Annual Investigation and Report of Groundwater Conditions Within United Water Conservation District

A summary of findings for the previous water year (2015-2016) current water year (2016-2017), and ensuing water year (2017-2018)

Prepared by
Groundwater Department

UNITED WATER CONSERVATION DISTRICT

March 2017

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UNITED WATER CONSERVATION DISTRICT
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I, Daniel C. Naumann, Secretary/Treasurer of the Board of Directors of United Water Conservation District, do certify that I am in receipt of the Annual Investigation and Report of Groundwater Conditions within United Water Conservation District – *A summary of findings for the previous water year (2015-2016), current water year (2016-2017), and ensuing water year (2017-2018).*

Daniel C. Naumann 3/7/2017

Signature Date

ANNUAL INVESTIGATION AND REPORT
OF
GROUNDWATER CONDITIONS WITHIN
UNITED WATER CONSERVATION DISTRICT

A SUMMARY OF FINDINGS FOR THE
PREVIOUS WATER YEAR (2015-2016),
CURRENT WATER YEAR (2016-2017),
AND ENSUING WATER YEAR (2017-2018)

PREPARED BY
GROUNDWATER DEPARTMENT
UNITED WATER CONSERVATION DISTRICT

Cover Photo: Vern Freeman Diversion looking northwest on the morning of January 23, 2017 after a few days of storms (Santa Clara River flowing approximately 3,400 CFS with a crest flow of 3,200 CFS at 11:30AM). Photo by John Carman.

MARCH 7, 2017

INTRODUCTION

Background

United Water Conservation District (the District) is organized and operates pursuant to the Water Conservation District Law of 1931, which is set forth in Division 21 of the Water Code. [Section 74000 et seq.]

The District may establish and levy groundwater charges against persons operating groundwater producing facilities within zones(s) of the District. Such groundwater charges are in furtherance of the District's activities in the protection and augmentation of the water supplies for users within the District or its zone(s) which are necessary for the public health, welfare and safety of the people of the State of California. In connection with the establishment and levying of such charges, Section 75560 of the Water Code provides that "The district shall annually cause to be made an engineering investigation and report upon the groundwater conditions of the district". The annual groundwater conditions report is provided to the District's board of directors to assist the board in evaluating the nature and extent of groundwater overdraft within the District.

Definitions

Several terms are defined here to minimize confusion as to their meaning within the context of this report. The following definitions are provided from the California Water Code:

> *Water Year* means July 1st of one calendar year to June 30th of the following calendar year. (**§** 75507)
>
> *Annual Overdraft* means the amount, determined by the board, by which the production of water from groundwater supplies within the district or any zone or zones thereof during the water year exceeds the natural replenishment of such groundwater supplies in such water year. (**§** 75506)
>
> *Accumulated Overdraft* means the amount of water necessary to be replaced in the intake areas of the groundwater basins within the district or any zone or zones thereof to prevent the landward movement of salt water into the fresh groundwater body, or to prevent subsidence of the land within the district or any zone or

> zones thereof, as determined by the board from time to time. (§ 75505)

The management of the basins within the District has required artificial recharge to be an integral part of annual replenishment. Therefore, this report includes both artificial recharge and natural recharge in all calculations of overdraft. The above definition of "accumulated overdraft" for water conservation districts differs significantly from the definition in the Water Code used for water replenishment districts, where "accumulated overdraft" is an accumulated total of annual overdrafts. The District has historically tracked this accumulated total of annual overdrafts. However, data analysis via the District's Geographic Information System (GIS) and use of the Ventura Regional Groundwater Flow Model (formally USGS RASA Model, [Hanson et. al, 2003]) has allowed for calculation of "accumulated overdraft" under the meaning of Section 75505. In this report, we use the term "**total of annual overdrafts**" for the running total of accumulated annual overdrafts, and the term "**accumulated overdraft**" for the long-term increase of the average annual replenishment that is necessary to prevent landward movement of salt water or to prevent subsidence. Techniques for these calculations and differences between the overdraft totals are described in the sections "Data and Methods" and "Discussion".

Groundwater Basins of the District

All or portions of eight groundwater basins lie within the District. These basins are defined by their hydrologic, geologic and physiographic interconnectivity, which influence the quantity, and quality of groundwater available in each of the basins. Four ground water basins are located completely within the boundaries of the District. These four basins include two along the upstream reaches of the Santa Clara River (Fillmore and Santa Paula basins), as well as two basins in the coastal plain area (Oxnard Forebay and Oxnard Plain basins). In addition to these four groundwater basins, most of the Mound Basin in the Ventura area and portions of the Pleasant Valley and Las Posas groundwater basins also lie within the District. A majority of the Piru Basin is within the District; however the eastern tip of the Piru Basin extends beyond the eastern boundary of the District. The locations of these basins are shown on Figure 1.

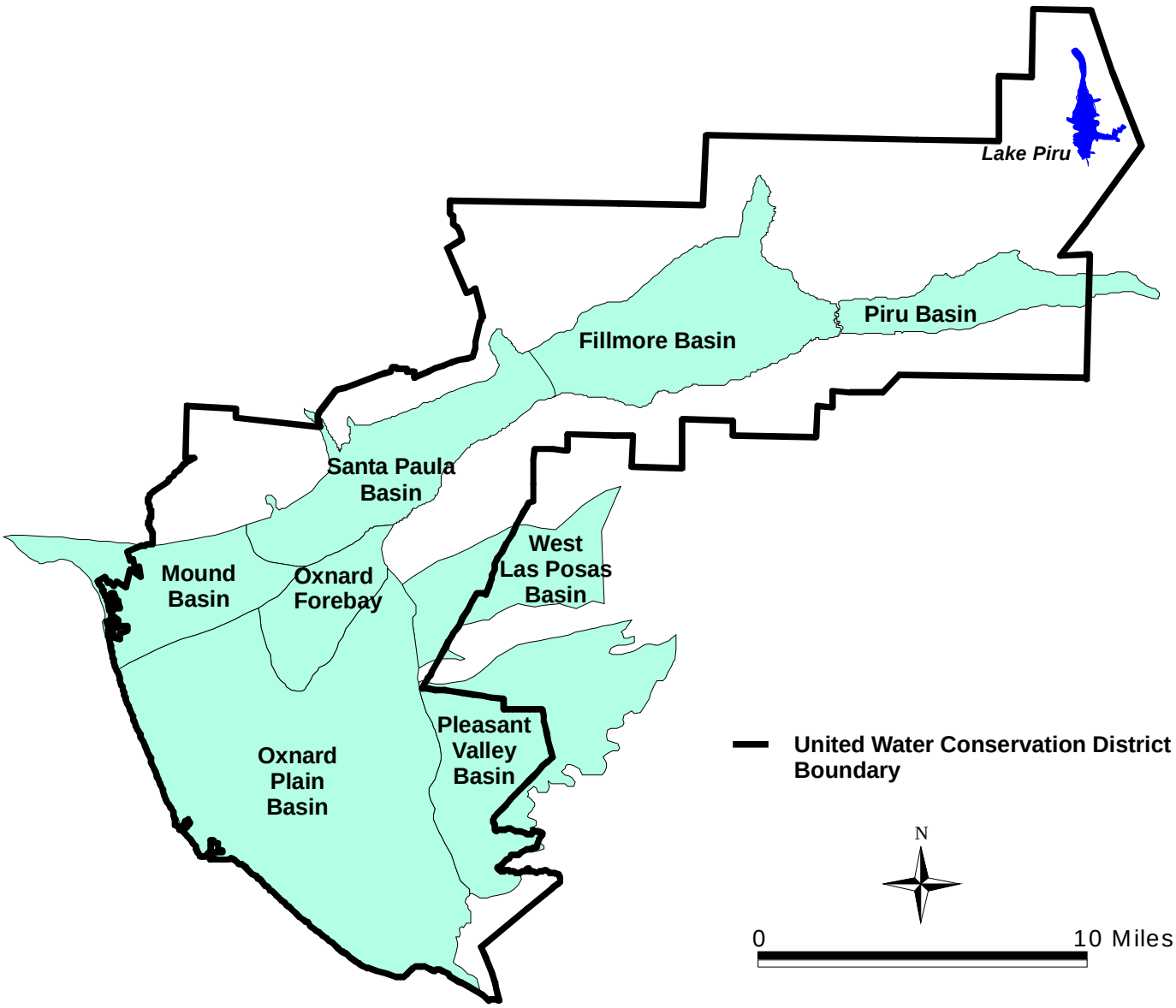

Figure 1. Groundwater basins of United Water Conservation District.

PURPOSE AND SCOPE OF REPORT

This report provides the District's board of directors with updated information on groundwater overdraft so that the board may consider that information when deciding: 1) whether to levy a groundwater charge or charges, and 2) whether a zone or zones should be established within which groundwater charges should be levied.

The District compiles and evaluates hydrologic data to promote efficiency in its water conservation operations and to assist in planning for future water needs. The District also uses these data to prepare a district-wide water balance to evaluate the occurrence and extent of groundwater overdraft. This report presents those findings concerning the occurrence and extent of groundwater overdraft, and other related issues, as outlined in section 75574 of the Water Code.

DATA AND METHODS

The methods used by the District to compute “Annual Overdraft” were changed in 1991. Prior to 1991 it was assumed that overdraft only occurred in the Oxnard Plain Basin, and the amount of overdraft was calculated using groundwater elevation data. Beginning in 1991, the District began using a District-wide water balance method to evaluate and report “Annual Overdraft”. This method compares estimates of annual recharge to reported groundwater extractions. Precipitation and surface-water data compiled by federal, state, and local agencies are used to evaluate groundwater recharge.

Utilizing the Ventura Regional Groundwater Flow Model (formally USGS RASA Model), Geographic Information System (GIS) and its extensive historic data bases of groundwater levels, groundwater extractions, artificial recharge and water chemistry, the District has been able to document and model the response of the hydrologically interconnected basins to varying climatic cycles and, subsequently, to variations in the seasonal amounts of natural and artificial groundwater recharge. The District has used these tools and information to calculate "Accumulated Overdraft" which is the long-term increase of the average annual replenishment that is necessary to prevent landward movement of salt water or to prevent subsidence.

FINDINGS AS REQUIRED BY SECTION 75574 OF WATER CODE

(a) The average annual overdraft for the immediate past 10 water years is estimated to be approximately **74,600 acre-feet**.

(b) The annual overdraft for the current water year is estimated to range up to **-4,000 acre-feet**. This **negative** number implies that replenishment will exceed extractions for the District, as a whole.

(c) The annual overdraft for the ensuing water year is estimated to be between **0 and 74,600 acre-feet**.

(d) The accumulated overdraft as of the last day of the preceding water year is estimated to range between **20,000 and 25,000 acre-feet**.

(e) The accumulated overdraft as of the last day of the current water year is estimated to range between **20,000 and 25,000 acre-feet.**

(f) The estimated amount of agricultural water to be withdrawn from the groundwater supplies of the District for the ensuing water year is **154,000 acre-feet**.

(g) The amount of water for M&I purposes to be pumped from the groundwater supplies of the District for the ensuing water year is estimated to be approximately **36,000 acre-feet**.

(h) The estimated amount of water for surface distribution for the ensuing water year is expected to be much less than the long-term average of **64,000 acre-feet**.

(i) The amount of water, which is necessary for the replenishment of the groundwater supplies of the District, is estimated to be at least **1,462,000 acre-feet**.

(j) The District is not obligated by contract to purchase any amount of water, except State Project water, ordered for and reimbursed by the Port Hueneme Water Agency. This amount of water is not to exceed 1,850 acre-feet per year.

(k) The total production of water from the groundwater supplies of the District during the preceding water year was approximately **189,900 acre-feet** [WC Section 75561 (c)].

An additional finding, which was incorporated in the required findings, is that the "total of annual overdrafts" for the District as of the end of the preceding water year was approximately **1,828,000 acre-feet**.

Description of Findings as Required by Section 75574 of Water Code

(a) The annual overdraft (explained in item b) of the preceding ten years is averaged to derive the average annual overdraft. The average annual overdraft of **74,600 acre-feet** means that over the last ten years the average pumping has exceeded the average recharge, both natural and artificial, on a District-wide basis.

(b) Although the annual overdraft for the previous year can be calculated, the **annual overdraft** for the current water year must be estimated. This is because only a portion of the year has passed. At best, the appropriate data are available for the period July 1 through February 28 of the current water year. To standardize this prediction for current year overdraft, the groundwater staff developed a regression curve fit that compares overdraft for previous years to rainfall through February for each of the years 1981-82 through 2015-2016 (Figure 2). The goal is to be able to predict the annual overdraft for the current year, based on the percentage of normal rainfall as of the end of February. The prediction is considerably improved by weighting in the prior year precipitation[i] . This serves to recognize antecedent conditions, which influences how readily the Santa Clara River, streams and precipitation can recharge to groundwater.

As of February 28 of this current water year (2016-2017), precipitation was approximately **167%** of normal for that date. The previous year precipitation was approximately **57%** of normal at the end of February. The overdraft is predicted to be approximately **-4,000 acre-feet**. The **negative** number implies a net **surplus** to the aquifers. A review of overdraft data since 1981 suggests that a net District-wide surplus of water will occur when the weighted precipitation, of the current year and the prior year, equals or exceeds approximately of **125%** of normal. For the 2016-2017 water year this weighted precipitation is **130%**.

[i] Weighted percent of normal precipitation = [present year + (previous year * 0.5)]/1.5

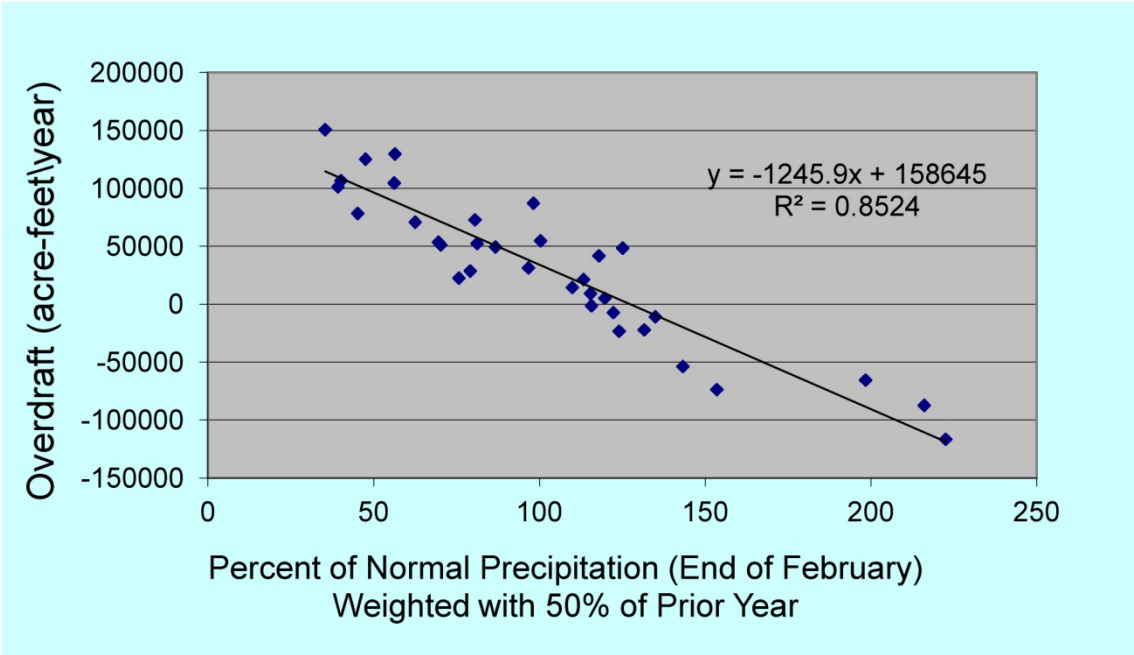

Figure 2. District-Wide Overdraft vs. Percent of Normal Precipitation.

The prior year overdraft is calculated once all the data are available for the period July 1 to June 30. In this manner, the actual overdraft is calculated approximately 8 months in the arrears. This calculated overdraft for the prior year is then used with the 9 preceding years to determine the ten-year average annual overdraft.

Last year, the regression correlation was used to predict an approximate overdraft district-wide of approximately **86,000 acre-feet** for the period July 1, 2015 through June 30, 2016. After receiving data for the entire year, the actual annual overdraft was determined to be approximately **129,800 acre-feet**. Therefore the projected annual overdraft was underestimated by approximately **43,800 acre-feet**. A basic summary of the methodology for determining the hydrologic balance for the groundwater basins is included in Appendix A of this report.

(c) The annual overdraft for the ensuing water year is difficult to forecast. It projects the hydrologic balance 16 months in advance. The projected district-wide overdraft is assumed to be between 0 acre-ft and the ten-year average annual overdraft.

(d) "Accumulated Overdraft" means the amount of water necessary to be replaced in the intake areas of the groundwater basins within the District to

prevent the landward movement of salt water into the fresh groundwater body, or to prevent subsidence of the land within the district or any zone(s) thereof (**§** 75505, California Water Code).

The District has utilized the Ventura Regional Groundwater Flow Model and Best Management Objective (BMO) groundwater level goals to calculate "Accumulated Overdraft". Groundwater modeling in 2006 for the 2007 Fox Canyon GMA Management Plan update calculated the amount of pumping reduction in the South Oxnard Plain and Pleasant Valley basins needed to raise groundwater levels so that on the average over a complete hydrologic cycle (1944 to 1998 hydrology) there is no net landward movement of seawater (Fox Canyon GMA, May 2007). This pumping reduction is the "Accumulated Overdraft" and is estimated to be 20,000 acre-feet to 25,000 acre-feet mostly in the Lower Aquifer System (LAS).

(e) The "Accumulated Overdraft" does not change from year to year unless new water supply projects are brought on line or unless there is a long-term change in pumping or climate. The "Accumulated Overdraft" should be recalculated every 5 years as these new projects are put in place.

The Ventura Regional Groundwater Model is in the process of being rebuilt and recalibrated. When the rebuilt model becomes available the accumulated overdraft will be reevaluated. While the model is being rebuilt groundwater levels and chloride concentrations are continuing to be monitored in BMO wells and other wells.

(f) The amount of agricultural water likely to be withdrawn for the ensuing water year should be reported as the same as the previous year unless there is overriding information that pumping will change. Because the Groundwater Conditions Report is finished in early March before the year's rainfall can be accurately predicted, it is more conservative to use the previous year's pumping. The number comes from the District's Finance Department's semi-annual statements of pumping charges, where the water usage is reported as either agricultural or M&I.

(g) As in (f), it is more conservative to use the previous year's pumping. The number comes from the previous year's semi-annual statements of pumping charges.

(h) The long-term average diversions for the Freeman Diversion are approximately 64,000 acre-feet per year.

(i) The total replenishment necessary for replenishment of groundwater supplies of the District comes from the equation: Total Replenishment = 0.80 * Total Annual Overdrafts. The 80% factor comes from the USGS observation that about 19% of the annual overdraft is water derived from dewatering of fine-grained sediments (and subsequent subsidence); this water cannot be forced back into the sediments, it is storage space lost forever, and thus should be subtracted from the total water needed to replenish the aquifer. A factor of 20% is used instead of 19%, to signify a higher degree of error associated with determining water derived from dewatering of fine-grained sediments.

(j) The District is not obligated by contract to purchase any amount of water, except State Project water, ordered for and reimbursed by the Port Hueneme Water Agency. This amount of water is not to exceed 1,850 acre-feet per year.

(k) The preceding year's water production comes from the District's Finance Department records of reported pumping from the semi-annual statements of pumping charges.

"Total of Annual Overdrafts" – this additional finding is a cumulative total of each years' annual overdraft (item b). It is derived by adding the previous water year annual overdraft to last year's "total of annual overdrafts." In the wettest years when there is a surplus of water, this total will be reduced. In average and dry years, the total will increase. Even in some slightly wetter years, there exists a District-wide overdraft and the total will increase.

DISCUSSION

The occurrence of overdraft in a groundwater basin is often controversial. This is due in part to the definition of the term. Overdraft is defined as "*the condition of a groundwater basin or aquifer in which the amount of water extracted exceeds the amount of water that recharges the basin over a period of many years (during which hydrologic conditions do not significantly change)*" (Bachman et al., 2005). Within the District, the withdrawal of groundwater is known through reporting by pumpers. The recharge within the District by artificial means is also known through measurements of diversions, spreading, and pipeline deliveries (e.g., State water deliveries and Conejo Creek diversions as discussed in Appendix B). Natural recharge, however, must be determined through indirect measurements. This natural recharge occurs primarily along the

rivers and streams within the District, but also occurs by direct infiltration from rainfall and by leakage through adjacent bedrock and alluvial units.

The District calculates the natural recharge in its basins using measured data on stream flow, precipitation, and groundwater levels. The value reported as annual overdraft compares the natural and artificial annual recharge to annual withdrawals. The average annual overdraft varies over the long-term with fundamental changes in both historic pumpage and artificial recharge facilities. Year-to-year, however, the annual District-wide overdraft varies widely with the climatic cycle. Wet years produce a surplus of replenishment whereas dry years result in an overdraft.

Long-term overdraft is more serious than an annual overdraft. Long-term overdraft occurs when recharge is less than extraction over a period of many years. Long-term overdraft has resulted in landward migration of saline ocean water on the Oxnard Plain and dewatering of salt-rich clays surrounding the aquifers; this dewatering has resulted in salt water moving from the clays to the aquifer and in compaction of the clays (UWCD, 2004). The majority of this saline ocean water is likely contained in the extensive offshore portions of the aquifers of the Oxnard Plain. It is in the areas of the submarine canyons that this seawater is drawn into onshore portions of the aquifer where it is a hazard. It is also in these areas where it is imperative that an offshore gradient be maintained to prevent further intrusion. Thus, the calculation of "accumulated overdraft" for water conservation districts in the Water Code is very appropriate to the District's situation -- it is the replenishment water necessary to prevent landward movement of salt water or to prevent subsidence. This is an inherently important aspect of the District's efforts to protect and augment water supplies for users within the District or its zone(s) which are necessary for the public health, welfare and safety.

We have calculated two values in this report that relate to long-term overdraft: 1) the amount of water necessary for the replenishment of the groundwater supplies of the District, which is calculated from the total of annual overdrafts, with a value of **1,462,000 acre-feet** as of 2015-2016; and 2) the accumulated overdraft, as per the Water Code, which represents the amount of additional replenishment water that is needed on a continuing basis in the future to prevent further salt water intrusion. The District's groundwater staff estimates that a minimum of approximately **20,000 to 25,000 acre-feet** of additional replenishment water per year is required to prevent further salt water intrusion. A large proportion of this saltwater intrusion is associated with seawater intrusion of the offshore extension of the aquifers and onshore seawater intrusion

in the vicinity of Port Hueneme and Point Mugu. The remainder is from poor quality water derived from the compaction of clays.

There is evidence for the occurrence of long-term overdraft in at least two of the groundwater basins of the District. Groundwater levels have generally been declining for periods of several decades in the Oxnard Plain and Pleasant Valley basins. While the factors causing declining groundwater trends may have varied among these two basins, long-term replenishment rates have not kept up with long-term withdrawal rates in either of them. Thus, these basins are considered by the District to be in a condition of long-term overdraft.

In the past, the Santa Paula Basin had been considered in a state of potential overdraft. A basin yield study (UWCD, 2003) by experts for the City of Ventura, Santa Paula Basin Pumpers Association, and the District suggests that the yield of the basin is probably near the historic pumping amount. A revised estimate of safe yield for the Santa Paula Basin is currently being prepared by a consultant to the District. A final report should be available in 2017.

The 2009-2010 Annual Report for the Santa Paula Basin (Santa Paula Basin Technical Advisory Committee, October 2011) concluded that: "…the majority of the wells in the Santa Paula Basin have experienced a gradual groundwater level decline during the 1998 to 2005 observation period and the 2005 to present (2010) observation period." UWCD (2011) concluded that: "The water level fluctuations observed from 1998 to 2009 in the Santa Paula Basin cannot be attributed solely to spatial or temporal variations in pumping."

The stresses that cause long-term overdraft in a particular basin may be occurring only within that basin, or they may be occurring in several connected basins. For example, the seawater intrusion that has occurred in a portion of the Oxnard Plain Basin can be aggravated by increases in pumping from that basin, but it can also be aggravated by decreases in the replenishment supply coming from the upstream basins. This is caused by the hydraulic continuity between the aforementioned groundwater basins.

The California Department of Water Resources (DWR) recognized the hydraulic continuity of the District's several groundwater basins, and in 1980 DWR concluded that these basins should be considered as one groundwater basin, the Ventura Central Basin (DWR, 1980). The Ventura Central Basin was identified by the DWR as "subject to critical conditions of overdraft". The Bulletin 118 Update (DWR, 2003) did not re-evaluate the conditions of critical overdraft in the Ventura Central Basin and other California groundwater basins

because the task was not identified by the State Legislature, nor was there sufficient funding.

Mauricio E. Guardado, Jr., General Manager — Date: 3/6/17

Tony Morgan, PG, CHG, Deputy General Manager
Groundwater and Water Resources — Date: MAR 2, 2017

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Appendix A

Methodology for Hydrologic Balance

United Water Conservation District submits an annual groundwater conditions report to the State of California. The report is specifically written to meet our requirement under the Water Code.

In 1992, staff improved the methodology for determining the groundwater conditions within the District's boundaries. The new methodology determined annual hydrologic balance in a relatively simple manner. The balance incorporates precipitation, natural recharge, artificial recharge and return flow as recharge components and groundwater extraction and phreatophyte consumptive use as discharge components.

The balance for each groundwater basin is determined individually. The hydrologic balance for the entire district is the net sum of the balance for each basin. The data acquired for each basin includes:

- Annual rainfall (ft);
- Total area of each basin (acres);
- Mean daily surface flows (cfs);
- Daily artificial recharge (ac-ft);
- Mean daily diversions (cfs);
- Consumptive use rate (percent of groundwater pumping);
- Annual groundwater extractions (ac-ft); and
- Annual Phreatophyte consumptive use (ac-ft).

Precipitation

Recharge by precipitation on valley alluvium or aquifer outcrop is held constant at 10% for all the unconfined groundwater basins. Rain gauges at Lake Piru, Fillmore, Santa Paula, and El Rio are used to calculate the amount of recharge to the corresponding basin.

Area

The areas for the Piru Basin, Fillmore Basin, Santa Paula Basin, and the Oxnard Forebay Basin are from John Mann's 1959 report to the District.

Surface Flows

Mean daily surface flows for Piru Creek, Hopper Creek, Santa Clara River (at Blue Cut), Sespe Creek at Fillmore, and Santa Paula Creek are used in conjunction with the percolation rates for the Santa Clara River. Percolation rates on the Santa Clara are a function of mean daily flow rates and location on the river (Brownlie, Taylor EQL Report 17-C, Feb. 1981). Percolation rates are as follows:

Mean Daily Flows (cfs)	Percolation Rates (%/mile)	
	Upper 28 miles	Lower 11miles
0 - 100	1.8	>1.25
100 – 500	1.57	1.09
500 – 1000	0.456	0.317
> 1000	0.155	0.106

There exist ten reaches of the Santa Clara River, between Blue Cut and the ocean. Each reach is depicted in the accompanying map. Spreadsheets with mean daily flow for the river and gauged streams determine the flow of the river at any given location. At the confluence of the river and a contributing stream, the flow of the river becomes the total of the river upstream plus the contributing stream. The diversion at the Freeman Diversion is accounted for on a daily basis, to account for the loss in flow of the river. Similarly, the diversion of water from Piru Creek to the Piru Spreading Facility is accounted for on a daily basis.

Final data approved for publication is used whenever possible but due to the timing of this report, provisional data was used in some instances.

Artificial Recharge

The annual recharge to Piru, Saticoy, Noble and El Rio facilities are allocated to respective basins. It is assumed that there exists 100% efficiency in the recharge (i.e. no losses).

Groundwater Extractions

The groundwater extractions for each basin are tabulated through reported pumping to the District.

Consumptive Use

A 65% consumptive use factor is used for all the unconfined groundwater basins. In the unconfined groundwater basins, this results in a return flow of 35% of groundwater pumping. Pressure basins have 0% return flow that effectively recharge the UAS.

Phreatophyte consumptive use is estimated to be 3.5 ac-ft/year per acre. This is applied to the Santa Clara River and Sespe Creek channels.

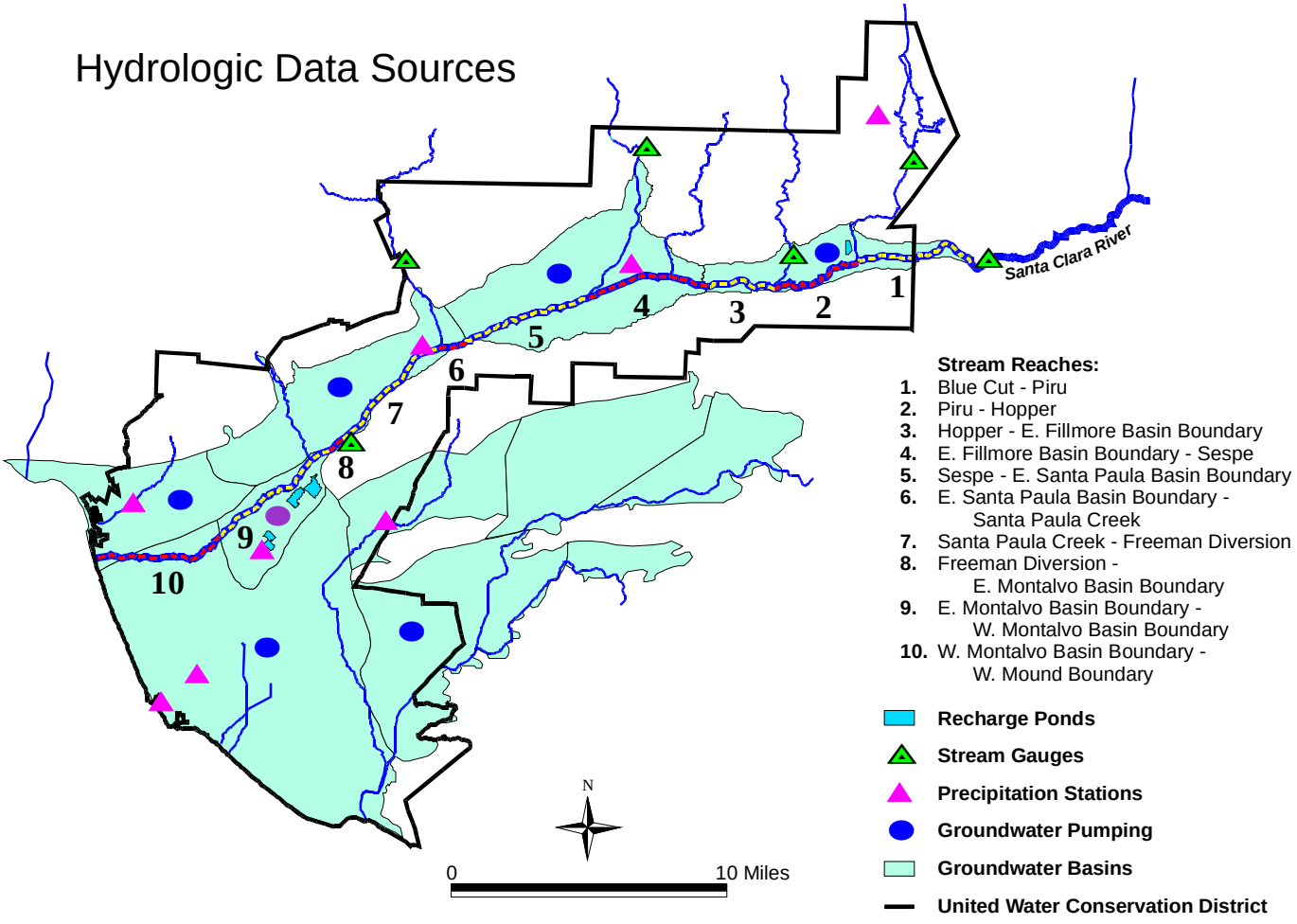
The phreatophyte acreage in each groundwater basin is as follows:

Piru	64 acres
Fillmore	540 acres
Santa Paula	384 acres
Montalvo	64 acres

Groundwater Basin Water Balance

[(Total Percolated Rainfall + Percolated Surface Water +Artificial Recharge + Return Flow)

- (Groundwater Extractions + Phreatophyte Consumptive Use)] = Basin Water Balance


Hydrologic Data Sources
Santa Clara River
1
2
3
4
5
6
7
8
9
10
N
0
10 Miles
Stream Reaches:
1. Blue Cut - Piru
2. Piru - Hopper
3. Hopper - E. Fillmore Basin Boundary
4. E. Fillmore Basin Boundary - Sespe
5. Sespe - E. Santa Paula Basin Boundary
6. E. Santa Paula Basin Boundary - Santa Paula Creek
7. Santa Paula Creek - Freeman Diversion
8. Freeman Diversion - E. Montalvo Basin Boundary
9. E. Montalvo Basin Boundary - W. Montalvo Basin Boundary
10. W. Montalvo Basin Boundary - W. Mound Boundary
Recharge Ponds
Stream Gauges
Precipitation Stations
Groundwater Pumping
Groundwater Basins
United Water Conservation District

Appendix B

Additional Water Resources Utilized within the District

State Water

The District has State water allocation of 5,000 acre-feet per year. The District contracts out 1,850 acre-feet per year of this allocation to Port Hueneme Water Agency where it replaces an equal amount of groundwater pumping on the Oxnard Plain. The District receives 3,150 acre-feet per year of this allocation through Pyramid Lake. This water eventually flows down the Santa Clara River within the District where it contributes to streamflow and groundwater recharge.

The full 5,000 acre-feet allocation is not received most years. The California Department of Water Resources determines what percentage of the allocation that is available for purchase each year which, is generally less than 100%, especially during periods of drought. The District does not purchase its full allocation of State water on very wet years due to the lack of available storage.

Conejo Creek Diversions

The Conejo Creek diversion, located near U.S Highway 101, diverts an average of approximately 5,600 acre-feet of water per year from Conejo Creek to Pleasant Valley County Water District, where it replaces groundwater pumping in the Pleasant Valley Basin.