ANNUAL REPORT

OF THE WARREN VALLEY BASIN WATERMASTER

A REPORT FOR

HI-DESERT WATER DISTRICT

DECEMBER 1992

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INTRODUCTORY REMARKS

Virtually all the water to meet the municipal needs of Yucca Valley is supplied by Hi-Desert Water District. The source of this supply is groundwater stored in the aquifer system which underlies the Warren Basin. The aquifer is recharged by infiltration of direct precipitation, which averages six inches annually, and by infiltration of runoff from the tributary draining area which is approximately 50 square miles in extent.

Investigations of the Warren Basin commenced in 1972 and have continued periodically up to the present. Even though the basin has been the subject of a myriad of hydrogeologic and geophysical investigations, the area is so highly complex and the available data so incomplete that, to date, several questions remain as to the character of the underlying aquifer system.

Early investigators concluded that the aquifers underlying Warren Basin were essentially homogeneous and isotropic, and that groundwater could be developed in equal quantities anywhere within the alluviated portion of the basin to a depth of 800 feet below ground surface. It was not until a comprehensive water well drilling program commenced in 1990 that a more complete understanding of the hydrogeologic model of the basin began to emerge.

The well drilling program of 1990 found that the aquifer system extended to a depth of at least 1200 feet in the central elongated portion of the basin and found,

further, that the character of the water-bearing sediments underlying Warren Basin were not areally or vertically the same. The easterly one-third of the basin was found to be underlain by sediments which, although permeable and water-bearing, exhibit such low values of aquifer transmissivity that wells located in this portion of the aquifer are, and will continue to be, poor producers of groundwater.

Groundwater levels have been known for years to be declining at an increasing rate. This occurs in spite of the fact that in recent years production of groundwater has diminished. This apparent paradox is explained by two factors:

1. The sides of the Warren Basin are not vertical, but incline towards the center of the basin and form an inverted triangle. The volume of sediments therefore decreases with depth. The width of the Warren Basin aquifer system at the water table, which currently lies at an average depth of 350 feet below ground surface, is approximately one-third the width of aquifer system at the surface.
2. The Specific Yield values of the water-bearing sediments decrease with depth, and are approximately one-half the values of those sediments which lie above a depth of 350 feet. Unfortunately these sediments are dewatered.

Because of the two factors described above, the quantity of water available to properly drilled water wells is constantly being reduced as water levels continue their decline. When the District Water Wells Nos. 7 and 9 were initially drilled in 1975,

depth to water was less than 200 feet and the wells produced more than 1500 gpm. Today (1992), depth to water exceeds 350 feet and production is less than one-half the original quantity, and even these lower rates cannot be sustained.

The sediments which form the aquifer system comprise about 300 feet of Recent alluvium, which is underlain by ±900 feet of older alluvial deposits. These older deposits are somewhat cemented or indurated. The aquifer is a rather long narrow body which trends in a generally west-to-east direction. It attains a maximum width of about one mile at the ground surface.

As a consequence of the aquifer's long, narrow configuration, most of the producing wells are aligned in a very narrow west-to-east band. Exploration wells and test holes drilled to the north and to the south of the narrow central portion of the basin have met with poor results or failed to obtain any substantial groundwater supply.

Warren Basin is bounded on the north by a row of fault-controlled hills and on the south by a gently north-sloping alluvial fan. In spite of numerous efforts to find adequate supplies of groundwater along the alluvial fans south of the central basin, no municipal groundwater supplies were found or have been developed. Detailed geophysical studies, including seismic and electrical resistivity techniques, have been unsuccessful in attempts to locate new sources of supply.

Wells that ten years ago were good producers have exhibited dramatic declines in water table elevations and in production. As new wells were drilled between

existing wells, mutual interference compounded the problem and has increased pumping levels of all wells throughout the basin.

Along with the problems of decreasing aquifer width and diminution of Specific Yield values is our newly recognized understanding of changes in the character of the basinal sediments which lie toward the easterly portion of the basin. Extending from the easterly end of the airport runway to the vicinity of the Mental Physics Facility, the sedimentary deposits exhibit a "facies" change. The sediments are comprised of a large volume of silt and clay, and coarse sands and gravels are scarce. The Specific Yield values of the entire vertical sequence of deposits is low. This results in wells which produce very small quantities of groundwater and which exhibit very large drawdowns of water levels when pumping, as in Wells Nos. 5, 11 and 13.

In 1983, Mr. Max Sloan, the District Engineer, presented the Hi-Desert Water District with a report entitled "Proposed Management Plan — Warren Valley Basin". The report noted that in 1977 the Hi-Desert Water District was appointed Watermaster of the Warren Valley Basin and was directed to prepare a basin management plan. The report noted further that to date (1983), beyond making a canvass of existing wells in the Warren Valley Basin, the partial monitoring of wells operated by the major pumping entities and a Court Order requiring installation of flow meters on all unmetered wells belonging to the major pumping entities, little action was taken to implement the basin management plan.

The basin management plan developed by the District Engineer recommended

that the plan be implemented in four phases, each phase of which included several work items that had to be performed. Figure 1 — Proposed Management Plan Warren Basin — was prepared from information contained in the Engineer's 1983 report.

As shown in Figure 1, the plan included development of a comprehensive well monitoring program and a continuing exploration drilling program to better define the nature, character and configuration of the Warren Basin Aquifer System. To date, certain steps of the plan have been undertaken and completed. However, because of the necessity to meet the increased water needs of Yucca Valley, work in regards to the collection of the essential basic data have been either reduced substantially or halted altogether. It is not difficult, therefore, to understand why discrepancies exist in study results obtained by independent investigators.

Previously prepared reports and memoranda by the District Engineer advised that basin-wide water level data be obtained at least semi-annually. Specific times were designated as the first week of October, at the end of the summer pumping season, and the first week of April, at the end of the wet season. The District was further advised that all wells within the data network system be measured within a four-to-five day period and that all wells be shut down for not less than 24 hours prior to the time they were to be measured. Continuity of procedures is essential for obtaining useful and comparative water level data. Unfortunately, these instructions have not been adhered to with diligence.

FIGURE 1

PROPOSED MANAGEMENT PLAN OF WARREN BASIN

Phase I

1. Canvass of existing wells in the Warren Valley Basin to determine which wells can be monitored and/or test pumped.

2. Establish a network of monitoring wells to determine static and dynamic water level fluctuations. This network should include, but not be limited to, all wells being pumped by HDWD, Blue Skies Country Club, and Mental Physics Institute.

3. Installation of meters on selected monitoring wells not presently equipped with measuring devices.

4. Initiate a comprehensive data collection plan including all items of inflow such as rainfall, surface inflow and subsurface inflow; and outflow consisting of pumping, consumptive use of vegetation, subsurface outflow and surface outflow.

5. Preliminary evaluation of collected data.

Phase II

1. Locate and construct additional observation wells as required.

2. Initiate a test program to determine if aquifer is being recharged by return irrigation, sewage effluent, or surface runoff.

3. Continue basic data collection program.

Phase III

1. Evaluation of collected data.

2. Confirmation of values of all items of the Hydrologic Equation: Inflow minus Outflow equals Change in Storage.

3. Formulate preliminary plans for management of the Warren Valley Basin.

Phase IV

1. Prepare final management plan for the Warren Valley Basin.

Since the Hi-Desert Water District purchased the Yucca Water Co., acquisition of data from wells formerly operated by Yucca Water Co. has improved markedly. It is expected that water well data from all Warren Basin wells will now be collected properly and on a regular basis.

In investigations prepared by our office in association with Egan and Associates, Inc., we found that the total quantity of groundwater stored in the aquifer system and available to the District as of the Fall of 1991 was about 122,000 acre-feet. This value included the presumption that water levels could be depressed to depths of 600 feet. Although groundwater is available below 600 feet, it is not considered available for extraction because of the pumping lifts that would be required.

During the past two years, consultants to the Blue Skies Country Club and to the Hi-Desert Water District have independently conducted Safe Yield Studies of the Warren Basin. Results of these efforts indicate that the Annual Safe Yield ranges from 600 acre-feet to 1800 acre-feet, with an agreed-to average annual Safe Yield in the order of 1200 acre-feet. It is no accident that there is a large discrepancy in Safe Yield values. Adequate hydrologic data are not available and long-term data, a requisite for accurate analysis, have never been continuously and accurately recorded.

PRESENT STATUS OF THE WARREN BASIN

Water level data collected by Hi-Desert Water District personnel have been analyzed during the course of the present assessment in order to determine the current

status (1992) of the groundwater resources of the Warren Basin. In order to clearly depict the condition of the basin, we have prepared a series of water level maps. Plate 1 — Groundwater Elevation - 1991, and Plate 2 — Groundwater Elevation - 1992, show contours depicting elevation of the water table for 1991 and 1992. Plate 3, entitled "Change in Water Levels 1991 - 1992" presents contours, or lines, of equal water level change for the selected period. As shown on Plate 3, water level decline has ranged from 0 feet near Well No. 5E to in excess of 10 feet near Well No. 3W.

To illustrate the significance of a basin-wide water level decline of 10 feet if it had occurred, we converted this change in water levels to the quantity of water that must be removed from storage in order to effect the decline. A change in overall water levels of 10 feet is manifested by a removal from storage of 5,900 acre-feet. If it were not for the annual recharge to the basin of ±1000 acre-feet, water levels would have been depressed an additional 2 feet and more water would have been removed from storage.

Recently collected data indicate that water levels have not been depressed equally throughout the basin. The largest declines occur in the vicinity of the high capacity wells, especially those that are pumped continuously for protracted periods of time. In such areas, the water table is characterized by a series of depressions, commonly referred to as "pumping holes". If allowed sufficient time, the water table near these wells would fully recover. However, due to the aquifer characteristics of low transmissivity and low permeability, full recovery may require days rather than

hours.

If water levels fully recover to true static conditions, the water table underlying Warren Basin would slope toward the east along a hydraulic gradient of 30 feet per mile.

It is interesting to note that, to date, because of a paucity of adequate data, no consideration has been given to what effect, if any, return of sewage effluent has on the groundwater regimen. All investigations have considered that return of sewage effluent is so minor, and depths to the water table so great, that sewage effluent plays only a very minor or no role whatsoever in the hydrologic equation.

Likewise, no consideration has been given either to return irrigation from applied water on the golf course at the westerly limits of the basin, or of phreatophyte losses by riparian vegetation on and adjacent to the Blue Skies Country Club golf course. All of these items must be assessed if an accurate determination is to be made of the Safe Yield of the Warren Basin.

Several years ago, the District Engineer, Max Sloan, attempted to determine the volume of subsurface flow exiting the basin in the vicinity of the Mental Physics facility. Due to a lack of hydrologic data, including such items as hydraulic gradient, aquifer permeability and cross-sectional area of the saturated sediments through which the water must pass, no quantification of outflow was developed.

During the course of geophysical studies performed for the District by Harding-Lawson Associates in 1984, some work was undertaken in the Covington Wash area.

The efforts were expended in order to define the subsurface geological features, to locate well sites, and to determine whether or not groundwater could be moving as subsurface flow into the easterly portion of the basin along Covington Wash. To date, no further efforts have been made in pursuit of this possible source of water supply. This is due, in part, to a lack of general interest, a shortage of adequate funds for investigative purposes, and to the possibility that the groundwater from Covington Wash could be a source of recharge to the Joshua Basin which lies to the east at a much lower surface elevation than Warren Basin.

According to information contained in a letter report dated March 4, 1992 by Kennedy/Jenks Consultants, present demand for water in the Warren Basin in 1992 is 3545 acre-feet. This demand will be met by a combination of sources including annual recharge, the Mainstream Well and by removal of groundwater from storage. This scenario will take place until 1995 when imported water will become available. At that time, supply will exceed demand by about 2700 acre-feet and less water will be withdrawn from the aquifer system. This will allow groundwater levels to recover. Based on information presented earlier in this report, a reduction in pumping of 2700 acre-feet will cause water levels to rise approximately 4.5 feet. However, by 1995, about 5000 acre-feet will have been removed from storage, which will be reflected by a decline of water levels of an additional 8.3 feet between now and 1995.

The character and quality of the groundwater of the Warren Basin is exemplified by the mineral analysis of Hi-Desert Water District Well No. 17.

Character of the groundwater supply is Calcium-Magnesium Bicarbonate. Total dissolved solids content is less than 200 mg/L. Nitrate ion concentration is less than 13 mg/L and Fluorides are less than 0.5 mg/L. The water is of excellent mineral quality, is suitable for all prevailing beneficial uses, and has not changed in character or quality in the past ten years.

SUMMARY STATEMENT

Although there are at least 25 water wells located throughout the Warren Basin, less than one-half of these wells are properly monitored for water level data. The findings and conclusions presented in this report are based on interpretation of information and data which are incomplete and which do not provide a high degree of confidence.

Considering how important it is to develop an accurate assessment of the local groundwater resources, it is recommended that the District take the necessary steps to implement the monitoring program suggested by their District Engineer in 1983, and that this program be undertaken forthwith.

REFERENCES CITED

1. "Proposed Management Plan Warren Valley Basin". Berryman & Stephenson, Inc.; June 1983.

2. "Perennial Yield and Quantity of Groundwater in Storage of the Warren Basin." Robert C. Fox and John Egan and Associates, Inc.; August 1991.

3. "Warren Basin Safe Yield/Perennial Yield". Krieger & Steward, Incorporated; November 1991.

4. Letter Report Regarding Impact of Safe Yield Revision. Kennedy/Jenks Consultants; March 4, 1992.

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OF THE

WARREN VALLEY BASIN WATERMASTER

FOR

FISCAL YEAR 1991/92

NOVEMBER 19, 1992

On February 10, 1992, Judge Philip E. Schaefer of the West District for the County of San Bernardino Superior Court of the State of California ordered the Warren Valley Basin Watermaster to report to the Court on an annual basis the water levels in the basin and any matters that impact the safe yield of the basin. The initial report is to be filed December, 1992.

Basin Data

Water extracted from the basin in acre feet

	Fiscal Years		
	1991/1992	1990/1991	1989/1990
Institute of Mentalphysics	13	27	44
Blue Skies Country Club	281	373 est.	362
Hi-Desert Water District	2,347	2,524	3,304
Total	2,641	2,924	3,710

In fiscal year 1991/92 the Hi-Desert Water District wells that were sounded recorded an average drop in water level of 22 feet. Well soundings at Blue Skies Country Club and Mentalphysics are not available (see Exhibit A).

Other matters affecting the basin.

Due to the community response to the Hi-Desert Water District's public awareness education and conservation programs, the District experienced a reduction in consumption of 6.1% in FY 1990/1991 compared to FY 1989/1990 and 8.9% in FY 1991/1992 compared to FY 1990/1991. In addition to public service announcements and media advertising, Ordinance 68 and Resolution 90-4 were adopted by the Hi-Desert Water District's Board of Directors. Ordinance 68 established prohibitions and restrictions on the use of water while Resolution 90-4 requires the installation of ultra-low flow conservation fixtures in all new construction and when replacing fixtures in existing structures, and upon change of ownership or use.

In June of 1990 the residents of Improvement District M of the Mojave Water Agency voted to issue general obligation bonds to fund the construction of a water transmission pipeline to bring state water to the pipeline project's participants. It has been assumed that annually, the project will deliver 7,250 acre feet of water. Hi-Desert Water District is allotted 59% or 4,278 acre feet of the water available from the project.

On January 10, 1991, an agreement was entered into by Hi-Desert Water District (District) and Bighorn-Desert View Water Agency

(Agency) dealing with the environmental impacts from extracting water from the Ames Valley Water Basin (Basin). Within the agreement the District agreed that water pumped from any wells owned by the District within the Basin will be limited to 800 acre feet per year. The amount of water pumped from the Basin may be increased depending on the water needs of the property owners within the Basin by an amount equal to one half acre foot per year for each new residential water meter installed by the District.

On July 9, 1991, the Hi-Desert Water District (District) and the Bighorn-Desert View Water Agency (Agency) entered into an agreement entitled "Drought Emergency Interbasin Groundwater Sharing Agreement". The agreement provided for the purchase of 500 acre feet of surplus water by the District from the Agency for a period of five years. The agreement also permits the possible negotiated sale of the Agency's contracted Mojave Water Agency State Project water supply to the District for a period of five years following the fulfillment of the surplus water portion of the agreement.

GROWTH

During fiscal year 1991/1992 the Court allowed the Hi-Desert Water District to offer for sale 194 water meters, 2%. Actual sales for the period were 76 water meters, while 29 water meters were installed. Also, during the period 23 water meters were refunded.

HI-DESERT WATER DISTRICT WELL SOUNDING FOR FISCAL YEAR 1991/1992

SOUNDING LEVELS ARE AT MONTH END

Well Number	July 1991	Aug 1991	Sept 1991	Oct 1991	Nov 1991	Dec 1991	Jan 1992	Feb 1992	Mar 1992	Apr 1992	May 1992	June 1992	Annual Increase (Decrease)
East 5	268	242	* 320	* 34	269	274	* 285	239	233	233	* 284	280	** (12)
7	354	348	* 366	348	349	* 358	342	422	* 443	417	* 423	* 441	(80)
9	437	434	436	435	435	435	435	426	* 453	* 430	* 452	* 436	(3)
10	* 363	345	* 346	* 370	* 371	* 373	* 373	345	338	334	338	* 352	12
12	443	441	443	436	* 461	435	430	431	* 448	426	435	* 456	(19)
14	362	387	372	381	366	* 423	373	395	* 397	384	* 423	* 426	(63)
16	* 501	* 499	491	478	* 501	* 489	* 489	479	* 486	* 485	484	* 496	(45)
17	* 450	* 465	440	436	441	* 442	431	431	* 442	* 438	---	431	5
18	338	348	364	* 373	* 366	347	* 375	333	* 358	* 368	* 370	* 368	(29)
West 2	411	* 428	* 425	415	414	415	416	414	* 425	417	* 423	* 425	** (14)
3	* 333	317	* 335	320	* 335	321	* 330	321	* 330	* 334	* 334	* 335	(4)
5	* 412	372	* 422	* 429	* 429	377	* 421	* 416	* 414	* 408	* 419	* 433	(20)
6	408	411	* 424	* 425	* 425	424	* 423	* 423	413	414	414	415	(7)
9	* 419	* 421	408	408	408	421	409	408	408	* 422	* 424	* 426	(9)
10	---	---	---	---	---	---	---	---	---	* 435	423	425	** 10
11	320	320	320	320	320	320	325	327	330	326	326	326	(4)

* Well pumping when sounded

** No sounding on July 3, 1991

EXHIBIT A