley climate in the Valley is dry with typically less than 1 foot of average rainfall annually, while the surrounding mountains receive upwards of 18 inches annually. The seasonal variation in rainfall is pronounced, with the great majority occurring during the winter

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months from November through March.

In Phase 1, the court concluded in its Order dated November 3, 2006 that the alluvial basin as described in California Department of Water Resources Bulletin 118-2003 should be the basic jurisdictional boundary for purposes of the litigation.

The majority of groundwater production is extracted from aquifer materials to maximum depths of about 1,000 to 1,500 feet. Beginning with early exploration, settlement, and study in the Antelope Valley, groundwater was known to occur at shallow depths in the Valley. The occurrence of a number of natural springs, and a large central area of flowing artesian wells was noted. Continued development of agriculture and the associated drilling of wells for irrigation supply in the 1900's resulted in a long history of declining groundwater levels to several hundred feet below much of the valley. Currently, groundwater is produced from wells generally less than 1,000 feet deep with the deepest wells extending to a maximum of about 1,500 feet.

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C. **Basin Land Use**

There are four land uses associated with water requirements in the Basin: agricultural, municipal and industrial ("M&I") including mutual water companies and military), rural residential, and environmental/open space (artificial lakes).

1. Agricultural Use

Agricultural land use is significant in the Basin. From 1950 to the mid-1970's some 55,000 to 60,000 acres were agricultural production, dominated by alfalfa but with stable acreages of truck, field, and deciduous (orchard) crops and a noteworthy increase in grain crops. From the mid to late-1970's through the 1980's, agricultural land use significantly declined, to about 12,000 acres by 1990-91. Through the 1990's, agricultural land use more than doubled to about 28,000 acres. Since 2000, agricultural land use was in a range of about 25,000 to 28,000 acres through 2005, and slightly declined into a range of about 23,000 to nearly 26,000 acres through 2009. The recent period of generally stable agricultural land use has been marked by somewhat constant alfalfa farming but significantly increased truck cropping.

2. Municipal And Industrial Use

Presently, the Basin has a total population of over 300,000 with Lancaster and Palmdale having by far the greatest populations of any urban center (about 145,000 to 150,000 each). In contrast, Quartz Hill, Rosamond, Littlerock, and North Edwards, the developments of Desert View Highlands and Lake Los Angeles, as well as the Edwards AFB, each has a population of about 15,000 or less.

The combined populations of the mutual and private water companies in the Basin are estimated to be around 12,000. While there is no readily available record of rural residential population in the Basin, available data from Los Angeles and Kern Counties indicate that slightly more than 7,000 improved parcels are located throughout the Basin, outside the service areas of municipal water purveyors or smaller mutual or other private water companies.

3. Environmental Use

Two environmental/open space areas in the Basin are recognized as having water requirements, specifically the Paiute Ponds wetlands and Apollo Lakes Park impoundments. The Paiute Ponds were originally created in 1961 with the construction of a dike across Amargosa Creek to prevent its overflow into Rosamond Dry Lake. Currently, the Paiute Ponds wetlands occupy an area of 400 acres, and consist of five main ponds and an extensive marshland area. Within the wetlands, a minimum of 200 acres is to be maintained as marsh-type habitat according to a three-party Letter of Agreement between the LACSD14, the California Department of Fish and Game, and Edwards AFB. The ponds include a series of impoundments occupying an additional 90 acres for duck hunting built by Ducks Unlimited and Edwards AFB in 1991.

The recreational impoundments at the Apollo Lakes Park occupy a collective area of about 40 acres, and they first received deliveries of recycled (currently tertiary-treated) water from the Lancaster Water Reclamation Plant in 1972.

D. <u>Water Requirements</u>

Water requirements are related to the land uses described above: agricultural, municipal and industrial, and environmental/open space. The predominant historical water requirements have been for agriculture and municipal uses.

The total water requirements have varied greatly throughout the historical period. This variation is attributable to agricultural water use. During the period of agricultural expansion

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through 1950, the Basin experienced the greatest increase in water requirements from early development to nearly 360,000 afy. Agricultural water demand comprised the vast majority of the total requirements through that period, increasing to nearly 350,000 afy by 1950. At that same time, M&I use was about 10,000 afy. During the period of peak agricultural activity through the early 1970's, total water requirements were between about 300,000 and 370,000 afy. In this time period, agricultural water use was slightly declining, and M&I water requirements were gradually increasing, from about 10,000 to 30,000 afy.

With the significant decline in agricultural activity through the early 1990's, total water requirements substantially decreased, from approximately 300,000 to about 150,000 afy. This decrease is primarily a result of the substantial decline in agricultural water demand from about 260,000 to about 70,000 afy. During the latter half of the agricultural decline, M&I water requirements increased from about 30,000 afy to about 70,000 afy, by 1990. Both agricultural and M&I water requirements increased at comparable rates throughout the 1990's. By 2000, total water requirements, by then including a small amount for environmental uses, had increased to approximately 255,000 afy. Since 2000, total water demand has remained generally stable between about 240,000 and 255,000 afy, a result of a generally offsetting increase in M&I water use and decrease in agricultural water use. Since 2000, agricultural water demand has ranged between about 110,000 and 140,000 afy; total M&I water requirements have ranged between about 98,000 and 122,000 afy (87,000 to 107,000 afy for the Public Water Suppliers, and around 13,000 afy for mutual, small private and rural residential users); and environmental water use has been about 7,000 to 10,000 afy.

E. <u>Water Supplies</u>

Water requirements in the Basin are met by a combination of four water supply components: Groundwater, local and imported surface waters, and recycled water. In general, groundwater was the predominant water supply in the Basin throughout the period of highest water demand, generally between about 280,000 and 380,000 afy, from the late 1940's through the mid-1970's. Groundwater pumping has subsequently decreased, into a range of about 130,000 to nearly 175,000 afy since 2000, and has averaged about 153,000 afy over the last

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decade. Since the mid-1970's, imported Project water has added to a small amount of local surface water to provide a surface water component of water supply that varied through the 1980's and 1990's, and has been about 70,000 and 90,000 afy since 2000, except during the last two years of reduced Project deliveries, when total surface water supplies have been reduced to 54,000 and 59,000 afy, respectively. Recycled water supply steadily increased from the 1970's, to about 21,000 afy since 2005.

F. <u>Total Safe Yield Analysis</u>

The total safe or sustainable yield of a groundwater basin is the amount of pumping that, for given land use conditions, produces return flows which, in combination with other recharge, results in no long-term depletion of groundwater storage.

Based on a combination of estimated natural recharge to the groundwater basin, use of supplemental water and its contribution to groundwater recharge, and land use practices in the Basin that utilize water and contribute return flows as groundwater recharge, estimates of sustainable (production) yield were made for both "native" and "supplemental" conditions. Under native conditions, return flows derive from the use of local groundwater only; that return flow is the only source of recharge other than natural recharge that derives from local precipitation and runoff within the watershed surrounding the Basin. Under supplemental conditions, return flows derive from the use of both local groundwater and supplemental water; those return flows add to other sources of recharge that include natural recharge plus any purposeful recharge of supplemental water.

The average long-term natural recharge is about 60,000 afy. The total sustainable or safe yield for the groundwater basin yield was then estimated by adding components of return flow that derive from the various uses of water in the Basin, and thus contribute to additional groundwater recharge.

Native safe yield is the amount of pumping which, under a given set of land use and other prevailing cultural conditions, generates return flows that, when combined with natural recharge, result in no long-term depletion of groundwater storage.

When the Basin was predominately dedicated to irrigated agriculture, throughout its

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period of significant increase in groundwater pumping through the 1960's, the safe yield that derived from about 60,000 afy of average natural recharge would be about 80,000 afy. As municipal-type land use increased in the 1990's and beyond 2000, the slightly higher return flows associated with that type of land use contributed to a small increase in native safe yield, to about 82,300 afy. The evolution of land uses from the mid 1990's to present has had no impact on native safe yield. Under all three sets of land use conditions that were considered (prevailing land uses prior to the initial filing of the current adjudication, average 1996 through 2005 land use conditions, and most recent (2005) land use conditions) native safe yield was consistently 82,300 afy.

In summary, for the range of land uses that have occurred over most of the last 15 years, native sustainable groundwater yield (relying only on natural recharge as the primary source of groundwater recharge) is about 82,300 afy.

G. <u>Native and Supplemental Water Safe Yields</u>

Since the mid-1970's, groundwater supplies in the Basin have been augmented by imported supplemental water from the State Water Project. Groundwater supplies have also been, and continue to be, augmented by local surface water diversions from Littlerock Creek. Since the mid-1990's, for the various periods used to estimate safe yield, Project imports have been between about 50,000 and 80,000 afy. During that same time, local surface water diversions have ranged up to nearly 7,000 afy. The use of all artificial or supplemental water supplies contributes to an increase in the overall safe yield of the Basin because, depending on how the supplemental waters are used, the uses produce an additional amount of groundwater recharge that adds to natural recharge. The Basin's total safe or sustainable yield with both native and supplemental water is estimated at 110,000 afy.

As with the estimates of native safe yield, estimates of safe yield for a combination of native and supplemental conditions need to recognize that they are similarly dependent on land and water use practices and on the amounts of supplemental water that are used to produce additional groundwater recharge.

Estimates of total safe or sustainable yield were derived for three sets of land use

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conditions that coincide with those used for the native yield estimates, but when supplemental water was also being used: (1) mixed agricultural and municipal-type land uses as existed, on average, over the five-year period immediately prior to the filing of the present adjudication, 1995-1999; (2) mixed agricultural and municipal-type land uses as existed, on average, over the ten-year period 1996-2005 at the end of the overall base period used in this report; and (3) mixed agricultural and municipal-type land uses as were present in 2005, at the end of the overall base period used in this report.

For the five-year period prior to the filing of the current adjudication, average use of supplemental water was nearly 68,000 afy. Its use augmented natural recharge sufficiently to support total safe or sustainable groundwater yield of nearly 108,000 afy. Since then, use of supplemental water has increased, to an average of about 73,000 afy over the 1996 through 2005 time period, and to 73,500 acre-feet in 2005; these uses augmented natural recharge to support increases in safe yield to about 110,000 afy.

For the mixes of land use that have occurred since the mid-1990's, native safe yield has been about 82,300 afy. Depending on what time period is selected to be representative (recognizing the variations in imported water supply and its utilization in the three scenarios described above), safe yield including return flows from imported water has increased to as much as about 110,000 afy as a result of supplemental water use

XI. EACH OF THE INDEPENDENT METHODOLOGIES FOR ESTIMATING NATURAL RECHARGE CLOSELY APPROXIMATES EACH OTHER AND LEND STRONG SUPPORT FOR A NATURAL RECHARGE OR NATIVE YIELD OF 82,300 AND OVERALL BASIN YIELD OF 110,000

The change in groundwater storage methodology and data described above were used to estimate groundwater storage changes that occurred within the Basin for the period of 1951 through 2009. The total change in storage as a result of gravity drainage over this 59-year period is approximately 5,600,000 acre-feet. Stated simply, the amount of groundwater in storage decreased by 5,600,000 acre-feet.

Just as agricultural pumping peaked in the early 1960's, so did the change in groundwater in storage. The storage change from gravity drainage between 1951 and 1962 was approximately -3,300,000 acre feet or 60 percent of the total storage change from gravity drainage over the entire investigation period. Groundwater storage decreased by about 1,200,000 acre-feet between 1963 and 1971, and from 1972 to 2009, the total decrease in storage from gravity drainage was about 700,000 acre feet.

Due to land subsidence in the Basin, the volume of water derived from aquifer compaction (subsidence) between 1951 and 2005 was approximately 400,000 acre feet.

The total decrease in storage over the 1951 through 2009 investigation period (excluding water derived from compaction from 2006 through 2009) was about 5,600,000 acre-ft with about 5,200,000 acre-feet from gravity drainage and about 400,000 acre-feet from compaction.

The natural recharge for the 1951 through 2005 period is about 59,000 afy and 57,000 afy for 15 and 20-year lag times, respectively. These estimates of natural recharge are very close to the independently developed natural recharge estimate of about 56,000 afy for the 1949 through 2005 period and about 58,000 afy for the 1951 to 2005 period.

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XII. CONCLUSION

The Basin is in overdraft for each of the following reasons:

Analysis of numerous water levels throughout the Basin shows that the amount of groundwater in storage has declined by more than five million acre-feet since 1951, and continues to decline at the rate of about 40,000 afy. This analysis is based solely on groundwater levels and well completion reports, and does not depend on the safe yield calculation.

There has been extensive subsidence in the Basin, beginning about 1930 and continuing to the present. The subsidence has exceeded six feet in places and has caused fissuring at Edwards Air Force Base. The subsidence is caused by the combination of extensive fine-grained sediments and pumping in excess of the safe yield. Therefore, pumping has exceeded safe yield since at least 1930.

The safe yield of the Basin has been calculated by a team of the leading groundwater experts in California, using the best available data and several independent scientific methodologies. The close level of agreement between the results of these independent methodologies lends considerable support to the conclusion that the native safe yield of the Basin is 82,300 afy; and the total safe yield of the Basin is 110,000 afy. Groundwater pumping has ranged from about 150,000 afy to 170,000 afy over the last decade, and has therefore exceeded the total safe yield by 40,000 to 60,000 afy. Because of this substantial overdraft, there is a need for the court to exercise its equitable jurisdiction and adopt a physical solution for the Basin.

Dated: December 20, 2010

BEST BEST & KRIEGER LLP

By ______________________

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PROOF OF SERVICE

I, Kerry V. Keefe, declare:

I am a resident of the State of California and over the age of eighteen years, and not a party to the within action; my business address is Best Best & Krieger LLP, 5 Park Plaza, Suite 1500, Irvine, California 92614. On December 20, 2010, I served the within document(s):

PHASE 3 TRIAL BRIEF SUBMITTED BY THE CITY OF LOS ANGELES, LOS ANGELES COUNTY WATERWORKS DISTRICT NO. 40, CITY OF PALMDALE, LITTLEROCK CREEK IRRIGATION DISTRICT, PALM RANCH IRRIGATION DISTRICT, PALMDALE WATER DISTRICT, QUARTZ HILL WATER DISTRICT, AND CALIFORNIA WATER SERVICE COMPANY

☒ by posting the document(s) listed above to the Santa Clara County Superior Court website in regard to the Antelope Valley Groundwater matter.

☐ by placing the document(s) listed above in a sealed envelope with postage thereon fully prepaid, in the United States mail at Irvine, California addressed as set forth below.

☐ by causing personal delivery by ASAP Corporate Services of the document(s) listed above to the person(s) at the address(es) set forth below.

☐ by personally delivering the document(s) listed above to the person(s) at the address(es) set forth below.

☐ I caused such envelope to be delivered via overnight delivery addressed as indicated on the attached service list. Such envelope was deposited for delivery by Federal Express following the firm's ordinary business practices.

I am readily familiar with the firm's practice of collection and processing correspondence for mailing. Under that practice it would be deposited with the U.S. Postal Service on that same day with postage thereon fully prepaid in the ordinary course of business. I am aware that on motion of the party served, service is presumed invalid if postal cancellation date or postage meter date is more than one day after date of deposit for mailing in affidavit.

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

Executed on December 20, 2010, at Irvine, California.

Kerry V. Keefe

Kerry V. Keefe

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