Arizona Department of Water Resources
Hydrology Division

ARIZONA
DEPARTMENT
OF WATER
RESOURCES

Prescott Active Management Area
2003-2004 Hydrologic Monitoring Report

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Revised Final Report

by

ADWR Hydrology Division - Technical Support Section and Field Services Sections
ADWR Water Management Division - Prescott AMA

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Introduction

This report presents hydrologic water-level monitoring data that have been compiled by the Arizona Department of Water Resources (ADWR) for the Prescott Active Management Area (AMA) during the period from February, 2004 through May, 2004. This year's report includes annual water-level measurement data collected at 126 index well sites and compilations of surface water and precipitation data the cover the period January, 2003 through December, 2003. Also included in this year's report are compilations of water use and recharge data, water budgets, groundwater storage estimates and summaries of on-going hydrologic studies and investigations in the area.

This report has been revised from an earlier version that was published on December 2, 2004. The revisions were made to correct a data omission and to address reader questions and comments. This report is the fourth in a series of hydrologic monitoring reports that describe hydrologic data and conditions for the Prescott AMA. This report may be downloaded as a PDF file from ADWR's website at: http://www.water.az.gov/.

Precipitation Data 2003

The 2003 precipitation totals for the Prescott AMA were below average, but showed improvement over 2002, which was the AMA's driest year on record (see Tables 1 and 2). Increases in annual precipitation were reflected in modest increases in surface water runoff, however many years of above average precipitation will be required to offset the negative impacts of the on-going drought.

Monthly total precipitation data for calendar year 2003 at the Prescott (Station 026796) and Chino Valley (Station 021654) precipitation stations are summarized in Tables 1 and 2. The data indicate that the annual precipitation at Prescott in 2003 was 15.43 inches or 81 percent of the long-term average, and the annual precipitation at Chino Valley was 11.21 inches or 95 percent of the long-term average. During the period from 1999 through 2003, annual precipitation at Prescott averaged 13.55 inches, and 7.48 inches at Chino Valley.

Table 1. 2002 and 2003 Monthly Precipitation in Prescott, Az. (Inches)

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2002	.03	0.00	0.23	0.39	0.00	0.00	1.99	0.11	2.38	0.79	0.69	0.56	7.17
2003	.53	3.43	1.95	0.26	0.03	0.01	3.32	2.77	0.97	0.00	1.52	0.64	15.43
1898-2003 Mean	1.73	1.85	1.74	0.95	0.48	0.40	2.89	3.28	1.73	1.08	1.26	1.64	18.98

Source: www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?azpres

Table 2. 2002 and 2003 Monthly Precipitation in Chino Valley, Az. (Inches)

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2002	0.14a	0.00a	0.57	0.39b	0.00	0.00	0.53a	0.00	2.35d	1.34e	0.00d	0.86f	5.32
2003	0.60d	2.31d	1.39d	0.20	0.00	0.00	1.79e	2.65e	0.86a	0.16c	1.15d	0.10	11.21
1948-2003 Mean	0.94	0.94	0.97	0.58	0.36	0.33	1.88	2.06	1.30	0.83	0.65	0.89	11.78

Source: www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?azchin

(some months during 2003 were missing one or more days of data, therefore monthly and annual total data are considered provisional)
a = 1 day missing, b = 2 days missing, c = 3 days missing, … z = 26 or more days missing

Actual total precipitation may exceed the indicated annual total due to missing days of data, official WRCC annual totals do not include months missing more than 5 days of data.

Surface-water Data 2003

Surface-water flow data provide important information concerning the amount of flow in rivers, springs and streams. Many of the discharge measurements are direct indicators of the volume of ground-water that is discharged from the regional aquifer system to springs and river channels. Surface-water data are also used to estimate the volume of water that is recharged to the aquifer system from streambed infiltration. Surface-water data were collected between January 1, 2003 and December 31, 2003 from seven United States Geological Survey (USGS) streamflow-gaging stations located in or near the Prescott AMA. Surface-water data are tabulated in Table 3. Daily discharge hydrographs for these gages are presented in Appendix A.

Comparisons of recent (calendar year 2003) discharge data were made to long-term annual mean discharge data and to median daily discharge data for the USGS gages with comparatively long periods of record. Comparisons were made for the gage on the Verde River near Paulden (09503700 – period of record 1963 to 2003), and for the gage on the Agua Fria River near Mayer (09512500 – period of record 1940 to 2003).

Within the AMA, 2003 annual runoff from the Granite Creek watershed exceeded the long-term average (Table 3). This is an indication that minor flood flows in 2003 were more frequent than usual on the Granite Creek drainage. Currently most runoff from the Granite Creek and Willow Creek watersheds is stored for recreational purposes in Watson Lake and Willow Lake. However, these reservoirs are occasionally spilled when maximum allowable reservoir storage is exceeded (Table 4).

2003 Annual Discharge – Verde River near Paulden

The 2003 annual discharge at the USGS gage on the Verde River near Paulden (09503700) was 20,011 acre-feet, or about 66 percent of the long-term mean of 30,430 acre-feet per year (from 1963 to 2003) (USGS, 2004). The 2003 median daily discharge was 22 cubic feet per second (cfs), or 88 percent of the long-term median daily discharge of 25 cfs (USGS, 2004). The median daily discharge at the Paulden gage is generally indicative of the typical baseflow of the Verde River at that location. The baseflow is primarily sustained by a series of springs that discharge groundwater to the channel of the Verde River and to the channel of lower Granite Creek a few miles upstream from the gage.

2003 Annual Discharge – Agua Fria River near Humboldt

The 2003 annual discharge at the USGS gage on the Agua Fria River near Humboldt (09512450) was 1,328 acre-feet. Prior to the installation of the USGS gage at Humboldt in 2000, the ADWR Field Services Section periodically measured stream flow on the Agua Fria River about a mile upstream from the present USGS gage site. ADWR’s discharge measurements were generally conducted on a seasonal basis, and provided 94 separate measurements during the 17-year period from August 21, 1981 to November 24, 1998. During that period, the average annual discharge measured was 1,359 acre-feet per year, and the median annual discharge was 1,219 acre-feet per year. The minimum measured discharge of .129 cubic feet per second (CFS), or 93 acre-feet per year, occurred on August 8, 1991. The maximum measured discharge of 12.95 CFS, or 9,375 acre-feet per year, occurred on March 23, 1986. Daily surface water discharge measurements for the Agua Fria River gage near Humboldt (09512450) primarily reflect groundwater discharge (baseflow); however, the gage discharge also reflects sporadic flows from infrequent precipitation/runoff events. During average to dry years some reaches of the Agua Fria River between Humboldt and the Mayer gage are dry (Wilson, 1988).

2003 Annual Discharge – Agua Fria River near Mayer

The 2003 annual discharge at the USGS gage on the Agua Fria River near Mayer (09512500) was 5,447 acre-feet, or about 33 percent of the long-term mean of 16,310 acre-feet per year (USGS, 2003). The 2003 median daily discharge was about 1.3 cfs, or about 62 percent of the long-term median daily discharge of 2.1 cfs (USGS, 2004). Baseflow conditions begin on the Agua Fria River near Humboldt.

Table 3. Summary of Provisional USGS Streamflow -Gaging Data for Selected Gages In and Near the Prescott AMA (01/01/2003 to 12/31/2003)

Gage Description	Gage Number	Period of Record	2003 Mean Daily Discharge (cfs) (1)	Long-term Annual Mean Discharge (cfs) (2)	2003 Median Daily Discharge (cfs) (1)	Long-term Median Daily Discharge (cfs) (2)	2003 Minimum Daily Discharge (cfs) (1)	2003 Maximum Daily Discharge (cfs) (1)	2003 Annual Runoff (AF) (1)	Long-term Annual Runoff (AF) (2)
Del Rio Springs near Chino Valley	09502900	1996-2003	1.45	NA	1.4	NA	0.85	2.3	1,050	NA
Granite Creek Near Prescott	09503000	1932-1947 1994-2003	8.73	5.87	.43	.22	0	463	6,319	4,250
Granite Creek at Prescott	09502960	1994-2003	6.65	4.17	.23	.19	0	227	8,811	3,020
Granite Creek below Watson Lake near Prescott	09503300	1999-2003	1.17	.72	0.06	.01	0	57	850	NA
Verde River near Paulden	09503700	1963-2003	27.64	42.0	22	25	19	401	20,011	30,430
Agua Fria River near Humboldt	09512450	2000-2003	1.83	NA	1.6	NA	0	39	1,328	NA
Agua Fria River near Mayer	09512500	1940-2003	7.52	22.5	1.3	2.1	.11	233	5,447	16,310

Data Sources:
2003 provisional streamflow-gaging data and graphics downloaded from USGS website: http://water.usgs.gov/az/nwis/
Long-term streamflow-gaging data from USGS Water Resources Data Water Year 2003: (USGS, 2004)

Footnotes:
(1) 2003 figures based on discharge measurements collected from 01/01/2003 to 12/31/2003.
(2) Long-term figures based on discharge measurements collected during respective gage's period of record.
NA = Not available

Groundwater Data and Conditions 2003-2004

The measurement of water-levels is an important data collection activity that provides information about changing groundwater storage conditions in the regional aquifer system. In general, rising water-levels are indicators of increasing groundwater storage conditions, while declining water-levels are indicators of decreasing groundwater storage. Groundwater conditions in the AMA's regional aquifer system were assessed by measuring the depth to water at 126 well sites located within or adjacent to the AMA (Figure 1). ADWR Field Services staff and USGS personnel conducted the water-level measurements during the period 01/08/2004 to 05/20/2004. The depths to water, water-level changes, and water-level elevations are summarized in Table 4.

Decreasing groundwater levels were observed at the majority of the 105 wells that were measured in both 2003 and 2004 that were used for statistical analysis (Table 4). For completeness, all data collected by the ADWR during 2004 have been presented in Table 4. However, not all wells that were measured in both 2003 and 2004 were used for the statistical analysis because of various non-standard well site conditions, such as cascading water, or recent or nearby pumping that could potentially bias a water-level measurement. Although some of the well data were not used for the statistical analysis, the data that were excluded were still often reflective of regional and local conditions.

Statistical analysis of the water-level data indicates that 95 of the 105 wells (90 percent) that were measured in both 2003 and 2004 showed water-level declines that ranged from –0.1 to –31.9 feet (Table 5). The mean decline was –2.7 feet and the median decline was –2.2 feet. The 2003 to 2004 mean annual water-level decline rate of –2.7 feet per year was greater than the long-term mean annual water-level decline rate of about –1.4 feet per year in 48 of the 55 wells (87.3 percent) that were measured in 1994 and 2004 (Table 4).

Water-level declines were observed in most parts of the AMA. Declines ranged from less than -1 feet to over –5 feet in wells that were measured that penetrate the Upper Alluvial Unit (UAU) and Lower Volcanic Unit (LVU) aquifers located in the northwestern portion of the Little Chino (LIC) sub-basin near the Town of Chino Valley and Del Rio Springs (Townships 16 and 17 North, Range 2 West). Declines ranged from less than -1 foot to over -9 feet in wells that penetrate the UAU, LVU and/or bedrock in the Mint Wash and Williamson Valley Road areas north and east of Granite Mountain (western portion of Township 15 North, Range 2 West, and eastern portion of Township 15 North, Range 3 West). Declines ranged from less than -1 to –3 feet in wells that penetrate the UAU, LVU and/or bedrock in the Lonesome Valley, Indian Hills and Coyote Springs areas of the Little Chino sub-basin (Townships 15 and 16 North, Ranges 1 East and 1 West).

Water-level declines in four deep wells that are completed in the LVU in the northwest portion of the Upper Agua Fria (UAF) sub-basin in the Prescott Valley area (Township 14 North, Range 1 West, Section 10) were excluded from the statistical analysis either due to cascading water conditions or due to nearby pumping conditions in 2003 (Table 4). However, the annual water-level decline for these deep wells was about –25 to -30 feet based on the water level change measured in well B-14-01 10ACA, and from a review of the hydrograph for piezometer well

B(14-1) 10ADB1 PZ1 (see Figure 2). Water-level declines ranged from less than -1 foot to about –5 feet in wells located in other parts of the Upper Agua Fria sub-basin (Townships 13 and 14 North, Ranges 1 East and 1 West).

Increasing groundwater-levels were observed in 10 of the 105 wells (10 percent) that were used for statistical analysis. Water-level increases ranged from +0.2 to +16.5 feet (Table 4). The mean increase was +4.9 feet and the median increase was +2.5 feet. The 2003 to 2004 mean annual rise rate of +5.6 feet was substantially greater than the long-term rise rate of +0.5 feet per year that was observed in 7 of the 55 wells (12.7 percent) that were measured in 1994 and 2004 (Table 4). It should be noted that the results are strongly influenced by a significant water-level rise in well, B-15-01 19DCD1, which rose by about +16.5 feet during 2003. This well is a piezometer well located near the City of Prescott's Airport Recharge facility. The recoveries in this well are undoubtedly related to recharge activities at the facility. It should be noted that a domestic well located in the Humboldt area, A-13-01 13CAB, also rose by about +16.5 feet during 2003. However, the water-level change measured in this well was excluded from the statistical analysis because the measured rise is not typical of other wells in the area, and suggests that the 2003 water-level measurement may have been influenced by unobserved nearby or recent pumping.

Water-level rises ranging from less than +1 foot to +4 feet were measured in wells that penetrate the UAU and undifferentiated volcanic rocks in the Upper Agua Fria sub-basin (Townships 13 and 14 North, Ranges 1 East and 1 West). A small cluster of 5 wells located in the Mint Wash area (Township 15 North, Range 3 West) showed rises ranging from +1 to +11 feet.

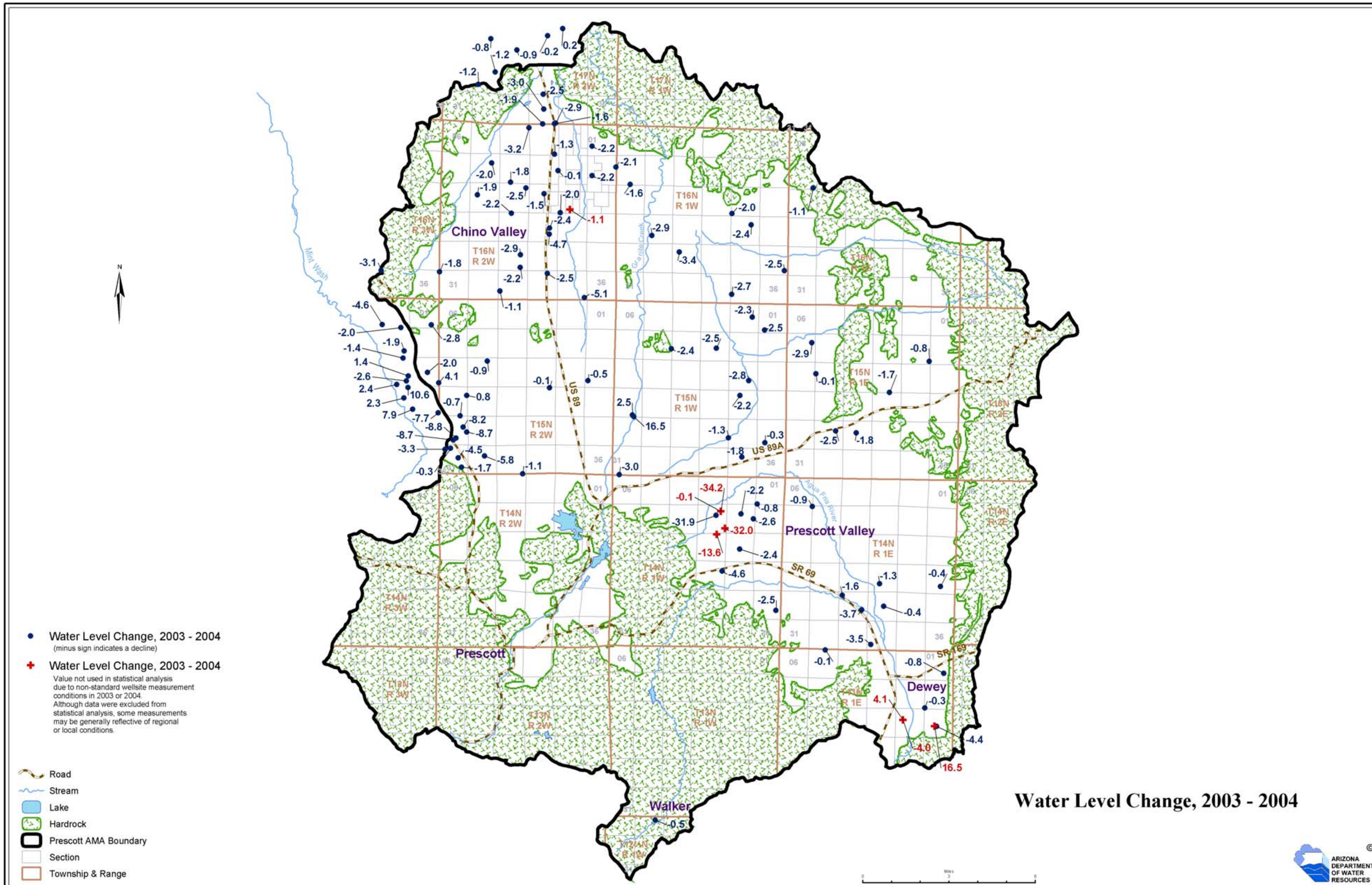

Figure 1 Water-level Change 2003 - 2004

Table 4. Summary of Water-level Data in the Prescott AMA and Vicinity (1994 to 2004)

(Figures rounded to nearest 0.1 foot)

SITE ID	LOCAL ID	1994 DTW	1999 DTW	2003 DTW	2003 REM	2004 DTW	2004 REM	94-04 CHG.	99-04 CHG.	03-04 CHG.
343153112122901	A-13-01 01DCA	209.5	207.6	208.8		209.6		-0.1	-2.0	-0.8
343157112135401	A-13-01 02CAD					83.8				
343233112164901	A-13-01 05ABB		151.7	152.3		152.4			-0.7	-0.1
343050112130901	A-13-01 12CCC	69.8	71.0	73.4		73.7		-3.9	-2.7	-0.3
343017112124301	A-13-01 13CAA	110.3	130.8	150.1		154.5		-39.8	-19.3	-4.4
343017112124801	A-13-01 13CAB			237.6	**	221.2	**			16.5
343028112135701	A-13-01 14BDC1	28.7	30.5	51.5	R	55.5		-26.9	-25.0	-4.0
343028112135702	A-13-01 14BDC2		51.6	36.9	T	32.8			18.8	4.1
343652112172101	A-14-01 08BBB	197.6	200.6	200.5		201.4		-3.8	-0.8	-0.9
343434112145201	A-14-01 22CAD			76.9		78.2				-1.3
343428112123701	A-14-01 24DCB	306.3	301.0	301.7		302.1		4.2	-1.1	-0.4
343353112144101	A-14-01 27ACC	48.3	43.8	42.5		42.9		5.4	0.9	-0.4
343415112161401	A-14-01 28BBB	52.1	63.6	80.7		82.3		-30.2	-18.7	-1.6
343333112160201	A-14-01 28CDC					173.9				
343337112152901	A-14-01 28DAC2		86.1	99.7		103.4			-17.3	-3.7
343244112150901	A-14-01 34CCA	66.7	73.9	76.5		80.0		-13.3	-6.1	-3.5
344148112172701	A-15-01 07ADA	458.7	463.7	471.4		474.3		-15.6	-10.6	-2.9
344117112130901	A-15-01 11DDD	212.7	216.6	218.8		219.6		-6.9	-3.0	-0.8
344052112171701	A-15-01 17BCC	313.8	314.2	314.0		314.1		-0.3	0.1	-0.1
344029112143501	A-15-01 22ABB	57.9	60.2	63.7		65.4		-7.5	-5.2	-1.7
343906112154701	A-15-01 28ACC	312.9	313.2	316.8		318.6		-5.7	-5.4	-1.8
343909112163201	A-15-01 29ADB			382.0		384.5				-2.5
344628112172801	A-16-01 07DDD			115.0		116.2				-1.1
342722112225901	B-12H01 20ACD	67.4	69.9	85.4		85.9		-18.5	-15.0	-0.5
342722112224201	B-12H01 20ADD					4.5				
342712112231701	B-12H01 20CAC					40.7				
342716112224101	B-12H01 20DAA		97.2			97.5			-0.3	
343655112192201	B-14-01 01CCC		336.4	338.3		339.1			-2.7	-0.8
343634112205201	B-14-01 10ACA			680.5		712.4				-31.9
343641112204202	B-14-01 10ADB1 PZ1		566.3	668.2	S	702.4			-136.1	-34.2
343641112204203	B-14-01 10ADB1 PZ2	331.5		324.5	S	324.6		6.9		-0.1
343610112203201	B-14-01 10DDA			721.2	C	753.2	C			-32.0
343637112195701	B-14-01 11ACB	341.3	342.0	342.1		344.3		-2.9	-2.3	-2.1
343628112193001	B-14-01 11DAA	327.5	328.5	329.8		332.4		-4.9	-3.9	-2.6
343651112184001	B-14-01 12ABA					268.0				
343552112332401	B-14-01 14AAD					514.5				
343540112195701	B-14-01 14ACC	371.1	371.8	370.8		373.2		-2.1	-1.4	-2.4
343601112205301	B-14-01 15ABA	498.5	536.2	724.6	C	738.2	C	-239.7	-202.0	-13.6
343453112203401	B-14-01 22ADA	325.9		342.6		347.2		-21.3		-4.6
343343112183801	B-14-01 25DAC	45.4	57.2	64.2		66.7		-21.3	-9.5	-2.5
343309112332401	B-14-03 34ADB					121.2				
344208112191201	B-15-01 01CDC	366.8	370.3	377.4		379.9		-13.1	-9.6	-2.5
344233112193801	B-15-01 02ADC	323.1	327.0	332.6		334.9		-11.8	-7.9	-2.3
344134112223501	B-15-01 08DAA			379.8		382.2				-2.4
344136112205601	B-15-01 10DBB			312.0		314.5				-2.5
344038112194401	B-15-01 14DBD	323.5	328.8	336.4		339.3		-15.8	-10.5	-2.8
343930112235301	B-15-01 19DCD1	220.8	225.3	237.1		220.6		0.2	4.7	16.5
343930112235601	B-15-01 19DCD2		370.5	380.0		377.5			-7.0	2.5
344011112200901	B-15-01 23BAD	328.7	336.3	344.5		346.7		-18.0	-10.4	-2.2
343847112190401	B-15-01 25CDB	292.8	296.0	299.2		299.5		-6.7	-3.5	-0.3
343854112202701	B-15-01 26CBC1		399.2	403.0		404.2			-5.0	-1.3
34387112213101	B-15-01 27CCC					480.5				
343746112242601	B-15-01 31CCD		341.7	348.7		351.7			-10.0	-3.0
343820112195701	B-15-01 35ABD			382.9		384.7				-1.8
344206112300201	B-15-02 05CCC					199.4				
344207112306001	B-15-02 06CCC					127.5				
344038112253701	B-15-02 13CCB	363.7	365.1	368.0		368.5		-4.8	-3.4	-0.5
344106112291501	B-15-02 17ABA	297.2	295.5	294.1		295.0		2.2	0.5	-0.9
344005112300201	B-15-02 19ADA		334.4	335.7		334.9			-0.5	0.8

SITE ID	LOCAL ID	1994 DTW	1999 DTW	2003 DTW	2003 REM	2004 DTW	2004 REM	94-04 CHG.	99-04 CHG.	03-04 CHG.
343928112301401	B-15-02 19DDC		308.1	309.6		310.3			-2.2	-0.7
342020112270101	B-15-02 22AAB			372.7		372.8				-0.1
343905112301401	B-15-02 30ADC		119.5	143.7		151.9			-32.4	-8.2
343843112303101	B-15-02 30CDA		156.6	179.8		188.5			-31.9	-8.7
343858112300301	B-15-02 30DAA		144.7	168.5		177.2			-32.5	-8.7
343836112302401	B-15-02 30DCB		148.5	171.8		180.6			-32.1	-8.8
343813112301702	B-15-02 31ACD3		208.2	231.7		236.2			-23.5	-4.5
343829112303501	B-15-02 31BAD1		210.8	240.9		241.2			-30.4	-0.3
343827112304801	B-15-02 31BBD		166.3	182.9		186.2			-16.6	-3.3
343754112301101	B-15-02 31DDB		208.3	212.8		214.5			-6.2	-1.7
343755112291501	B-15-02 32ACC			274.7		280.5				-5.8
343715112275801	B-15-02 33DDC	437.5	430.0	427.0		428.1		9.4	1.4	-1.1
344241112312201	B-15-03 01DCD	102.0	95.1	96.0		98.8		3.2	-3.7	-2.8
344205112322901	B-15-03S 02DCD			83.8		85.8				-2.0
344122112322201	B-15-03 11DDB		64.5	72.1		74.0			-9.5	-1.9
344147112313201	B-15-03 13ACC		217.4	219.6		221.6			-4.2	-2.0
344025112310401	B-15-03 13DDD2			285.3		281.2				4.1
344110112322201	B-15-03 14AAB			53.6		55.0				-1.4
344022112323501	B-15-03 14CDD			11.3		8.9				2.4
344038112321101	B-15-03 14DAD			57.3		55.9				1.4
344029112321501	B-15-03 14DDA			22.7		25.3				-2.6
344017112321101	B-15-03 23AAA			28.2		17.6				10.6
343957112322001	B-15-03 23ADC		54.7	63.0		60.7			-6.0	2.3
343938112320101	B-15-03 24CCB		84.0	92.6		84.7			-8.6	7.9
343932112310401	B-15-03 24DDD		140.4	163.0		170.7			-30.3	-7.7
344210112330901	B-15-03S02CCB			20.4		25.0				-4.6
344628112174901	B-16-01 07CDD	158.4	163.9	172.7		174.3		-15.9	-10.4	-1.6
344540112202601	B-16-01 14CCC	284.7	290.3	298.1		300.1		-15.4	-9.8	-2.0
344501112232601	B-16-01 20CAC		222.2	226.5		229.4			-7.2	-2.9
344520112194301	B-16-01 23ACA			345.8		348.1				-2.4
344358112182901	B-16-01 25DDA	409.3	414.6	422.2		424.7		-15.4	-10.1	-2.5
344429112222001	B-16-01 28BCA	267.3	272.7	280.6		284.0		-16.7	-11.3	-3.4
344314112202401	B-16-01 35CBC	305.8	310.5	316.4		319.0		-13.2	-8.5	-2.6
344738112253301	B-16-02 01CBD	57.2	63.6	73.2		75.4		-18.2	-11.8	-2.2
344809112275201	B-16-02 03BBB1	51.5	55.7	60.2		63.4		-11.9	-7.7	-3.2
344723112265701	B-16-02 03DDC4	37.6	46.7	55.1		56.4		-18.8	-9.7	-1.3
344704112291601	B-16-02 08ACA	106.4	105.0	115.5		117.5		-11.2	-12.5	-2.0
344629112283401	B-16-02 09CDC	166.8	175.8	186.9		188.7		-21.9	-12.9	-1.8
344653112264901	B-16-02 11CBB1	53.2	55.9	58.9		59.0		-5.8	-3.1	-0.1
342658112244601	B-16-02 12ADD	110.2	115.6	123.6		125.7		-15.5	-10.1	-2.1
344645112253401	B-16-02 12CBD		76.9	87.0		89.2			-12.3	-2.2
344540112264501	B-16-02 14CCC		173.1	187.0		189.0			-15.9	-2.0
344543112262201	B-16-02 14CDA	163.7	152.5	172.8	V	173.9	V	-10.2	-21.4	-1.1
344613112271901	B-16-02 15ACB			174.7		176.2				-1.5
344622112275701	B-16-02 16AAD		155.3	168.0		170.5			-15.2	-2.5
344607112294301	B-16-02 17BDC	166.2	175.5	186.3		188.2		-22.0	-12.7	-1.9
344535112283001	B-16-02 21BAA2	218.6	225.6	239.4		241.5		-22.9	-15.9	-2.2
344507112270101	B-16-02 22DBA	192.4	201.8	212.0		214.4		-22.0	-12.6	-2.4
344458112270601	B-16-02 22DBD		212.2	223.0		227.7			-15.5	-4.7
344422112283201	B-16-02 28BDD	287.0	301.9	314.0		316.9		-29.9	-15.0	-2.9
344357112280901	B-16-02 28DDC	288.1	295.7	310.0		312.3		-24.2	-16.6	-2.2
344347112310701	B-16-02 31BBB1	111.5		115.3		117.1		-5.6		-1.8
344314112285201	B-16-02 33CBC			354.0		355.1				-1.1
344347112271001	B-16-02 34ABA2	265.1	272.4	284.0		286.5		-21.4	-14.1	-2.5
344304112254701	B-16-02 35DDD	297.0	302.5	311.9		317.0		-20.0	-14.5	-5.1
344348112331401	B-16-03 35BBB		115.0	126.4		129.5			-14.5	-3.1
345109112264401	B-17-02 14CCA			93.8		93.6				0.2
345048112292201	B-17-02 20ABD			185.9		186.7				-0.8
345030112282301	B-17-02 21ACC			113.9		114.8				-0.9
345056112271601	B-17-02 22ABB			27.3		27.5				-0.2
344950112291101	B-17-02 29ADC			232.8		234.0				-1.2
344928112294601	B-17-02 29CAC		456.0	459.4		460.6			-4.6	-1.2
344846112271401	B-17-02N34ACC	10.7	12.9	13.3		16.3		-5.6	-3.4	-3.0
344819112265701	B-17-02N34DDD1	4.6		21.8		23.4		-18.8		-1.6

SITE ID	LOCAL ID	1994 DTW	1999 DTW	2003 DTW	2003 REM	2004 DTW	2004 REM	94-04 CHG.	99-04 CHG.	03-04 CHG.
344819112265601	B-17-02N34DDD3	30.1	35.2	38.5		41.4		-11.3	-6.2	-2.9
344820112272701	B-17-02S34ABB			9.7		11.6				-1.9
344917112273101	B-17-02W27DCC	9.2	11.6	14.4		16.8		-7.6	-5.2	-2.5

DTW = Depth to Water (in feet)

GWSI Remarks: C = cascading water
O = obstruction
P = pumping
R = recently pumped
S = nearby pumping
T = nearby recently pumped
V = foreign material (oil)

Other Remarks: ** = probable, but unobserved recent pumping ; or other anomalous conditions
Note (1) Wells with water-level measurements annotated with remarks were not used in statistical analysis.
Note (2) 2004 water-level measurements conducted between 1/08/2004 and 5/20/2004.

Table 5. Statistical Summary of Water-level Change Data in the Prescott AMA and Vicinity (1995 to 2004)

(Figures rounded to nearest 0.1 foot)

Period of Change →	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004
Number of Wells Used Analysis	16	17	44	43	87	92	84	85	105
Number of wells showing Increases in water-levels	1	4	10	7	21	9	10	19	10
Sum of increase (feet)	+0.6	+18.0	+33.0	+39.5	+22.7	+35.7	+16.9	+31.0	+48.7
Minimum increase (feet)	+0.6	+2.0	+0.1	+0.1	+0.1	+0.1	+0.2	+0.1	+0.2
Maximum increase (feet)	+0.6	+7.0	+9.2	+16.3	+4.8	+15.0	+5.8	+4.3	+16.5
Mean of increases (feet)*	+0.6	+4.5	+3.3	+5.6	+0.9	+4.0	+1.7	+1.6	+4.9
Median of increases (feet)**	+0.6	+4.5	+1.5	+4.4	+1.2	+1.1	+0.5	+0.9	+2.5
Number of wells showing Declines in water-levels	15	10	34	35	63	82	73	65	95
Sum of declines (feet)	-54.3	-23.0	-71.4	-51.5	-188.2	-300.1	-288.8	-165.7	-255.9
Minimum declines (feet)	-0.5	-1.0	-0.2	-0.1	-0.1	-0.1	-0.1	-0.3	-0.1
Maximum declines (feet)	-13.4	-6.0	-12.6	-7.5	-19.6	-21.0	-42.3	-10.9	-31.9
Mean of declines (feet)*	-3.6	-2.3	-2.1	-1.5	-3.0	-3.7	-4.0	-2.5	-2.7
Median of declines (feet)**	-2.2	-1.5	-2.1	-1.2	-1.6	-2.25	-2.3	-1.7	-2.2
Number of wells showing no Change in water-levels	0	3	0	1	3	1	1	1	0

* The mean of increases or declines is the arithmetic average of each group of measurements (that is, the average change in water-level for wells with measured increases in water-level or the average change in water-level for wells with measured decreases in water-level). For example, the sum of all measured water-level increases in the 10 wells that showed increases between 2003 and 2004 was +48.7 feet. The mean increase in water-level, +4.9 feet, was calculated by dividing the sum of increases (+48.7 feet) by the number of measurements that showed increases (10).

** The median of increases or declines is a statistical measure of the central value of each group of measurements. Half of the measurements in each group are less than the median, and half of the measurements in each group are greater than the median. For example, the median decline in water-level, -2.2 feet, equals the 48th ranked well of the 95 total wells that showed rises between 2003 and 2004.

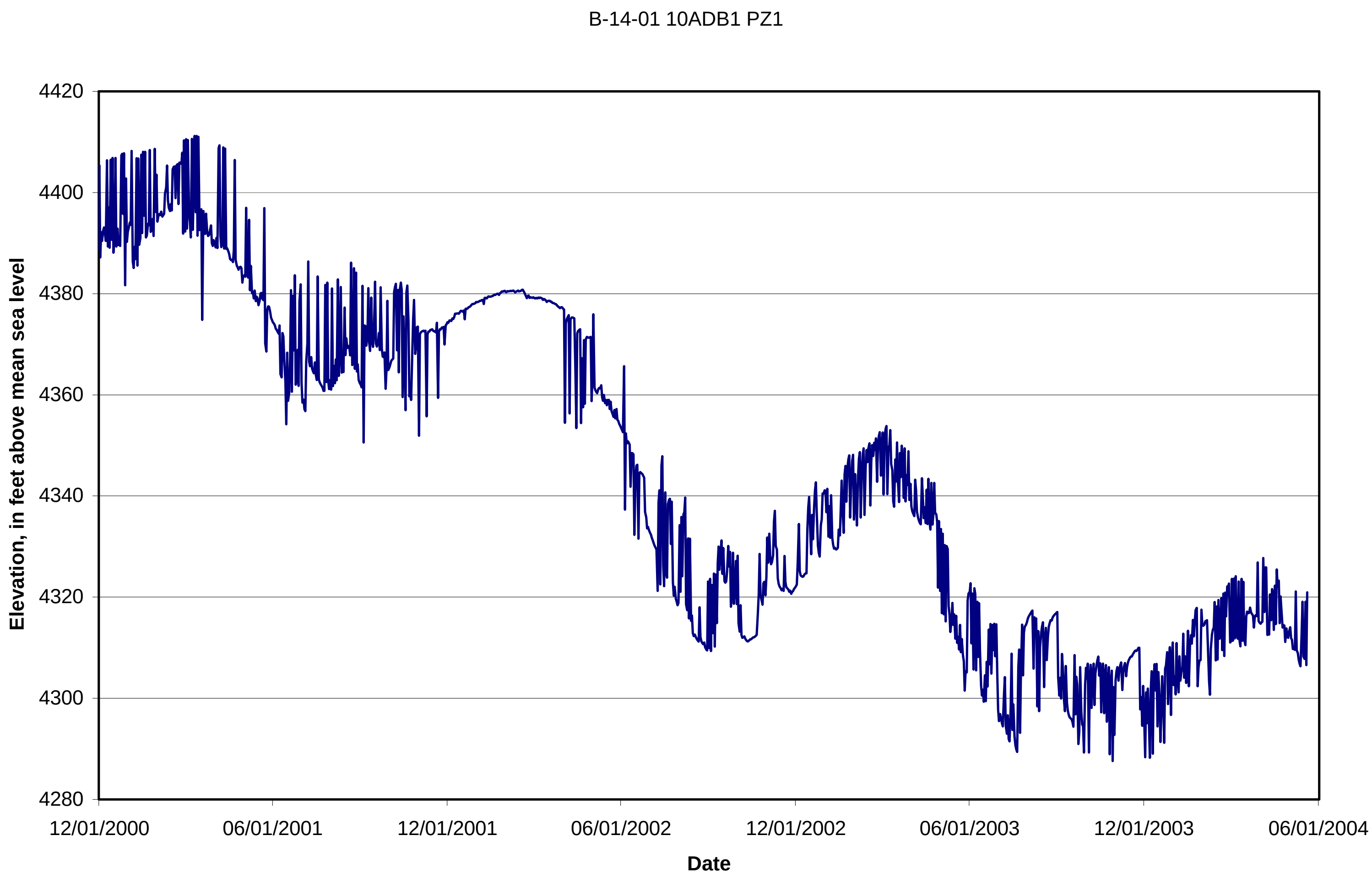

Figure 2 Hydrograph of Town of Prescott Valley “Fat Chance” Piezometer Well B-14-01 10ADB1 PZ1

Groundwater Pumpage 2003

Groundwater pumpage represents the single largest component of outflow from the aquifer system in the Prescott AMA. Groundwater pumpage data provide important information that is used to assess the ever-growing demand on the aquifer system. Groundwater pumpage data are used to compile hydrologic water budgets, and supply well-specific pumpage inputs to groundwater flow models. It is important to note that the pumpage totals listed in the following tables represent actual physical withdrawals of groundwater from the regional aquifer system. However, under Arizona law some pumpage (for example, the recovery of recharge credits) is not considered to be groundwater. These legal distinctions must be considered for purposes of calculating safe-yield (see next section on the water budget).

Annual pumpage totals are metered for each non-exempt well in the AMA, and are reported by the well owners to the ADWR. The 2003 non-exempt pumpage data is summed for each major provider or water use category in Table 6. Table 7 lists the total non-exempt well pumpage for the period 1990 to 2003. The 2003 non-exempt well pumpage total in the Prescott AMA was 19,160 acre-feet (Table 7). The 2003 non-exempt pumpage was about 17 percent greater than the average annual non-exempt pumpage of 16,400 acre-feet per year during the last 14 years (Table 7).

Table 6. Reported 2003 Non-Exempt Pumpage by Water Providers or Water Use Category in the Prescott AMA

Water Provider or Water Use Category	2003 Reported Non-Exempt Pumpage
City of Prescott	8,120
Prescott Valley	4,860
Agricultural Users	4,037
Non-irrigation Users	1,359
Small Providers	784
Total	19,160

Table 7. Reported Non-Exempt Well Pumpage in the Prescott AMA (1990-2003)

Year	Pumpage (Acre-feet)
1990	16,088
1991	13,780
1992	12,007
1993	15,279
1994	15,426
1995	15,011
1996	17,635
1997	17,132
1998	15,229
1999	15,642
2000	17,291
2001	18,171
2002	21,815
2003	19,160
1990-2003 Total	229,666
1990-2003 Average (Rounded to nearest 10 AF)	16,400

Exempt wells are registered wells that are not authorized to be equipped with a pump that can withdraw more than 35 gallons per minute. Exempt wells are also commonly referred to as domestic wells and account for a substantial volume of groundwater pumpage in many parts of the AMA. Exempt wells often supply the water needs for residents that do not live within the service area of a local water provider. Large concentrations of exempt wells are found in the Chino Valley area, and in other areas that surround the regional aquifer system where wells are often drilled in comparatively thin, marginally productive alluvial deposits and/or volcanic rocks and bedrock (Mint Wash, Lonesome Valley, Coyote Springs, Dewey and Humboldt areas). In 2002, the total number of confirmed, drilled domestic or exempt wells in the AMA was estimated at about 7,700 (ADWR, 2002) The total estimated exempt well pumpage in the Prescott AMA in 2002 was estimated at about 3,100 acre-feet per year (ADWR, 2002). The distribution of exempt well pumpage was estimated at 1,700 acre-feet per year for the regional groundwater basin area of the AMA and 1,400 acre-feet per year for the surrounding foothills and mountainous bedrock areas (ADWR, 2002).

During 2003, 397 Notices of Intention to drill new exempt wells were filed in the Prescott AMA. However, only 329 of the wells also had well logs filed, indicating that the well was actually drilled. Even though some wells were probably drilled that didn't have logs filed, it is also known that some of the wells that were drilled replaced existing wells. Based on these considerations, the number of additional exempt wells in the AMA in 2003 is estimated to be about 330 (260 in the groundwater basin area and 70 in the mountainous bedrock areas). The amount of additional exempt well pumpage in 2003 is estimated at about 130 acre-feet for the groundwater basin area of the AMA (.5 acre-feet per well), and 25 acre-feet for the mountainous bedrock area that surrounds the groundwater basins (.33 acre-feet per well). Using ADWR's 2002 estimate of domestic well pumpage and the estimated growth in domestic well pumpage during 2003, groundwater pumpage from domestic wells in the AMA was estimated to be about 3,255 acre-feet per year during 2003.

Recently a question has been raised regarding whether the volume of groundwater that is estimated to be pumped from exempt wells that are located in the mountainous bedrock areas of the AMA should be counted as an outflow in the AMA's hydrologic groundwater budget (see next section on the water budget). Unfortunately, this is not a simple question to address because some exempt wells that are located in bedrock areas pump groundwater from shallow perched or local bedrock aquifer systems that are essentially isolated from the regional groundwater basin aquifer system, and may receive some natural recharge that is not accounted for in the AMA's mountain front recharge estimates. For now, ADWR acknowledges that some portion of the exempt well pumping in bedrock areas may contribute to the net overdraft from the regional aquifer system. Next year's monitoring report will examine this question in further detail.

2003 Conceptual Hydrologic Water Budget

A conceptual **hydrologic water budget** prepared from the assembled 2003 pumpage, recharge and surface water discharge data is presented in Table 8. It is important to point out that the conceptual hydrologic water budget is a physically-based water budget that tabulates all major inflows (natural, incidental and artificial recharge) and outflows (pumping, natural discharge and groundwater underflow) from the regional aquifer system for the year in question, and provides an estimate of the actual annual change-in-groundwater storage within the AMA's regional aquifer system.

Hydrologic water budgets differ from **"long-term planning or accounting water budgets"** that may be used to examine average conditions for water management or track the legal status or character of water for "safe-yield" accounting purposes. For example, under Arizona law a water storer may accrue recharge credits allowing for future withdrawal of stored water. Stored water for which credits are issued is not counted as a contribution to safe-yield, because that amount of water belongs solely to the water storer and is expected to be "recovered" at a future date. Therefore, although this recharge temporarily increases groundwater in storage, it has no net impact on the safe-yield volume (ADWR, 1998). In practical terms this means that recharge of effluent or surface water by a water storer wouldn't necessarily be reflected as an inflow in a long-term planning or annual accounting water budget unless the credits earned for the recharge were used (pumped) within the same year the recharge occurred. Additionally, the pumping or "recovery" of previously earned recharge credits by a water storer in a later year, would not be considered a debit or groundwater outflow in the accounting water budget.

As mentioned in the previous section, next year's monitoring report will contain further analysis on the net contribution of exempt well pumping in bedrock areas to groundwater overdraft in the regional aquifer system. Additionally, next year's report will also examine potential incidental recharge from septic systems that is currently not included in the conceptual hydrologic water budget.

The 2003 conceptual hydrologic water budget for the Prescott AMA indicates that groundwater outflows exceeded inflows, resulting in a -11,300 acre-foot change-in-groundwater storage for the year. It should be noted that while the average annual change-in-groundwater storage has ranged from about -10,000 to -15,000 acre-feet per year over the last several years, the long-term assessment of groundwater storage change includes the annual water budgets for all years, some of which may occasionally reflect substantially reduced annual overdrafts due to above average precipitation and flood recharge.

Table 8. Conceptual Hydrologic Water Budget (2003) Prescott AMA

(Figures rounded to nearest 10 acre-feet)

Groundwater Inflows	**2003 Volume (acre-feet)**
Natural Recharge (1)	6,600
Incidental Recharge (2)	2,020
Artificial Recharge:	
(City of Prescott) (3)	3,480
(Prescott Valley) (4)	1,740
Total Inflows	**13,840**
Groundwater Outflows	
Groundwater Pumpage:	
Non-Exempt (5)	19,160
Exempt (6)	1,830
Groundwater Discharge:	
Underflow to Big Chino (7)	1,800
Del Rio Springs Discharge (8)	1,050
Agua Fria Baseflow near Humboldt (9)	1,300
Total Outflows	**25,140**
Inflow – Outflow = (Change-in-Groundwater Storage)	**11,300**

1) Estimate for long-term average annual mountain front recharge (Nelson, 2002, pg. 10). Actual annual volumes may vary significantly from the long-term average. Plus recharge from 2003 Granite Creek Spill below Watson Lake (USGS streamgaing station (09503300) = 850 AF.
2) Estimated at 50% agricultural water use for 2003 (Corkhill, and Mason, 1995, pg. 58), (Nelson, 2002, pg. 10).
3) Includes recharge of treated effluent and surface water, as reported in 2003 - City of Prescott Annual Underground Storage Facility Report-Schedule 73.
4) Includes recharge of treated effluent, as reported in 2003 – Town of Prescott Valley Annual Underground Storage facility report-Schedule 71.
5) ADWR Registry of Groundwater Rights database.
6) Estimated domestic and exempt well pumpage in Prescott AMA groundwater basin area only. 1,425 AF/yr of additional domestic well pumpage estimated for surrounding mountainous area (see pumpage section of this report for further details).
7) ADWR model simulated underflow to Big Chino in 1999 (Nelson, 2002, pg. 14, Table 5).
8) USGS 2003 annual discharge at Del Rio Springs gage (09502900). Note! Unquantified diversions of groundwater discharged from the cienega above the USGS Del Rio Springs gage are not reflected in the gage's annual total. Also a minor, unquantified volume of groundwater supports a small riparian area in the immediate area of the springs. For comparison purposes, the 1999 ADWR- model simulated groundwater discharge including undifferentiated ET component at Del Rio Springs = 1,800 AF/yr (Nelson, 2002, pg. 14, Table 5).
9) USGS 2003 annual discharge at the Agua Fria gage near Humboldt (09512450). Annual discharge reduced to account for significant surface water runoff. For comparison purposes, the 1999 ADWR – model simulated groundwater discharge including a minor undifferentiated ET component to Agua Fria River near Humboldt = 1,400 AF/yr (Nelson, 2002, pg. 14, Table 5).

Groundwater in Storage

Estimates of volume of groundwater stored in the AMA's aquifer system are vital to the effective management of the AMA's water resources. Monitoring data and conceptual water budgets provide data necessary to compile such estimates. The total volume of groundwater in storage in the Prescott AMA was estimated from water-level data to be about 3.0 million acre-feet in 1994 (Corkhill, 1998). It should be noted that this estimate has inherent uncertainty due to necessary assumptions concerning aquifer thickness and storativity that are still not well known in many parts of the regional aquifer system, therefore this estimate should be assumed to be no more reliable than about +/- 25 percent.

Since 1994, annual water-level decline rates have ranged from mean annual values of about –1.5 to –4.0 feet per year, and median annual decline rates have ranged from about –1.2 to –2.3 feet per year (Table 5). For the purpose of making this estimate, an average annual water-level decline rate of –1.4 feet per year was assumed (this is the average annual decline rate of the 47 wells 88.6 percent of the total wells measured in 1994 and 2004). Based on the –1.4 foot per year annual decline rate, and assuming an average aquifer storativity of .07 percent (from the Prescott AMA groundwater flow model) and an estimated regional aquifer area of about 175 square miles (from the ADWR Prescott AMA groundwater flow model) the change in storage over the 10-year period from 1994 through 2003 is estimated to be about –110,000 acre-feet.

Conceptual hydrologic water budget data provide another independent means of estimating the change in aquifer storage. Over the period from 1994 to 2003 conceptual hydrologic water budgets developed for the AMA have indicated groundwater overdrafts that range from as low as about –2,800 acre-feet in 1995 (a flood year) to about –15,500 acre-feet in 2002. Assuming an annual average overdraft of about –10,000 acre-feet per year for the 10-year period yields an estimated decrease in groundwater storage of about –100,000 acre-feet. The correspondence between the two storage change estimates is consistent with previous modeling results and comparisons, and provides confidence in the general accuracy of the monitoring data and the methods of analysis. Based on the new data the total volume of groundwater in storage in the Prescott AMA is currently estimated to be about 2.9 million acre-feet (+/- 25 percent).

Although 2.9 million acre-feet (+/- 25 percent) seems like a substantial volume of groundwater in storage, one that could theoretically sustain the current overdraft for a long period of time, it is important to realize that the estimated total volume of groundwater in storage is not realistically recoverable. Local hydrologic conditions, potential water quality considerations and existing well locations would undoubtedly limit the technical, economic and practical feasibility of "draining" the aquifer. Since all projections indicate future population growth for the area, with additional water demand and overdraft, estimates of the amount of time that the AMA's population could be sustained by aquifer depletion would be inflated if current overdraft rates were projected far into the future. Additionally, a water management strategy that would permanently rely on aquifer depletion would be contrary to the AMA's safe-yield goal, and ensure an uncertain and unsustainable future for the AMA.

Related Hydrologic Activities and Studies

Prescott Valley Production Well Drilling

Over the last several years the Town of Prescott Valley has been engaged in groundwater exploration studies and activities designed to augment its water supply. During 2003 the Town of Prescott Valley completed final plans to drill several new production wells in the southern Lonesome Valley area to relieve the stress on its over-burdened southern well field (the Santa Fe field).

During the first half of 2004 the Town drilled 5 new production wells north of Highway 89A, in Township 15 North, Range 1 West, sections 27, 33 and 35. The production capacity of the wells ranges from about 400 to 1,000 gpm (personal communication from Kimberly Moon - Town of Prescott Valley, 2004). The five new wells are collectively referred to as the North well field. Two of the wells are currently being equipped with 600 gpm pumps and should be online in the near future. When all the new wells are equipped with pumps and delivery infrastructure, the Town plans to cycle its water production between the two well fields and allow the Santa Fe field to "rest" or recover for several months each year.

Figure 3 New Town of Prescott Valley well being drilled in the Lonesome Valley area

City of Prescott Big Chino Hydrologic Studies

During 2003 the City of Prescott continued to collect data and analyze the potential impacts of pumping and transferring groundwater from previously irrigated agricultural land in the Big Chino sub-basin to the Prescott AMA. Recent hydrologic studies and analysis were conducted by City of Prescott in the CV/CF Ranch area that is located in the Big Chino sub-basin, approximately 25 miles northwest of the City of Prescott.

During its studies the City drilled 3 exploration wells into playa deposits located in the central portion of the Big Chino sub-basin and also developed a groundwater flow model that covers a large portion of the northwestern and central part of the Big Chino sub-basin. The intent of the City's study was to assess the physical availability and water quality of groundwater from the CV/CF Ranch prior to the purchase of the property. An additional objective was to assess the potential impact of developing up to 8,717 acre-feet/yr on other groundwater users.

In late spring of 2004, the City dropped its option to purchase the CV/CF Ranch, and turned its focus to an adjacent property, the JWK Ranch. Further research and analysis is currently underway to study the potential impacts of pumping on the JWK Ranch.

USGS Research and Modeling of the Verde River Watershed Region

Three major USGS hydrogeologic investigations of the Verde River watershed, including portions of the Little Chino sub-basin of the Prescott AMA are currently on-going, or are nearing completion. Hydrogeological and geophysical data developed from all the USGS studies will be used in future updates of the Prescott AMA groundwater flow model.

One on-going USGS study is investigating the geology and hydrology of the Upper and Middle Verde River watershed. This study is being led by John Hoffman (USGS-Tucson) and includes other USGS staff and field data collection assistance from ADWR staff working out of the Prescott AMA office. This study is part of the Rural Watershed Initiative, a program established by the State of Arizona and managed by the ADWR that addresses water supply issues in rural areas while encouraging participation from stakeholder groups in affected communities (Yavapai County is also a major cooperator in the study). The objectives of the Rural Watershed Initiative investigations are to develop (USGS, 2002):

1) a single database containing all hydrogeologic data available for the combined areas,
2) an understanding of the geologic units and structures in each area with a focus on how geology influences the storage and movement of groundwater,
3) a conceptual model that describes where and how much water enters, flows through, and exits the hydrologic system,
4) a numerical ground-water flow model that can be used to improve understanding of the hydrogeologic system and test various scenarios of water-resources development.

Progress toward achieving the first three objectives of the investigation is well underway, and an interim report on the hydrogeology and conceptual model of the groundwater system is anticipated for mid-2005. The data, analysis and interpretations that will be presented in the interim report will serve as the foundation for developing the groundwater flow model that will be used to examine the potential impacts of future groundwater development in the area. Data and information from the ADWR Prescott AMA groundwater flow model and from other USGS investigations will also be incorporated into the USGS model. Further information on this study may be obtained by downloading USGS factsheet, FS-059-02, at: **http://www.az.water.usgs.gov/factsheet.htm.**

Another investigation, conducted by Laurie Wirt (USGS-Denver) and other USGS researchers, has studied the geologic framework of aquifer units and ground-water flow paths in the Verde River headwaters region (including the northern portion of the Prescott AMA's Little Chino sub-basin). The study has included extensive hydrologic, geologic, geophysical and geochemical data collection and analysis and provides interpretations of aquifer structure and characteristics including interpretations of possible groundwater flow paths in the vicinity of the Verde River headwater springs. This study is funded by a grant from the Arizona Water Protection Fund, administered by the ADWR, and is in its final stages of documentation and review. A final investigation report is anticipated for publication by late 2004 (personal communication from Laurie Wirt - USGS Denver, 2004).

An offshoot from the Wirt investigation is Vicki Langenheim's (USGS- Menlo Park) study of the geophysical framework of the Upper and Middle Verde River watershed. This study extended the original area established for geophysical data collection in the Wirt study, and included additional coverage and data analysis in the Prescott AMA. Funding for the study was provided by the Yavapai County Water Advisory Committee (WAC). A report on this study is anticipated for release during 2005, however a preliminary version of the report may be downloaded at this time at: **http://geopubs.wr.usgs.gov/open-file/of02-352.**

Yavapai County Study of Historical and Current Water Uses in the Big Chino Sub-basin

A study of historical and current water uses in the Big Chino sub-basin was completed in 2003 (Yavapai County, 2004). This study was conducted by the Yavapai County Water Advisory Committee and was supported and assisted by many individuals and agencies including: the Natural Resources Conservation District, the ADWR, the Yavapai County Flood Control District, John Olsen (former farmer and Yavapai County Supervisor) and Dave Smith (former Soil Conservation Service agent). The study utilized aerial photo interpretation and other methods to develop estimates of historical and current cropped acreage and water use for Big Chino agricultural lands. Projections of future cropped acreage and water use were also provided.

The intent of the study was to provide information on whether certain lands that may potentially be used for water transfers from the Big Chino sub-basin to the Prescott AMA were irrigated between January 1, 1975 and January 1, 1990. The study also provides additional information about the water uses in the Big Chino sub-basin for purposes of defining the potential impacts to the groundwater-levels and outflow. A copy of this report may be downloaded at: **http//www.co.yavapai.az.us/orggroups/wac/BCReport.pdf.**

NAU 3-D Visualization Model of the Upper Verde River Headwaters Area

Northern Arizona University (NAU) has recently been awarded an Arizona Water Protection Fund grant to develop a 3-dimensional visualization model (a GeoWall presentation) of the upper Verde River headwaters area. The visualization model will attempt to illustrate the complex geology, aquifer systems and springs that contribute the source waters of the upper Verde River system. The grant includes a public outreach phase that will include presentations to stakeholder groups in the area. The grant will be supervised by Dr. Abe Springer of NAU, and is scheduled for completion by the end of 2006.

Summary and Conclusions

The 2003 precipitation totals for the Prescott AMA were below average, but showed improvement over 2002, which was the AMA's driest year on record. However, many years of above average precipitation will be required to offset the negative impacts of the on-going drought. Total precipitation for calendar year 2003 at Prescott was 15.43 inches or 81 percent of the long-term average of 18.98 inches/year. Total precipitation at Chino Valley was 11.21 inches or 95 percent of the long-term average of 11.78 inches/year. During the period from 1999 through 2003, annual precipitation at Prescott averaged 13.55 inches, and 7.48 inches at Chino Valley.

Surface runoff and the baseflow of rivers and streams generally showed modest increases over 2002 levels, but were generally below long-term averages (except for the Granite Creek watershed). Surface flows gaged on the Verde River near Paulden totaled about 20,000 acre-feet for 2003, or about 66 percent of the long-term average. The median daily flow at Paulden which is indicative of the volume of groundwater discharged to the Verde from a system of headwater springs was 22 cubic feet per second or about 88 percent of the long-term median. Surface flows gaged on the Agua Fria River near Mayer totaled about 5,500 acre-feet for 2002, which is 33 percent of the long-term average. Median daily flow on the Agua Fria near Mayer was about 1.3 cubic feet per second or about 62 percent of the long-term median.

The long-term trend of water-level decline continued in most parts of the Prescott AMA during 2003. Water-level declines averaged –2.7 feet per year in 95 of the 105 wells (about 90 percent) that were measured in both 2003 and 2004 and were used for statistical analysis. Significant declines ranging from less than –1 to over –9 feet were observed in several domestic wells located in the Mint Wash and Williamson Valley Road areas north and east of Granite Mountain. A small cluster of wells in that same area showed rises ranging from +1 to +11 feet. Significant water-level declines on the order of –25 to –30 feet per year were observed in a piezometer well and in several deep production wells located in the Town of Prescott Valley's municipal well field that produce water from the volcanic aquifer system in the Prescott Valley area.

Non-exempt well pumpage totaled about 19,160 acre-feet for 2003. The 2003 non-exempt (domestic well) pumpage was about 17 percent greater than the 1990 to 2003 average. Groundwater pumpage from domestic wells in the AMA was estimated to be about 3,255 acre-feet per year during 2003. The distribution of exempt well pumpage was estimated at 1,830 acre-feet per year for the regional groundwater basin area of the AMA and 1,425 acre-feet per year for the surrounding foothills and mountainous bedrock areas.

A conceptual groundwater budget prepared using estimated inflow and outflow volumes indicates a groundwater overdraft of about 11,300 acre-feet occurred during calendar year 2003. The 2003 overdraft reflects the AMA's continued heavy reliance on non-renewable groundwater resources to sustain its current population and support future growth. Groundwater storage estimates indicate that groundwater storage has been depleted by about 100,000 acre-feet during the last decade. The current volume of groundwater in storage in the AMA is estimated at about 2.9 million acre-feet (+/- 25 percent).

Recent drilling activities by the Town of Prescott and exploration drilling and hydrologic studies by the City of Prescott underscore the fact that water supplies within the AMA are limited, and new sources of supply will be required to meet the AMA's safe-yield goal. Water importation studies by the City of Prescott are currently focused on the JWK Ranch area in the Big Chino sub-basin. Potential impacts of the planned pumping are a concern to many individuals and organizations in the area.

Some of the major hydrologic issues that are connected with the City's plans hinge on the potential impacts of pumping on the baseflow of the Verde River. The City is currently considering various options to mitigate any potential decrease in the Verde's baseflow that could be attributed to future Big Chino pumping. Another factor influencing future groundwater mining conditions is the determination of how much of any imported water will be dedicated to new sub-divisions and how much will be dedicated to serving sub-divisions already approved. While it is true that the dedication of a substantial portion of imported water to current uses would substantially reduce the overdraft, it must be remembered that the overdraft is not solely the result of municipal pumping. Pumping for agricultural, industrial and domestic purposes also contributes to the overdraft (Tables 6 and 8).

In conclusion, the monitoring data show continued decreases in groundwater storage within the AMA. These conditions, combined with continued population growth, present water providers in the AMA with major challenges to supply the future water needs of the area. The achievement of the AMA's safe-yield goal would seem to require some combination of significant water conservation measures, the maximization of effluent reuse and recharge, the development of any additional renewable water supplies within the AMA, future water importation, and limitations on the growth of water demands in the AMA. Regional concerns about water importation must be addressed through practical mitigation plans. Continued data collection, data analysis and groundwater modeling by the ADWR and ongoing studies by the USGS will play a vital role in helping the AMA analyze current and future hydrologic conditions, and hopefully develop long-term strategies to achieve and maintain its safe-yield goal.

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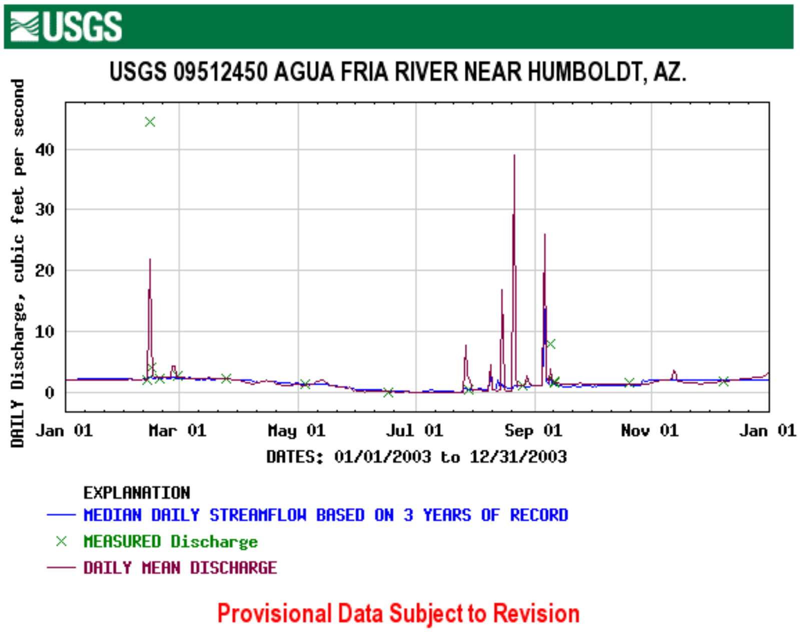
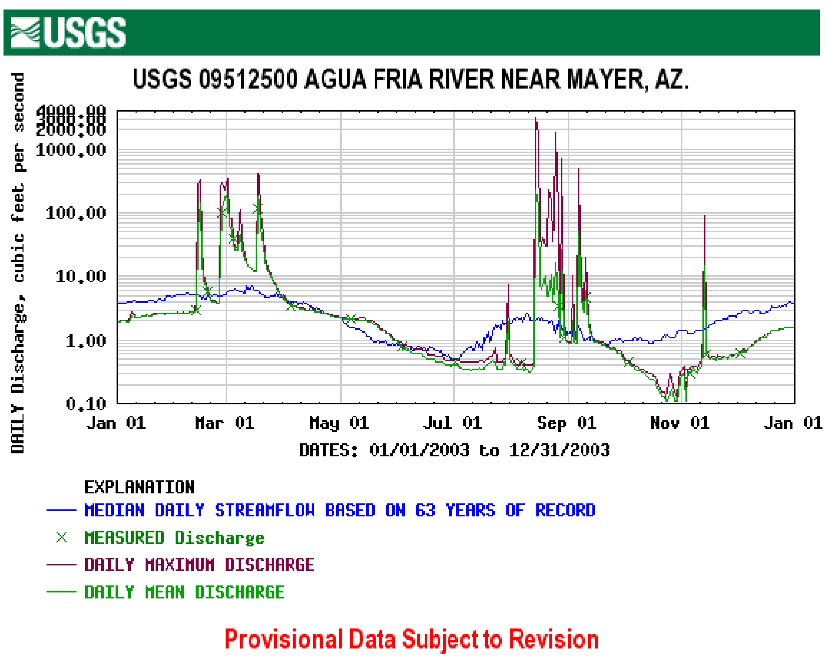
Appendix A Daily discharge hydrographs for selected USGS streamgages





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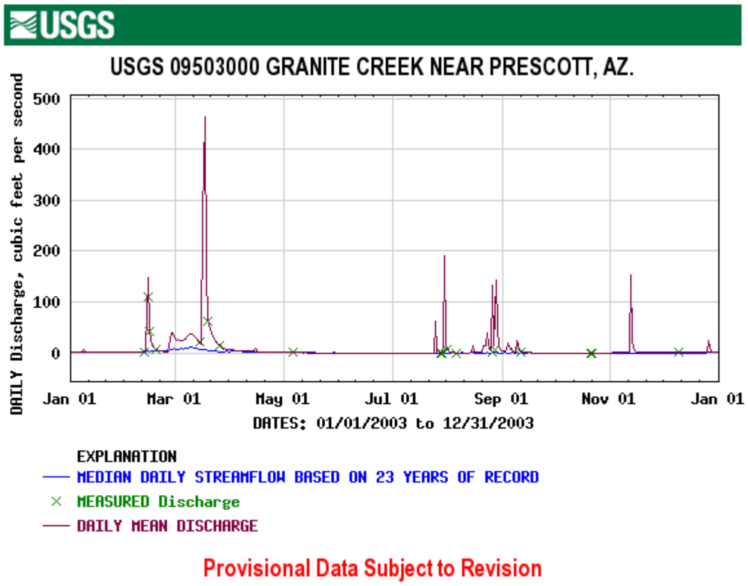
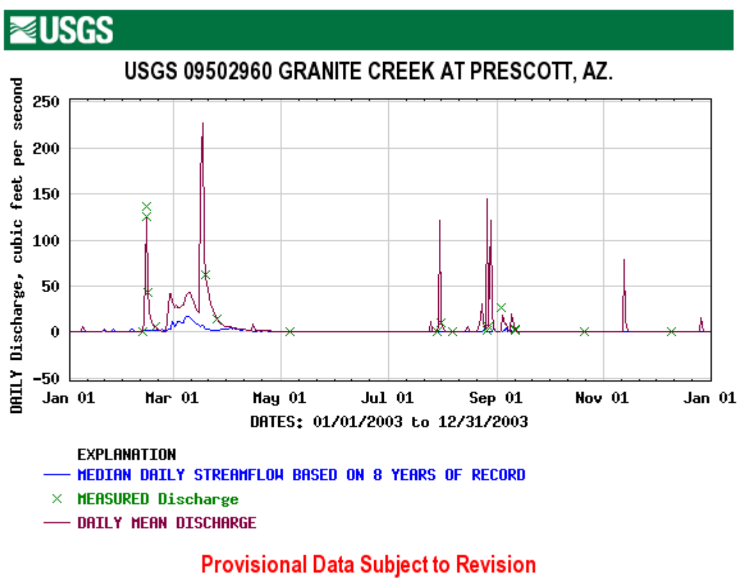
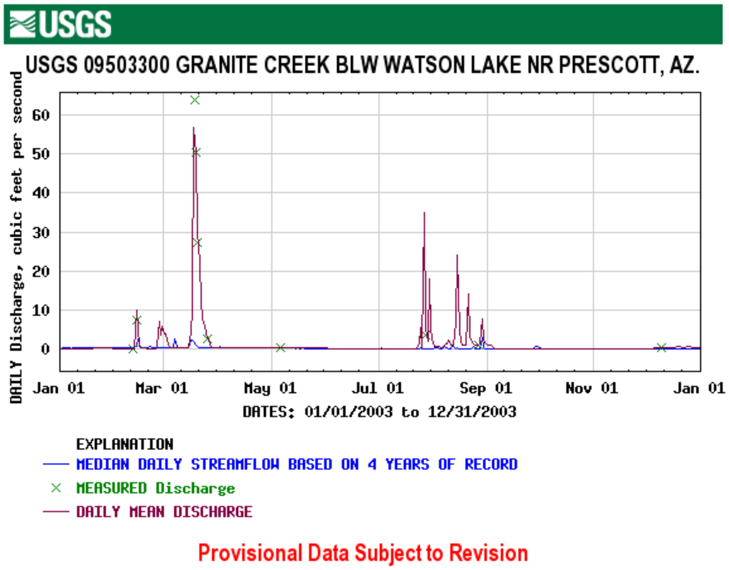
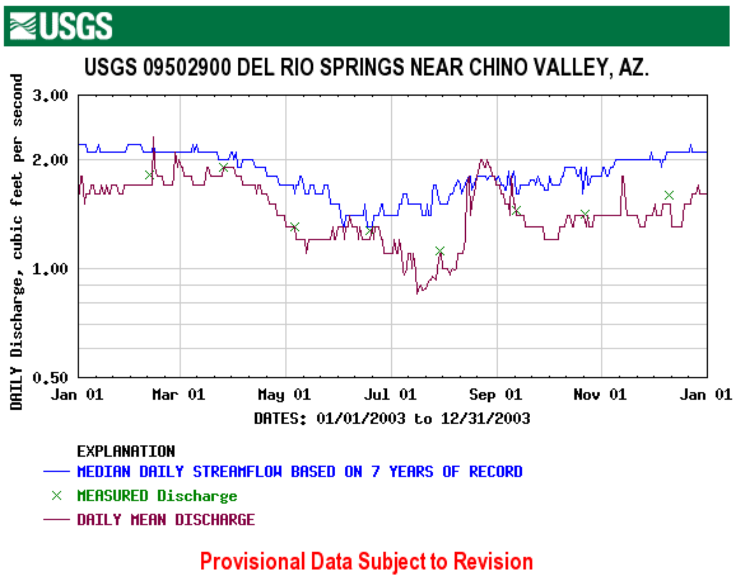




Appendix A Daily discharge hydrographs for selected USGS streamgages





Appendix A Daily discharge hydrographs for selected USGS streamgages