Summary of Water Level Change and Land Subsidence

WATER-LEVEL CHANGE

Depth-to-water (DTW) measurements were taken at 94 wells in the McMullen Valley basin by personnel of the Arizona Department of Water Resources (ADWR) in November/December 1994 and November/December 2004. DTW below land surface ranged from about 24 feet several miles northeast of Salome to about 700 feet southeast of Aguila. DTW increased (water-level decline) in 82 of the wells, remained unchanged (+/- 2 feet) in 4 wells, and decreased (water-level rise) in 8 wells. The water-level changes ranged from a decline of about 150 feet at a well northeast of the town of Salome to a rise of about 10 feet at a well north of the town of Aguila. The average water-level change of all the wells was a decline of about 24 ± 2 feet. Table 1 shows the measured wells for each time period.

The largest water-level declines are generally found in two areas; one area is around the towns of Salome and Wenden, and the other area is around the town of Aguila. Cones of depression in the aquifer of these predominantly agricultural areas have previously been identified (Remick, 1981). The most recent water-level changes observed indicate that these cones of depression have expanded since 1994. Near the towns of Salome and Wenden, water levels in 46 wells declined, and the average decline was about 32 feet. Near the town of Aguila, water levels in 13 wells declined, and the average decline was about 36 feet. Predominantly declining water-level trends in the McMullen Valley basin are believed to be due in part to continued groundwater withdrawals. Well pumpage from 1996 through 2003 was reported at about 179,000 acre-feet within the McMullen Valley basin (Arizona Department of Water Resources, 2006).

An area north of the town of Aguila contains nine of the 10 wells that showed a water-level rise, although the average trend in this area is a decline of about 2 feet. The water-level rises in this area ranged from 0.2 to 10 feet, and water-level declines in this area ranged from about 1 to 18 feet.

The hydrographs for selected wells (labeled A through C) show historical water level declines dating back to 1957. The linear trend is shown for each hydrograph from 1985 to the present; all three hydrographs show significant trends of declining water levels ranging from 1.6 to 2.9 feet per year.

LAND SUBSIDENCE

Past ADWR Water Level Change Map Series (WLCMS) Reports addressed only the groundwater level conditions and how the conditions changed over a specific period of time. Land subsidence information has been incorporated with this WLCMS Report (sheet 2) due to the availability of the land subsidence data as well as the connection between historical groundwater pumping and subsequent groundwater level decline and land subsidence.

Land subsidence caused by compaction of depleted aquifers is common in alluvial basins that are dependent upon groundwater (Galloway and others, 1999). Land subsidence in McMullen Valley basin was measured using Interferometric Synthetic Aperture Radar (InSAR) between 1992 and 1997 and between 2004 and 2009 (No data between 1999 and 2004).

ADWR has been monitoring land subsidence in the State of Arizona using InSAR since 2002. Synthetic aperture radar (SAR) is a side-looking, active (produces its own illumination) radar imaging system that transmits a pulsed microwave signal towards the earth and records both the amplitude and phase of the back-scattered signal that returns to the antenna. SAR that is processed using interferometry is a technique that compares the amplitude and phase signals received during one pass of the SAR platform over a specific geographic area with the amplitude and phase signals received during a second pass of the platform over the same area but at a different time. InSAR techniques, using satellite based SAR platform data, are used to produce land surface deformation products with 0.4 inch (1 centimeter) scale vertical resolution, 164 feet (50 meter) pixel resolution, and covering areas as large as 62 square miles (100 square kilometers).

Land subsidence on each map (sheet 2) is measured in feet of land surface elevation change during the time period indicated in the explanation. Decorrelation (white areas) are areas where the phase of the received satellite signal changed between satellite passes, causing the data to be unusable. This occurs in areas where the land surface has been disturbed (i.e. bodies of water, snow, agriculture areas, areas of development, etc). Grey areas within the subsidence feature are areas where land subsidence did not occur during that period of time.

The land subsidence maps (sheet 2) show that the majority of the McMullen Valley groundwater basin is subsiding. Two of the three land subsidence maps included in this report are the longest time-periods of record for both archived (1992 to 1997) and current (2004 to 2009) InSAR data. The third land subsidence map (2008 to 2009) illustrates the most recent annual land subsidence that is occurring in the McMullen Valley. From June 1992 to March 1997, the land surface subsided as much as 0.95 feet; from February 2004 to January 2009, the land surface subsided as much as another 0.59 feet; and from February 2008 to January 2009, the land surface subsided as much as 0.16 feet.

SELECTED REFERENCES

Arizona Department of Water Resources, 2006, Arizona Water Atlas, volume 7, section 7.5, available at: http://www.azwater.gov/AzDWR/StatewidePlanning/WaterAtlas/default.htm.

Galloway, D.L., Jones, D.R., and Ingebritsen, S.E., eds., 1999, Land subsidence in the United States: U.S. Geological Survey Circular 1182, 177 p.

Remick, W.H., 1981, Maps showing groundwater conditions in the McMullen Valley Area, Maricopa, Yavapai and Yuma Counties, Arizona: Arizona Department of Water Resources Hydrologic Map Series Report Number 6.

Pool, D.R., 1987, Geohydrology of McMullen Valley, west central Arizona: U.S. Geological Survey, Water Resources Investigations Report 87-4041, 51 p.

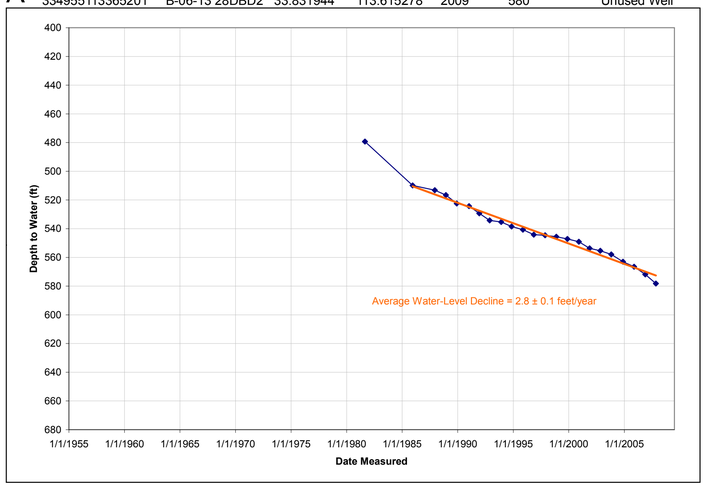
Table 1 - Depth to Water (DTW), Water Level Elevation (WLE), and Water Level Change (in feet) for wells located in McMullen Valley Basin measured in 1994 and 2004

CADASTRAL	WELL ID	HYDROGRAPH	DATE 1994	DTW 1994	WLE 1994	DATE 2004	DTW 2004	WLE 2004	WATER LEVEL CHANGE
B-05-12 05AAD1	334845113312201		11/9/1994	178	1729	11/15/2004	328	1579	-150
B-05-12 06DBC	334805113325001		11/9/1994	382	1469	11/15/2004	412	1439	-30
B-05-12 07ABC	334743113325401		11/9/1994	391	1471	11/15/2004	421	1441	-30
B-05-12 07BBD2	334744113331201		11/9/1994	378	1467	11/15/2004	409	1436	-31
B-05-13 01AAB	334840113333501		11/8/1994	393	1467	11/15/2004	425	1435	-32
B-05-13 01CBA	334816113341701		11/8/1994	390	1468	11/15/2004	426	1432	-36
B-05-13 02BBC	334831113353001		11/7/1994	442	1459	11/16/2004	478	1423	-35
B-05-13 02CDD	334748113350501		11/8/1994	399	1464	11/18/2004	440	1423	-41
B-05-13 02DBB	334818113350001		11/16/1994	24	1850	11/18/2004	28	1845	-5
B-05-13 03CAA	334818113360301		11/16/1994	450	1466	11/17/2004	487	1429	-37
B-05-13 04AAB	334843113364701		11/7/1994	482	1470	11/16/2004	508	1444	-26
B-05-13 04BBA	334843113372101		11/7/1994	502	1476	11/16/2004	527	1451	-25
B-05-13 04CBB2	334820113373802		11/9/1994	474	1493	11/18/2004	501	1466	-27
B-05-13 05AAB	334844113375001		11/9/1994	518	1482	11/18/2004	544	1456	-26
B-05-13 05CBB	334817113383901		11/25/1994	496	1522	11/16/2004	530	1488	-34
B-05-13 08DAA	334724113374001		11/9/1994	442	1481	11/18/2004	477	1445	-36
B-05-13 09BBA	334750113372001		11/7/1994	464	1471	11/17/2004	497	1438	-32
B-05-13 09BBB	334750113373501		11/9/1994	465	1475	11/18/2004	497	1443	-32
B-05-13 09CCD	334702113372201		11/7/1994	430	1472	11/18/2004	465	1437	-35
B-05-13 10CCC	334701113363101		12/22/1994	405	1458	11/18/2004	448	1415	-42
B-05-13 10CDB1	334711113361501		11/8/1994	409	1451	11/18/2004	446	1414	-37
B-05-13 11CBB	334725113352901		11/8/1994	390	1460	11/19/2004	428	1422	-38
B-05-13 12BBB	334750113342501		11/8/1994	380	1462	11/17/2004	413	1429	-34
B-05-13 12DAB1	334729113334201		11/8/1994	358	1471	11/15/2004	372	1458	-13
B-05-13 14ABB	334658113345801		11/8/1994	354	1466	11/17/2004	388	1432	-34
B-05-13 14BBB1	334658113353001		11/8/1994	158	1674	11/17/2004	174	1657	-17
B-05-13 15BAB	334659113361901		11/8/1994	406	1447	11/18/2004	442	1411	-37
B-05-13 15BBB	334656113363401		11/8/1994	414	1444	11/18/2004	453	1406	-39
B-05-13 15CAA1	334631113361001		11/10/1994	342	1492	11/18/2004	372	1463	-29
B-05-13 16DDB	334615113364901		11/9/1994	252	1600	11/18/2004	271	1581	-19
B-05-13 17ABA	334759113381601		11/9/1994	420	1502	11/22/2004	447	1474	-28
B-05-13 17BAA	334758113375401		11/9/1994	430	1503	11/18/2004	459	1474	-29
B-05-13 19BBD2	334557113393201		11/9/1994	348	1607	11/15/2004	370	1585	-22
B-05-13 21ACC	334542113370101		11/9/1994	261	1608	11/18/2004	278	1592	-16
B-05-13 21DCC	334515113370201		11/10/1994	268	1625	11/18/2004	291	1602	-23
B-05-13 23CAD	334534113350401		11/10/1994	138	1657	11/18/2004	154	1641	-17
B-05-13 26BAB	334515113351501		11/10/1994	149	1659	11/18/2004	164	1644	-16
B-05-13 28ACC	334452113370401		11/10/1994	282	1636	11/18/2004	303	1616	-20
B-06-09 02ABD	335349113094601		11/10/1994	550	1700	12/13/2004	569	1681	-19
B-06-11 05ADD	335334113250701		11/16/1994	232	1760	11/18/2004	240	1752	-7
B-06-11 07DBC	335227113263801		11/7/1994	461	1504	12/1/2004	482	1483	-21
B-06-12 13CCD	335122113275501		11/7/1994	465	1495	11/23/2004	488	1472	-23
B-06-12 19ACD2	335056113324001		11/8/1994	447	1487	11/15/2004	478	1457	-30
B-06-12 19DBB	335053113224001		11/8/1994	46	1893	11/16/2004	49	1890	-3
B-06-12 22AAA	335119113291701		11/9/1994	421	1498	12/2/2004	432	1488	-11
B-06-12 22ADD1	335058113291601		11/7/1994	434	1490	11/22/2004	460	1464	-26
B-06-12 22CDA1	335043113294401		11/7/1994	428	1489	12/3/2004	443	1475	-14

CADASTRAL	WELL ID	HYDROGRAPH	DATE 1994	DTW 1994	WLE 1994	DATE 2004 DTW	2004	WLE 2004	WATER LEVEL CHANGE
B-06-12 23ADA	335103113281601		11/7/1994	462	1493	11/22/2004	484	1472	-21
B-06-12 31BBB	334935113332201		11/8/1994	415	1475	11/16/2004	445	1444	-31
B-06-12 31CBB2	334910113332901		11/8/1994	400	1473	11/16/2004	432	1442	-31
B-06-13 25BBB	335029113342801		11/9/1994	484	1473	11/16/2004	534	1423	-50
B-06-13 28DBD2	**334955113365201**	**A**	**11/7/1994**	**539**	**1471**	**11/18/2004**	**563**	**1446**	**-25**
B-06-13 34CDD	334845113360701		11/7/1994	463	1465	11/11/2004	543	1386	-80
B-06-13 35BBB	334935113352001		11/7/1994	485	1465	11/16/2004	513	1437	-28
B-07-07 13DDA2	335646113555201		11/7/1994	585	1990	11/15/2004	583	1992	2
B-07-07 17DCC	335637113002801		11/7/1994	486	1923	12/14/2004	489	1920	-3
B-07-08 01DAA	335844113021501		11/7/1994	428	1877	12/14/2004	453	1853	-25
B-07-08 15BAA	335727113045101		11/7/1994	603	1654	12/13/2004	619	1638	-16
B-07-08 16AAA	335727113052201		11/7/1994	629	1620	12/13/2004	648	1602	-19
B-07-08 18DAD	335548113072601		11/10/1994	631	1581	12/13/2004	663	1549	-32
B-07-08 20CAA	335606113065501		11/8/1994	625	1604	12/13/2004	659	1570	-34
B-07-08 20DDD	**335545113062501**	**B**	**11/8/1994**	**630**	**1594**	**12/13/2004**	**661**	**1563**	**-31**
B-07-08 29DDD	335451113062401		11/7/1994	641	1585	12/21/2004	679	1547	-38
B-07-08 32DDD	335358113062601		11/8/1994	640	1588	12/13/2004	682	1545	-42
B-07-08 33BDD	335427113055701		11/8/1994	655	1584	12/13/2004	700	1539	-45
B-07-09 04BBD	335906113122901		11/9/1994	500	1638	11/18/2004	493	1645	7
B-07-09 04CBB	335840113123201		11/8/1994	495	1635	12/21/2004	498	1632	-3
B-07-09 08CCB	335738113133901		11/8/1994	482	1635	11/18/2004	477	1641	6
B-07-09 08DAD2	335742113124201		11/8/1994	512	1613	12/13/2004	522	1603	-10
B-07-09 10DAA	335750113104001		11/8/1994	571	1595	11/17/2004	561	1605	10
B-07-09 11ABB	335818113095801		11/25/1994	610	1576	11/17/2004	610	1576	0
B-07-09 12AAA	335818113083201		11/25/1994	642	1575	12/21/2004	649	1568	-7
B-07-09 12ACB	335800113085701		11/25/1994	632	1570	11/17/2004	646	1556	-14
B-07-09 12ADD	335754113083301		11/8/1994	634	1580	11/17/2004	630	1584	4
B-07-09 14AAB	335726113094501		11/25/1994	591	1587	11/17/2004	660	1517	-70
B-07-09 15CDD	335635113110601		11/9/1994	553	1600	11/18/2004	566	1587	-14
B-07-09 17DCD	335637113125301		11/9/1994	525	1616	11/18/2004	615	1526	-90
B-07-09 22DCC	335543113110001		11/9/1994	577	1604	12/13/2004	598	1582	-21
B-07-09 27ACA	335526113105301		11/10/1994	587	1599	11/18/2004	602	1584	-16
B-07-09 33ABB	335449113120601		11/9/1994	622	1613	11/18/2004	635	1600	-13
B-07-10 13BDA	335711113151901		11/9/1994	453	1652	11/16/2004	457	1648	-4
B-07-10 19AAA	335633113195701		11/9/1994	354	1700	12/14/2004	358	1696	-4
B-07-10 19DDD	335545113195701		11/10/1994	352	1706	11/16/2004	359	1699	-7
B-07-10 20ADA	335615113185901		11/9/1994	351	1709	11/16/2004	355	1705	-5
B-07-10 21ABD	335622113181901		11/9/1994	395	1671	11/16/2004	404	1662	-9
B-08-07 33BAD	335952112592801		11/7/1994	412	1961	12/13/2004	412	1961	0
B-08-09 26CCD	340005113101801		11/7/1994	537	1655	11/18/2004	555	1636	-18
B-08-09 28DCC2	340010113115901		11/8/1994	518	1646	11/18/2004	531	1634	-13
B-08-09 32AAA	340003113124201		11/8/1994	509	1654	11/18/2004	502	1661	7
B-08-09 32BAA	340003113131301		11/8/1994	509	1657	11/18/2004	505	1661	4
B-08-09 33AAB	340003113114801		11/8/1994	500	1661	11/18/2004	498	1663	3
B-08-10 12BCD	340242113153601		11/8/1994	187	2300	11/19/2004	217	2270	-31
B-08-10 35BBB	340003113164701		11/8/1994	539	1670	11/19/2004	536	1673	3
B-08-10 36BBB	**340003113154501**	**C**	**11/8/1994**	**529**	**1669**	**11/19/2004**	**530**	**1668**	**-1**

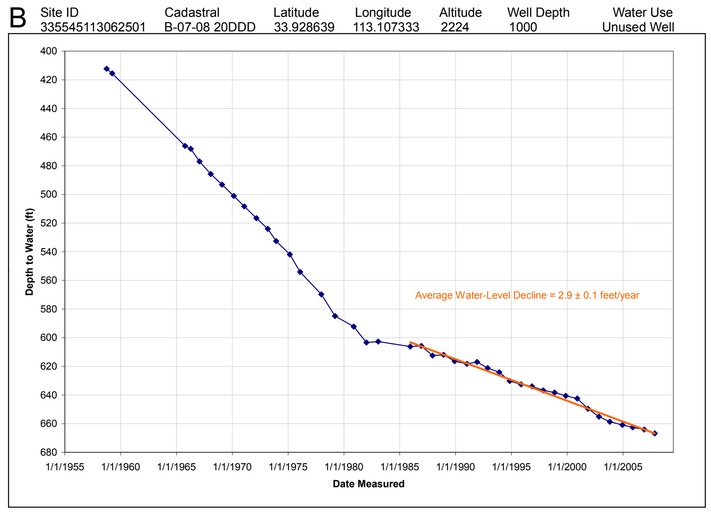
A

Site ID	Cadastral	Latitude	Longitude	Altitude	Well Depth	Water Use
334955113365201	B-06-13 28DBD2	33.831944	113.615278	2009	580	Unused Well



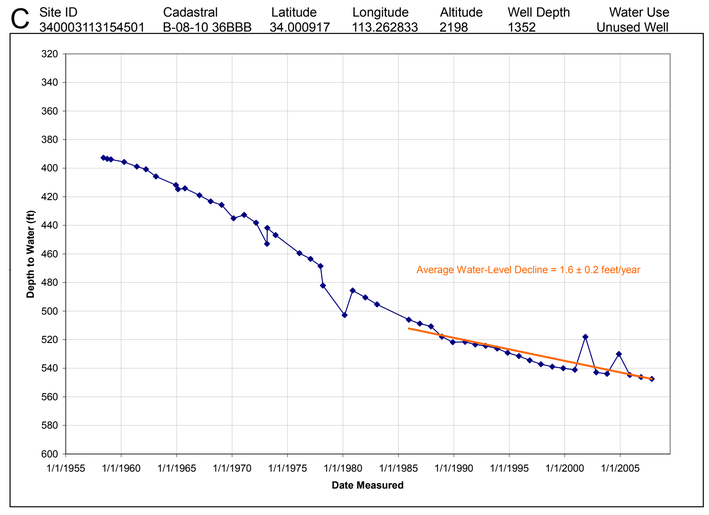
B

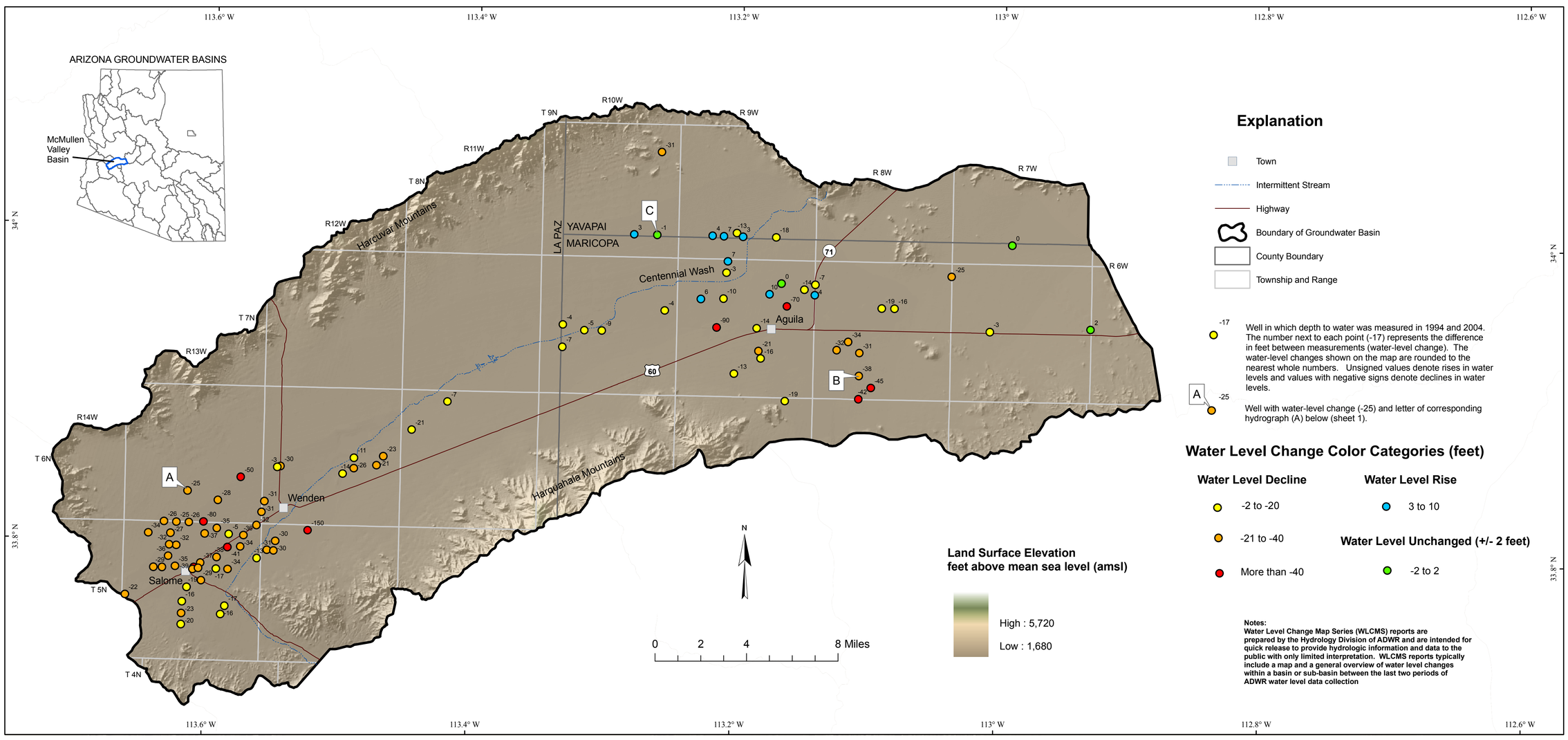
Site ID	Cadastral	Latitude	Longitude	Altitude	Well Depth	Water Use
335545113062501	B-07-08 20DDD	33.928639	113.107333	2224	1000	Unused Well



C

Site ID	Cadastral	Latitude	Longitude	Altitude	Well Depth	Water Use
340003113154501	B-08-10 36BBB	34.000917	113.262833	2198	1352	Unused Well





Notes:
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NORTH AMERICAN DATUM 1983 HARN

ARIZONA DEPARTMENT OF WATER RESOURCES

HYDROLOGY DIVISION

WATER-LEVEL CHANGE 1994 - 2004

WATER-LEVEL CONDITIONS FROM 1994 TO 2004 AND LAND SUBSIDENCE FROM 1992 TO 2009 IN McMULLEN VALLEY BASIN, ARIZONA

By
David Schmerge, Brian Conway, and Stephen Flora

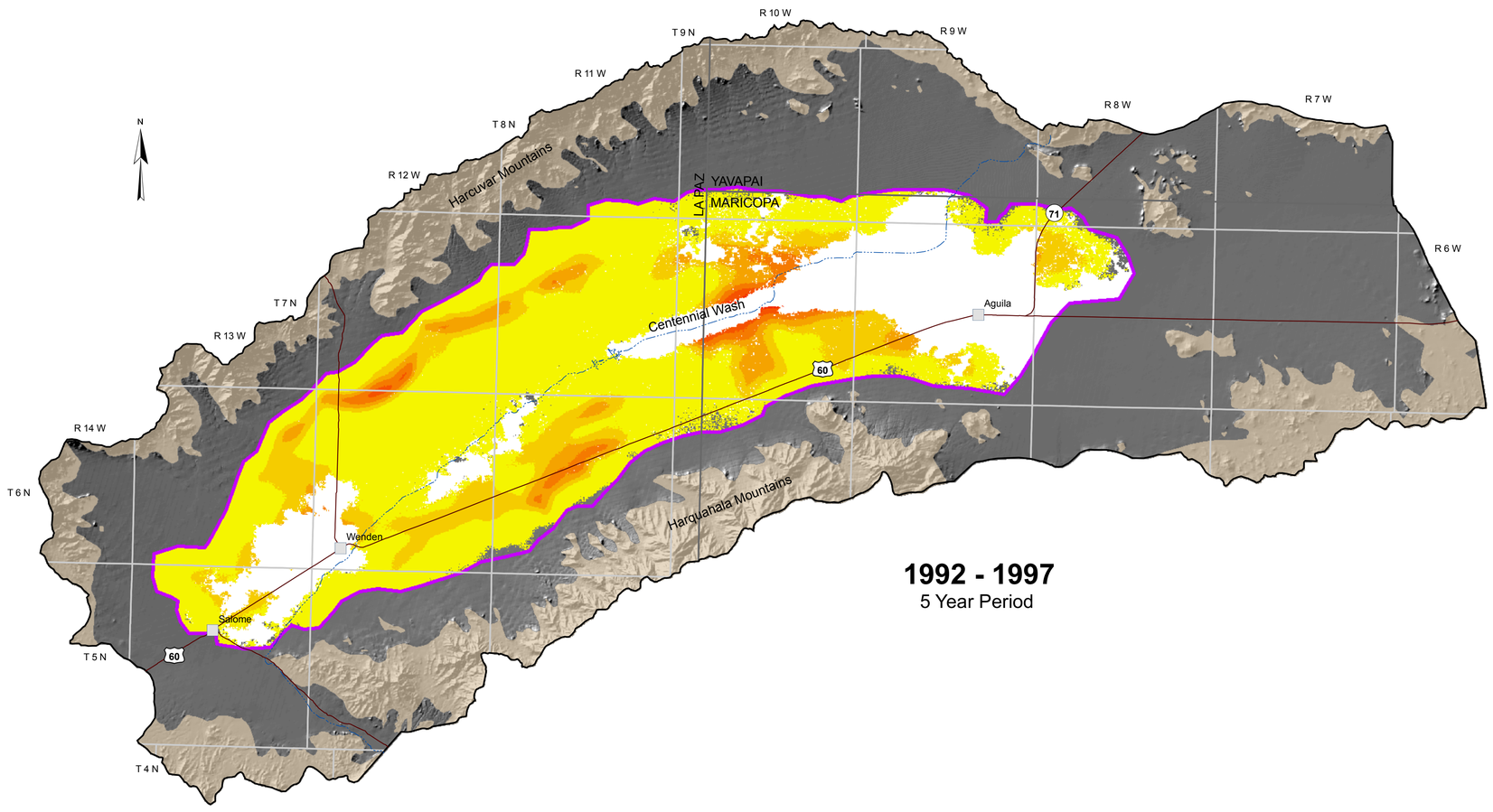
December 2009

For data go to:
https://gisweb.azwater.gov/waterresourcedata/

For more information or copies contact:
ADWR Information Services
3550 North Central Avenue
Phoenix, AZ 85012
(602) 771-8627
www.azwater.gov

REGISTERED GEOLOGIST CERTIFICATE NO. 34505 PEARCE DAVIS Date Signed 12/14/09 ARIZONA U.S.A.

Expires 3/31/2012



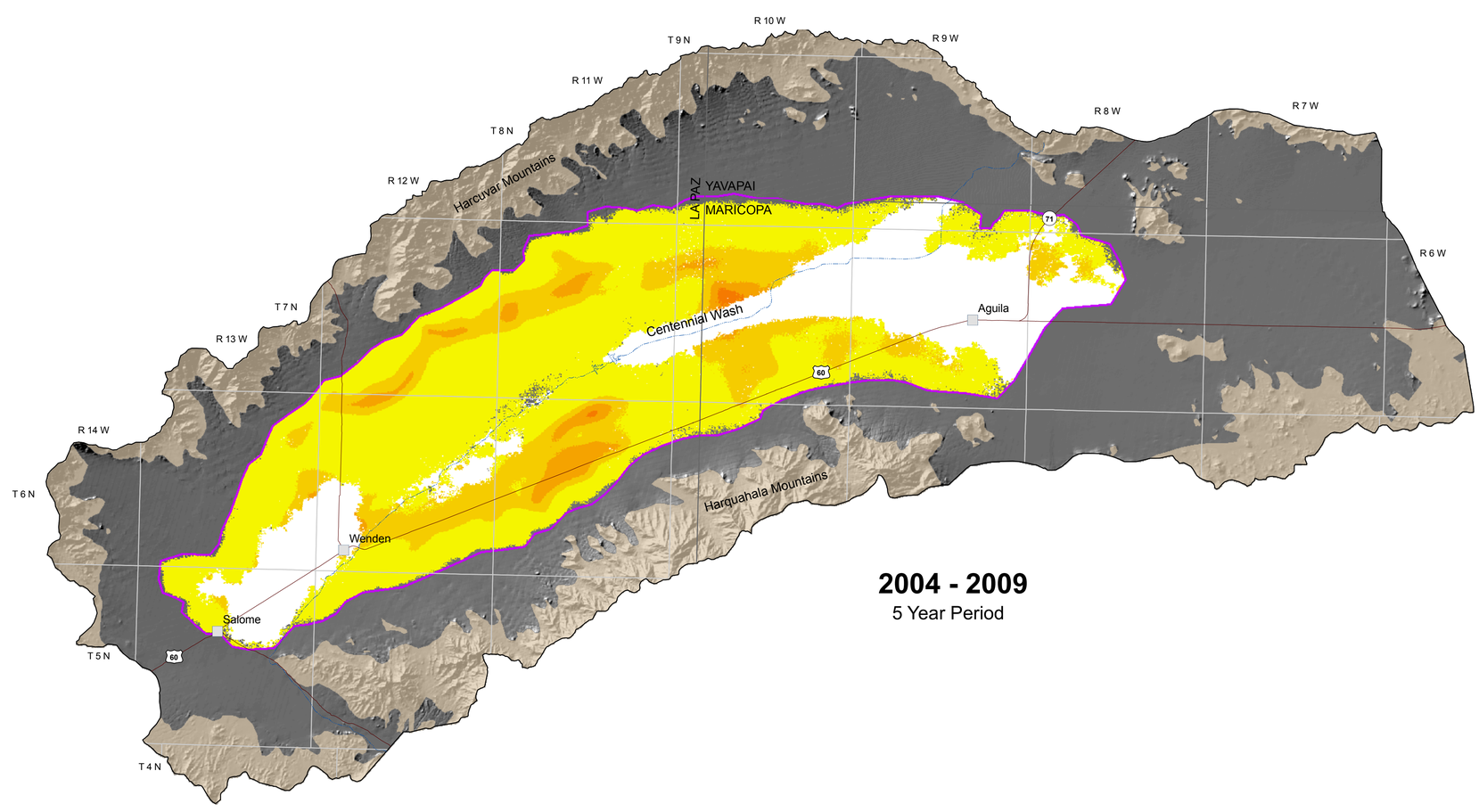
Explanation

- Town
- Intermittent Stream
- Highway
- Boundary of Groundwater Basin
- County Boundary
- Township and Range
- Hardrock
- Subsidence Feature

Land Subsidence (Feet)

06/08/1992 To 03/13/1997

- Decorrelation/No Data
- 0.82 To 0.95 Feet
- 0.66 To 0.82 Feet
- 0.49 To 0.66 Feet
- 0.33 To 0.49 Feet
- 0.16 To 0.33 Feet
- 0 To 0.16 Feet



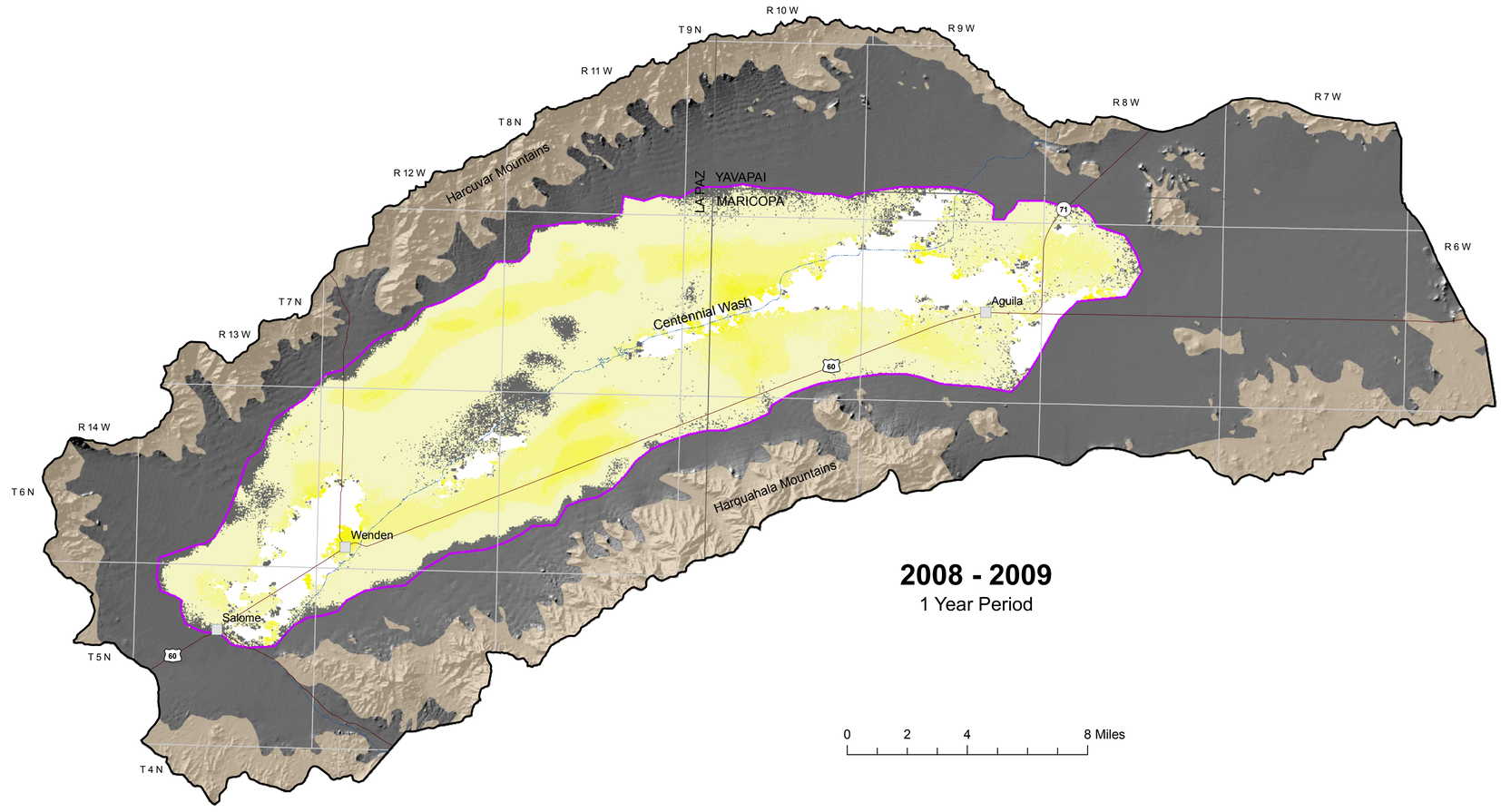
Explanation

- Town
- Intermittent Stream
- Highway
- Boundary of Groundwater Basin
- County Boundary
- Township and Range
- Hardrock
- Subsidence Feature

Land Subsidence (Feet)

02/05/2004 To 01/29/2009

- Decorrelation/No Data
- 0.82 to 0.95 Feet
- 0.66 to 0.82 Feet
- 0.49 to 0.66 Feet
- 0.33 to 0.49 Feet
- 0.16 to 0.33 Feet
- 0 to 0.16 Feet



Explanation

- Town
- Intermittent Stream
- Highway
- Boundary of Groundwater Basin
- County Boundary
- Township and Range
- Hardrock
- Subsidence Feature

Land Subsidence (Feet)

02/14/2008 To 01/29/2009

- Decorrelation/No Data
- 0.13 To 0.16 Feet
- 0.10 To 0.13 Feet
- 0.07 To 0.10 Feet
- 0.03 To 0.07 Feet
- 0 To 0.03 Feet

Notes:
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Land subsidence information has been incorporated with this WLCMS Report due to the availability of the land subsidence data as well as the connection between historical groundwater pumping and subsequent groundwater level decline and land subsidence. See sheet 1 for a summary on land subsidence data.

NORTH AMERICAN DATUM 1983 HARN

ARIZONA DEPARTMENT OF WATER RESOURCES

HYDROLOGY DIVISION

LAND SUBSIDENCE 1992 - 2009

WATER-LEVEL CONDITIONS FROM 1994 TO 2004 AND LAND SUBSIDENCE FROM 1992 TO 2009 IN McMULLEN VALLEY BASIN, ARIZONA

By
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