LAS CIENEGAS NATIONAL CONSERVATION AREA

WATER USE STUDY

Phase IA – ADWR Well Database Inventory

J. Haney
The Nature Conservancy

January 2005

EXECUTIVE SUMMARY

The Las Cienegas National Conservation Area (NCA) is located downstream from the town of Sonoita, Arizona. Sonoita is located in the headwaters of three watersheds – Cienega Creek, Sonoita Creek, and Babocomari River. Watershed divides do not necessarily correspond to groundwater divides. Sonoita is experiencing rapid population growth with households typically residing on 4+ acre "ranchettes". Groundwater pumping in the part of Sonoita that overlies the Cienega Creek groundwater basin upgradient from the Las Cienegas NCA will result in decreased groundwater discharge to wetlands in the NCA.

Data from two Arizona Department of Water Resources (ADWR) well databases were accessed to address the following questions for the study area: 1) how many wells exist and what are their water uses; 2) what is the groundwater level trend; and 3) are there sufficient water level data available to define the locations of the groundwater divides?

There are more than 1,250 wells in the nine township study area. Water uses are chiefly domestic and stock watering. Based on a population estimate of 900 people living in the Cienega Creek basin upstream from the NCA and a per capita daily water use of 280 gallons, total water use from wells in the study area is estimated to be about 282 acre-feet per year. Population growth will result in increased groundwater use. Long-term water level data indicate that water levels are fairly steady, with water level rise in some areas and water level decline in other areas; there is no obvious pattern of water level change. There are insufficient recent water level measurements in the study area to delineate the locations of the groundwater divides.

The following actions are recommended in order to obtain sufficient hydrologic data and understanding to provide for the long-term protection of the wetland resources at Las Cienegas NCA:

- Conduct a water level measurement sweep of wells in the Sonoita area.
- Evaluate available data on groundwater, surface water, and channel geomorphic conditions at the Las Cienegas NCA.
- Develop a conceptual hydrogeologic model and a water budget for the upper Cienega Creek basin utilizing existing data and published and unpublished reports.

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LAS CIENEGAS NCA WATER USE STUDY
HEADWATERS AREA-SONOITA REGION
Phase IA – ADWR Well Database Inventory

J. Haney

January 2005

Las Cienegas National Conservation Area (NCA) is located in the upper Cienega Creek basin north from the town of Sonoita. Three watersheds have their origins in the vicinity of Sonoita: Cienega Creek, Babocomari River, and Sonoita Creek. Watershed divides do not necessarily correspond to groundwater divides. The location of the groundwater divides between the three watersheds is not well documented. Based on information from ADWR and USGS, I chose to use the 10-digit HUCs as the approximate groundwater basin delineation. HUC boundaries in the vicinity of Sonoita are shown on **Figure 1**.

The actual location of the groundwater divide is critical, because pumping in the Cienega Creek groundwater basin up-hydraulic gradient from the springs and wetlands at Las Cienegas NCA will reduce discharge at those springs and wetlands in an amount equal to the volume of pumping. Population in the upper Cienega Creek basin is about 2,600, with household living chiefly on 4+ acre "ranchettes". Population growth is occurring in the Sonoita area and increased groundwater pumping for domestic supply is expected, via private domestic water wells and municipal/water company wells. Thus, it is critical to understand current and projected water use in the Sonoita area as well as groundwater-surface water relationships in the Cienega Creek basin, including the actual location of the groundwater divides between the three watersheds in the Sonoita vicinity.

For this study, well data were accessed from two Arizona Department of Water Resources (ADWR) well databases – the Wells-55 Registry and the Groundwater Site Inventory (GWSI). The two ADWR well databases were utilized to determine: 1) how many wells are registered in the study area and what are their uses; 2) what is the long-term groundwater level trend in the area; and 3) are there sufficient recent water level data in the Sonoita area to define the locations of the groundwater divides between the three watersheds?

A nine township study area was selected in the vicinity of Sonoita. There are 1,247 wells in the Wells-55 registry and 283 wells in the GWSI database in the study area; study area and locations for these wells are shown on **Figures 1 and 2**. Water use for the wells in the Wells-55 registry is shown in **Table 1**.

Table 1. ADWR-55 Registry Wells

Water Use	# of wells
Domestic	932
Stock	235
Irrigation	45
Industrial/Comm	5
Mining	3
Municipal	6
Other	21

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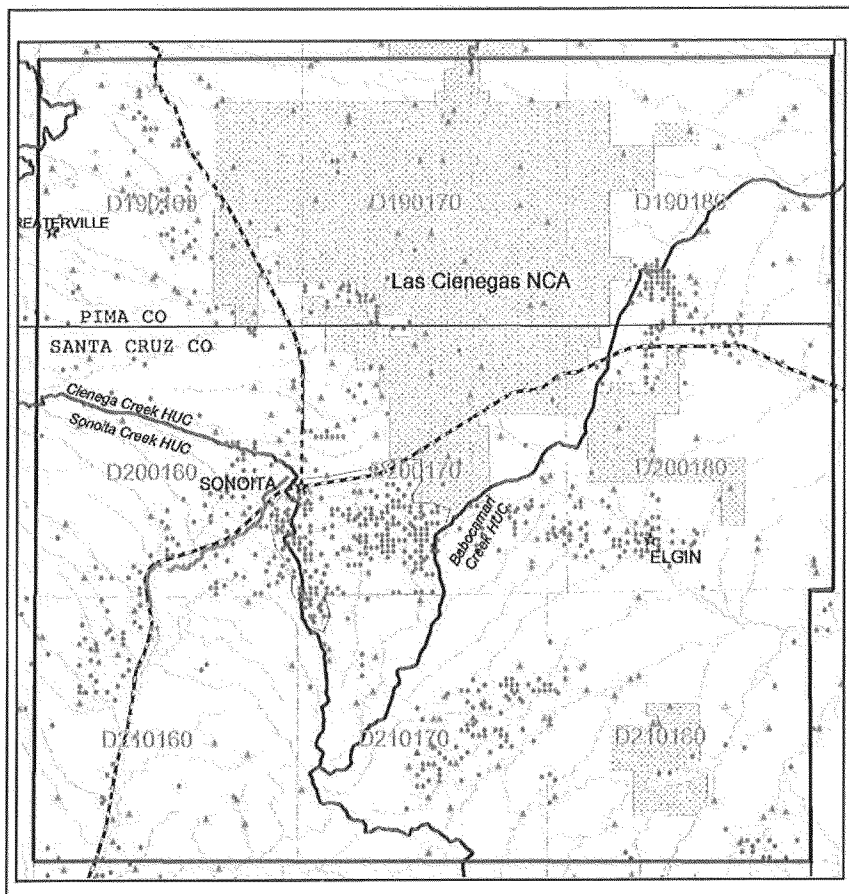
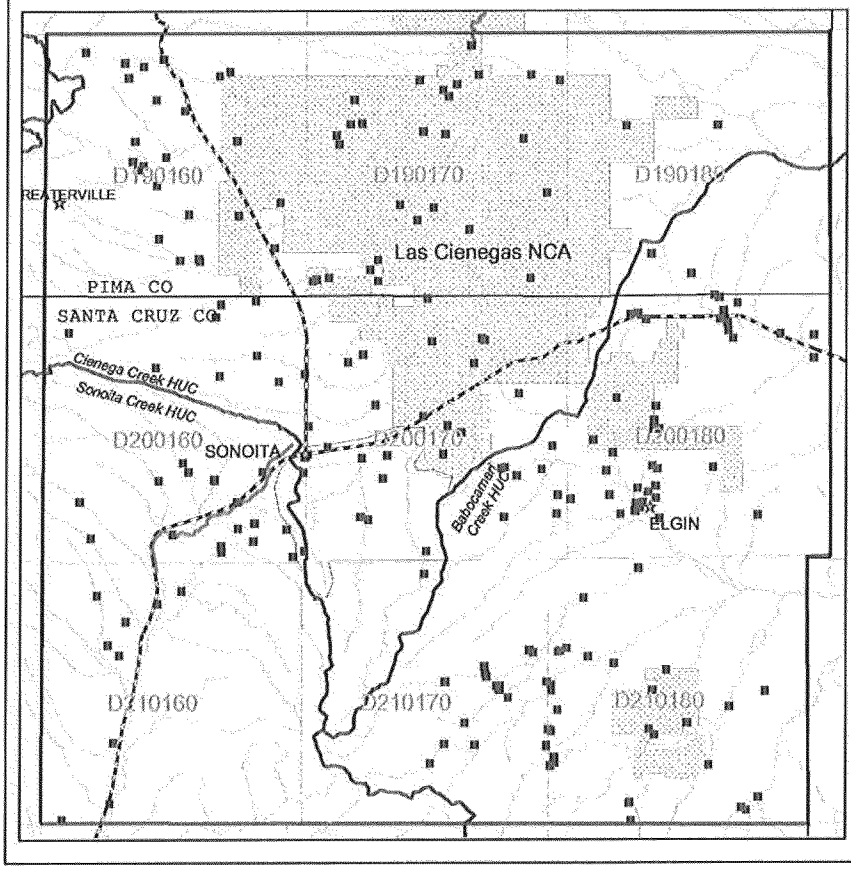


Map Explanation:
- Study Area
- 10-digit HUC

ADWR 55 Well Water Use
- DOMESTIC/MUNICIPAL
- IRRIGATION
- STOCK
- COMM/INDUSTRIAL
- MINING
- OTHER

Figure 1. ADWR 55-Registray Wells
Las Cienegas NCA Headwaters Region



Map Explanation:
- GWSI Wells
- Study Area
- 10-digit HUC

Figure 2. GWSI Wells
Las Cienegas NCA Headwaters Region

The Wells-55 Registry contains well information submitted by well owners; accuracy of this information has not been confirmed. The GWSI well database consists of wells that ADWR staff have visited and confirmed their location, construction details, and water levels. Some of these wells are visited annually by ADWR staff for the purpose of measuring water levels – these wells are called Index Wells. Accuracy of the GWSI database is better than the Wells-55 Registry, but contains fewer wells. The two databases commonly overlap, so there is redundancy.

In the GWSI database, 29 wells in the study area have recent water level data, obtained between January 2000 and June 2004, and 16 wells have long-term water level data (GWSI Index Wells). Water level data and well locations are given in **Appendix A.** The majority of the wells with recent water level data are located near Elgin in the Babocomari watershed. There are four wells with recent water level data located in the Cienega Creek watershed. Two of these wells also have long-term water level data. There are insufficient recent water level measurements in the GWSI database to define the location of the groundwater divides between the three basins. Five of the index wells have water level data spanning the decades from 1950 to 2003; hydrographs for these wells are provided in **Appendix B**. Long-term water level data indicate that water levels are fairly steady, with water level rise on the order of 4 feet in some areas and water level decline on the order of 5 feet in other areas. There is no obvious pattern to water level change based on the limited available data.

There is a high density of domestic water wells in the area to the south and east from Sonoita. About 323 wells occur in a 10 square mile area in this region, which works out to about 1 well per 20 acres, although the actual densities vary. The NSF Science and Technology Center for Sustainability of semi-Arid Hydrology and Riparian Areas (SAHRA) at the University of Arizona has studied domestic water demand associated with "ranchettes" in the Sonoita/Elgin area (email from Gary Woodard to Jeanmarie Haney, dated December 15, 2004). They define a ranchette as one house on 4 or more acres with an unmetered private well and a septic tank. Ranchettes are the dominant household type in the Sonoita area. They have found that the median or typical water usage for ranchettes is approximately 280 gallons per capita per day (gpcd), which is roughly double that of households on large lots served by water providers. The mean or average water usage for ranchettes is over 400 gpcd, reflecting a wide range in water demand. Some ranchettes use several acre-feet per year. The great majority of this water is used outdoors, which is a consumptive use. There does not appear to be a correlation between lot size and water use. Anecdotal evidence indicates a trend toward smaller lot size, thus, even if per capita demand remains constant or declines modestly, water demand per acre may increase over time.

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About 2,600 people live in the Cienega Creek basin; about 900 of those live upstream from the Las Cienegas NCA (ESRI 2000 Population Dot Data). If mean water usage is 280 gpcd, then domestic water use is about 282 acre-feet per year (AF/yr) in the area upstream from wetland resources at Las Cienegas NCA. A water budget should be developed for the basin to illustrate inflows and outflows to the aquifer. Although the situation does not appear to be critical at this time with respect to water balance, not enough is know regarding groundwater flow paths and groundwater-surface water relationships to adequately document the threat that continued growth in the Sonoita area poses to the wetland resources at the Las Cienegas NCA.

ON-SITE WELLS

The U.S. BLM maintains a database of hydrologic features, including wells, windmills, springs, and seeps, located on the Las Cienegas NCA. These features are summarized in Table 2 and shown on **Figure 3.** The wells, windmills, seeps, and springs have hydrologic significance. It is my understanding that USBLM has been monitoring water levels in wells for some years; however, I have not yet had access to those data.

Table 2. Hydrologic Features from USBLM Database

FEATURE	COUNT
Reservoir	56
Well	52
Trough	21
Windmill	16
Water tank	8
Seep	2
Spring	2
Barn	1
Gaging sta	1

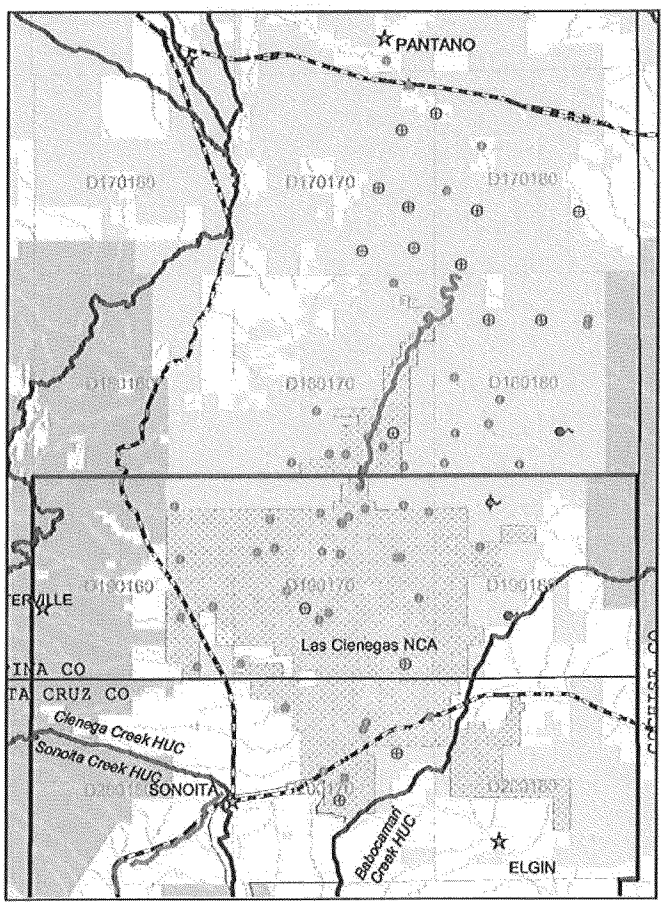

Figure 3. US BLM Hydrologic Features Las Cienegas NCA

RECOMMENDATIONS

The wetland resources at Las Cienegas NCA are a valuable component of the NCA. Appropriate management of these resources must consider up-gradient, off-site water uses as well as on-site water uses and watershed condition. Because the Sonoita area is up-gradient from the NCA and is experiencing rapid growth and associated increased water use, it is imperative to understand the hydrogeologic conditions in the upper Cienega Creek basin, such as groundwater-surface water interactions and location of groundwater divides, as well as the current and projected water use in the Sonoita area. The following recommendations will provide a good start on this understanding:

1. Conduct a water level measurement sweep of wells in the Sonoita area.

Water levels should be measured from a significant number of non-pumping wells distributed evenly throughout the Sonoita-Elgin area. All wells should be measured in a short time period (less than one week). Land surface elevations at the well heads should be measured with an accuracy of 0.2 feet. There data will allow development of a water altitude contour map, which would delineate the groundwater divides for the area. Bill Brannon at the National Audubon Society Research Ranch in Elgin has summer interns that may be available to conduct this work, if funding and technical supervision is provided.

2. Evaluate available data on groundwater, surface water, and channel geomorphic conditions at the Las Cienegas NCA.

The BLM has been measuring water levels in wells, stream flow, water usage (I'm assuming that the wells are metered), and channel geomorphic conditions at the NCA for a number of years. These data should be thoroughly reviewed and integrated into development of a conceptual hydrogeologic model and water budget.

3. Develop a conceptual hydrogeologic model and a water budget for the upper Cienega Creek basin utilizing existing data and published and unpublished reports.

Additional sources of information for the area are listed at the end of this report. These reports should be acquired and reviewed. A conceptual model of hydrogeologic conditions should be developed to assist in appropriate management of the area's wetland resources. A current and projected water budget should be developed.

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ADDITIONAL SOURCES OF INFORMATION FOR PHASE II STUDY

U.S. BLM files – water level sin wells, water use, streamflow, and channel morphology data for wells at Las Cienegas NCA.

Geologic maps for the area.

Liciniu Bota. *Modeling of Groundwater Flow and Surface/Groundwater Interaction for Upper Cienega Creek Basin*. MS Thesis, Department of Hydrology and Water Resources, University of Arizona. 1997.

Erik Lloyd Knight. *A Water Budget and Land Management Recommendations for Upper Cienega Creek Basin*. MS Thesis, Department of Hydrology and Water Resources, University of Arizona. 1996.

Robert Naeser and Anne St. John. *Water Use and the Future of the Sonoita Valley*. Appleton-Whittell Research Ranch, National Audobon Society. 1996.

Eric Mitchell Roudebush. *The Influence of Bedrock on Perennial Streamflow in the Upper Cienega Creek Basin, Pima County, Arizona*. MS Thesis, Department of Hydrology and Water Resources, University of Arizona. 1996.

Hans Jarlath Huth. *Hydrogeochemical Modeling of Western Mountain Front Recharge, Upper Cienega Creek Sub-Basin, Pima County, Arizona*v. MS Thesis, Department of Hydrology and Water Resources, University of Arizona. 1996.

John Mark Boggs. *Impact of Future Ground-Water Development in Cienega Creek Area, Pima, Santa Cruz, and Cochise Counties, Arizona*. MS Thesis, Department of Hydrology and Water Resources, University of Arizona. 1980.

Carl Nuzman. *Water Supply and Utilization, Empire-Sonoita Planning Area, Pima-Santa Cruz Counties, Arizona*. Layne-Western Company, Inc. July 1970.

Peter N. Schwartzman. *A Hydrogeologic Resource Assessment of the Lower Babocomari Watershed, Arizona*. MS Thesis, Department of Hydrology and Water Resources, University of Arizona. 1990.

Gayle Elizabeth Bradbeer. *Hydrogeologic Evaluation of the Sonoita Creek Aquifer*. MS Thesis, Department of Hydrology and Water Resources, University of Arizona. 1978.

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APPENDIX A

WELLS WITH RECENT WATER LEVELS

AND

INDEX WELLS

LAS CIENEGAS NCA HEADWATER AREA
SONOITA REGION

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Table A1. Wells with Recent Water Level Measurements

	Depth to Water (feet)				
Local ID	2000	2001	2002	2003	2004
D-19-16 15ABA	202.5	202.47	203.1	202.6	
D-19-17 17BBD	-21.29				-28.5
D-19-18 33DAB		133.9			
D-20-16 24DAD2		205.6	205.5	206.5	
D-20-17 02CCC		40.5			
D-20-17 10DAB		35.5			
D-20-17 24CDD	152.3	151.4	158.19	152	
D-20-17 25CCD		216.5			
D-20-17 35ABB	187.4	186.7	180.69		
D-20-18 02DDD		133.6			
D-20-18 03ACC		153.5			
D-20-18 03CAA	134.6	134.4	135	136	
D-20-18 03DBD					
D-20-18 05ACD		14.2			
D-20-18 05BDD		27.2			
D-20-18 05DAB		34.1			
D-20-18 12ACD		107.4			
D-20-18 17BCB	239.1	171.1	171.1	171	
D-20-18 17DDA		108.4			
D-20-18 20AAA		63.5			
D-20-18 28BCB		27.4			
D-20-18 28CBB		13.4			
D-20-18 29ADC					
D-20-18 29CCD		51.1			
D-20-18 29DBC		18.5			
D-20-18 29DCA		21			
D-20-18 29DCB		45.8			
D-20-18 32AAB		20.3			
D-20-18 33BBB	19	20.76	20.81	20.97	
D-21-16 09ABA	34.4	45.71	47.38	47.54	
D-21-17 13BCB		48.6			
D-21-17 14CAA	10.94	16.655	18.61	16.29	
D-21-17 14DBB		25.6			
D-21-17 14DBC		16.4			
D-21-17 14DDC1		52.2			
D-21-17 14DDC2		45.8			
D-21-17 14DDD1		45.6			
D-21-17 14DDD2		33.4			
D-21-17 24AAB	12.5	16.405	17.14	18.79	
D-21-17 26BAC		73.9			
D-21-17 27ABC		44.6			
D-21-17 27DBA		132.2			
D-21-17 27DBD		159.7			
D-21-18 04BBC		23.7			
D-21-18 06DDA		49.1			
D-21-18 16CDD		224.8			
D-21-18 16DAB		80.8			
D-21-18 17ACC		54.3			
D-21-18 18AAD		71.4			
D-21-18 18BAA		143.7			
D-21-18 18BAB		151.9			
D-21-18 18CCB1		17.05			
D-21-18 18CCB2		34.92			
D-21-18 19BCD		63.1			
D-21-18 19BDC		41.5			
D-21-18 19CCB		60.9			
D-21-18 22CAC1		34.5			
D-21-18 22CAC2		36.4			
D-21-18 24BBB		124.7667	124.2	124.5	
D-21-18 27DBD		47.9			
D-21-18 28ABB		98.2			
D-21-18 30BCD		32.3			
D-21-18 30CAC		7			
D-21-18 30CBA		32.1			
D-21-18 30CBC		108.4			
D-21-18 32DAA1		13.22			
D-21-18 33DDC1		33.1			
D-21-18 35ADC		33.3			
D-21-18 35CAD		36.9			
D-21-18 35DBD		14.5			

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TABLE A2. INDEX WELLS AT LAS CIENEGAS HEADWATERS

Well ID	Owner	Well Depth (feet)
D-19-16 15ABA	Uknown	300
D-19-17 17BBD	BLM Safford District	845
D-20-16 12DDA	Vera Earl Ranch	150
D-20-16 24DAD1	Uknown	---
D-20-16 24DAD2	Fair and Rodeo Association	341
D-20-17 24CDD	Sam Frazier	230
D-20-17 35ABB	G. Maloney	---
D-20-18 03CAA	J. Schock	200
D-20-18 17BCB	BLM	248
D-20-18 33BBB	Chuck Stockton	---
D-21-16 09ABA	Rail Cattle Company	276
D-21-16 32DAB	First Patagonia	---
D-21-17 14CAA	Uknown	---
D-21-17 24AAB	Uknown	---
D-21-18 18AAD	J.Jelks Jr/N.L.Houston	98
D-21-18 24BBB	Ruken Jelks	---

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APPENDIX B

WATER LEVEL HYDROGRAPHS FOR INDEX WELLS

LAS CIENEGAS HEADWATERS – SONOITA REGION

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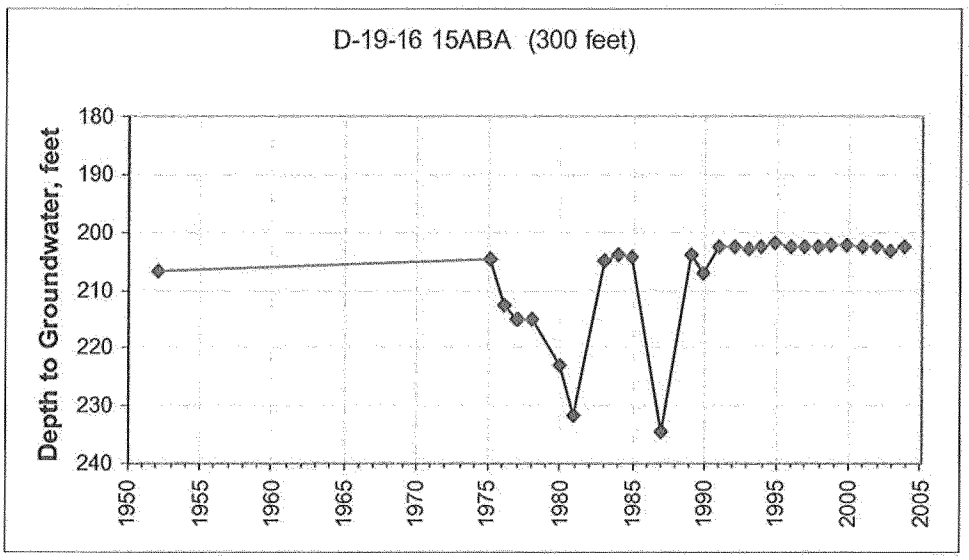

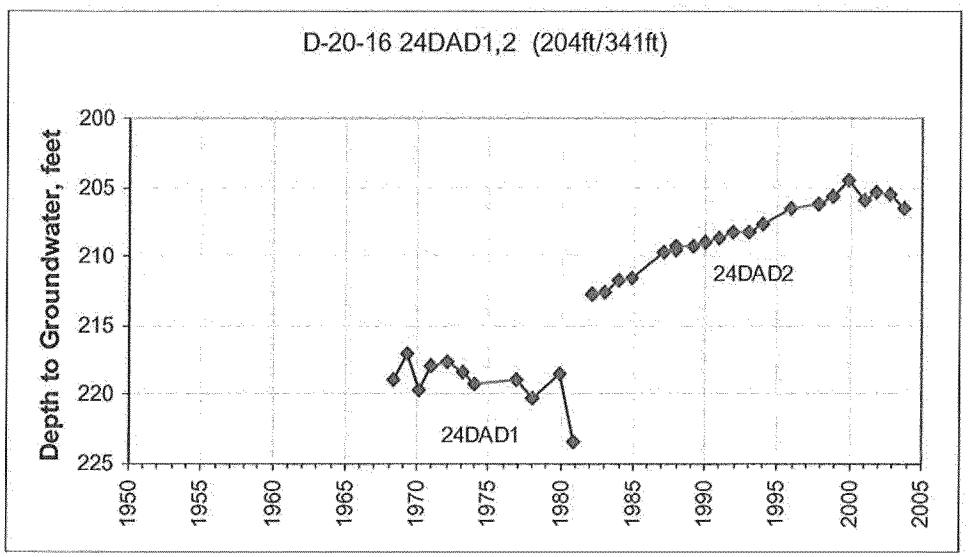

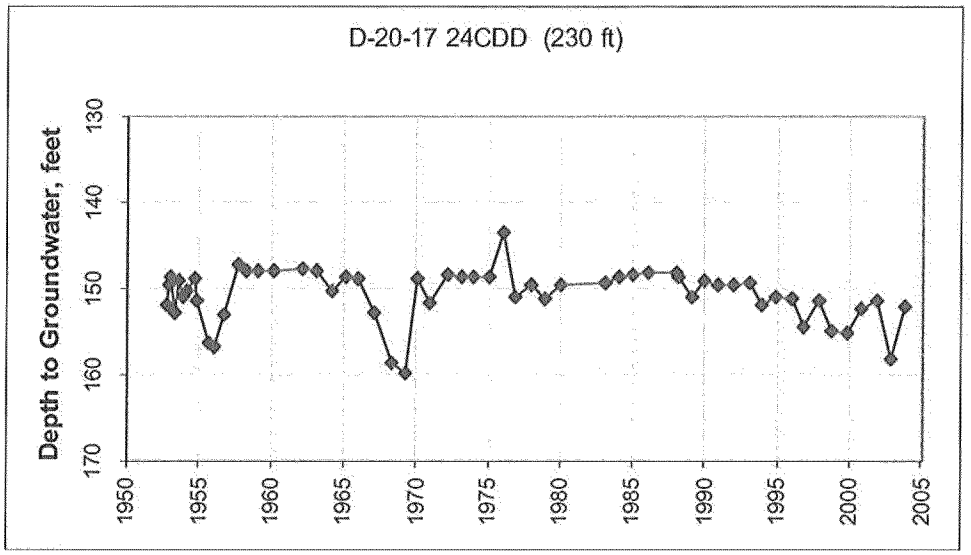

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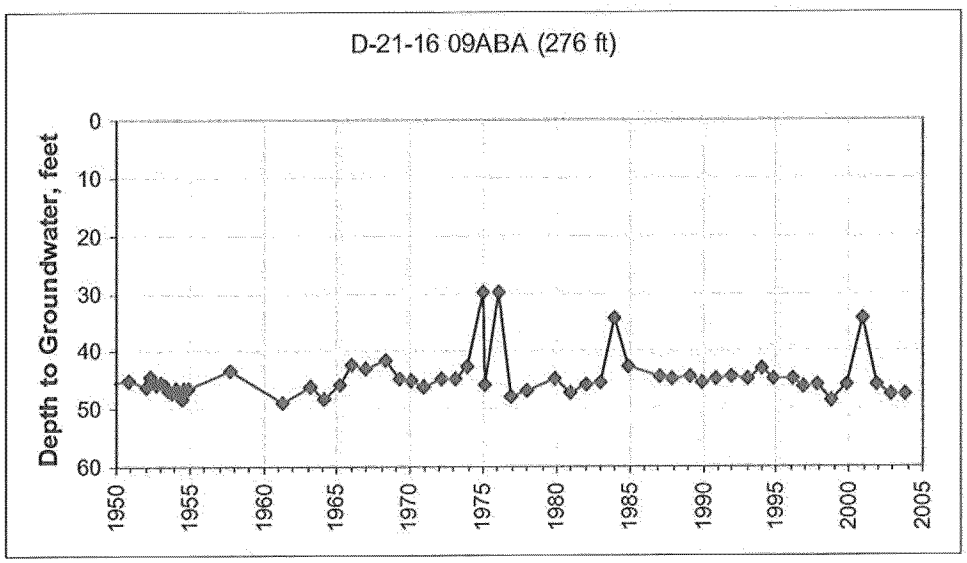
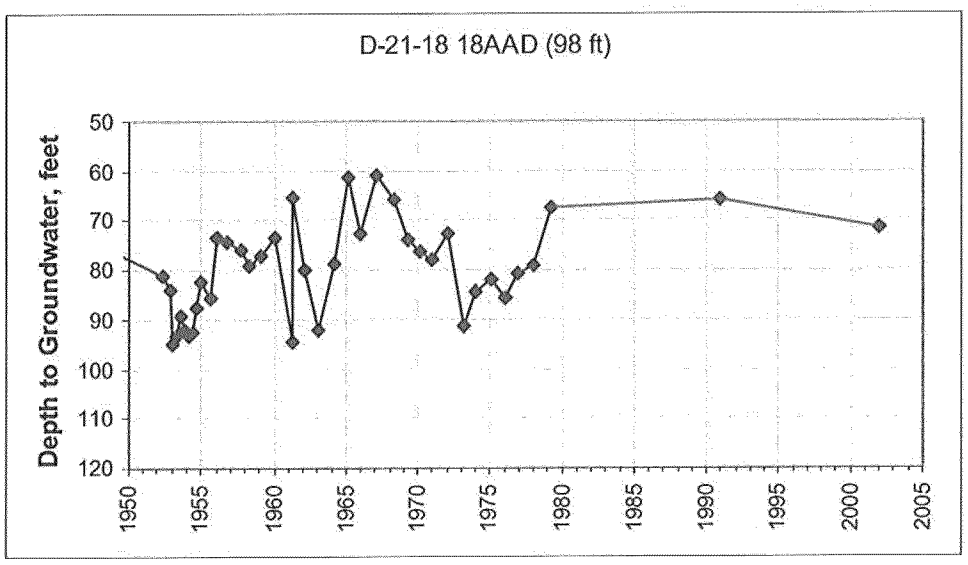

D-21-16 09ABA (276 ft)
Depth to Groundwater, feet
0
10
20
30
40
50
60
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005


D-21-18 18AAD (98 ft)
Depth to Groundwater, feet
50
60
70
80
90
100
110
120
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

APPENDIX C

FULL-SIZED MAPS OF WELLS

LAS CIENEGAS NCAHEADWATERS AREA

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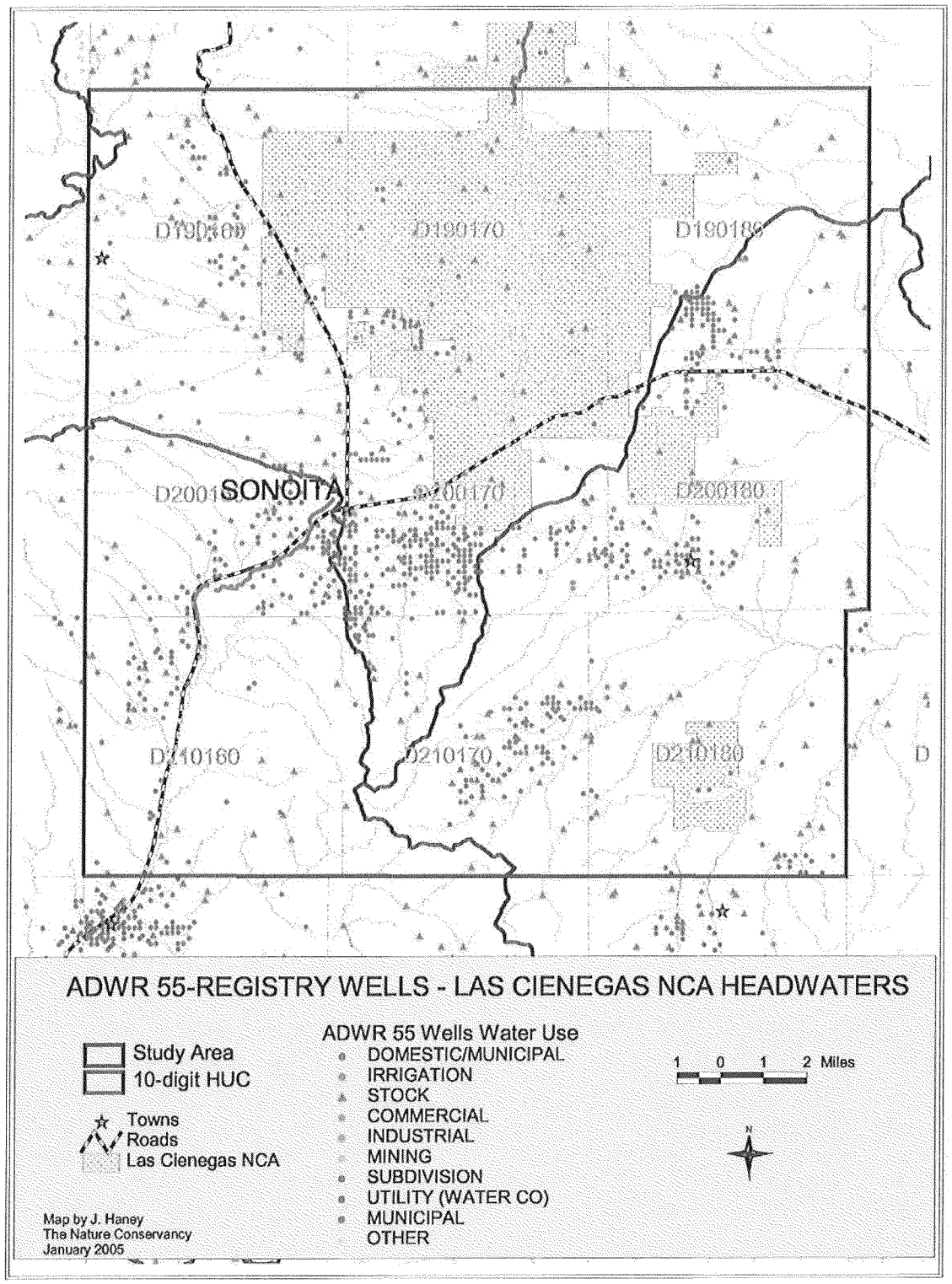
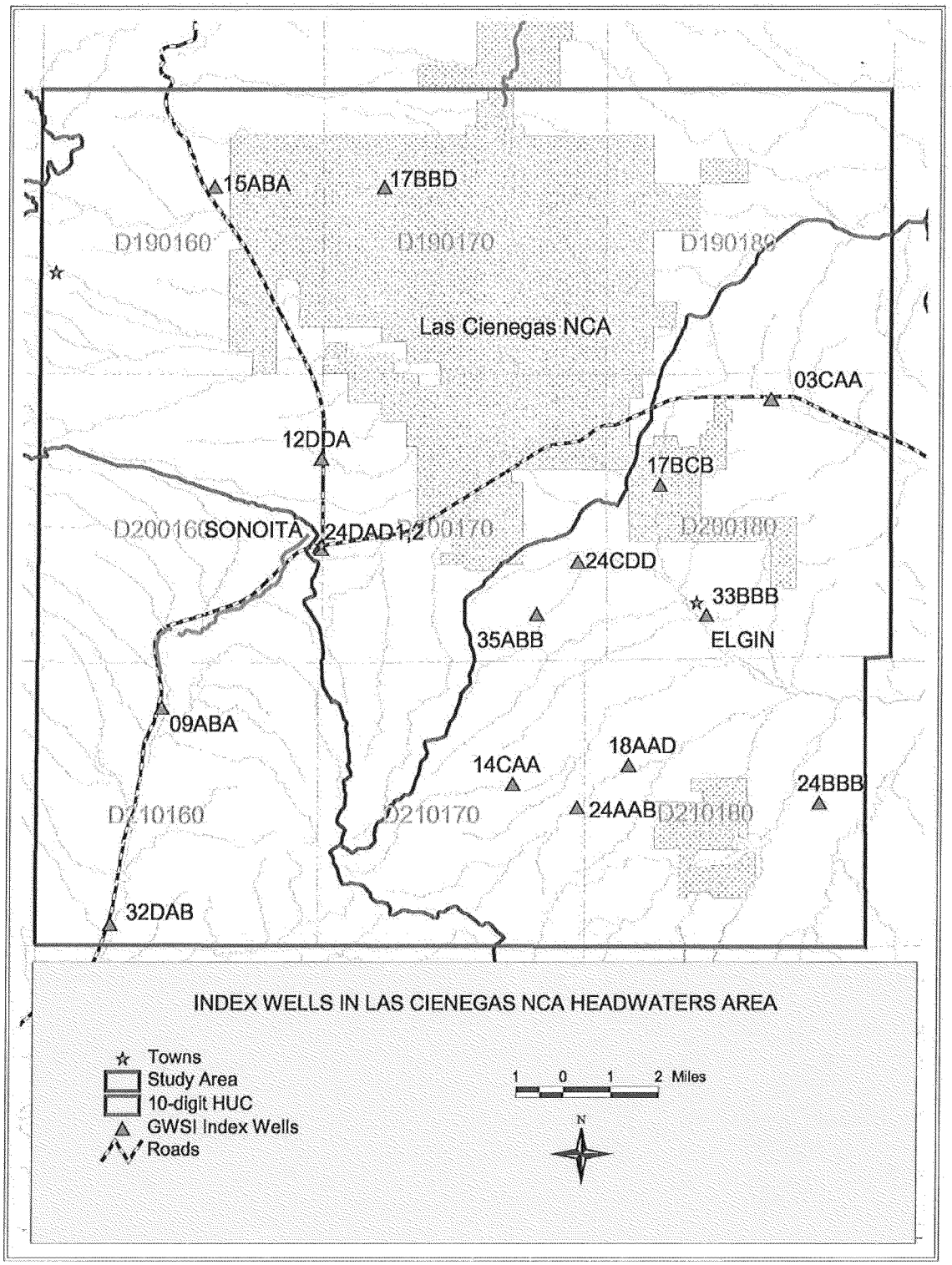

D190160
D190170
D190180
D200160
SONOITA
D200170
D200180
D210160
D210170
D210180
D
ADWR 55-REGISTRY WELLS - LAS CIENEGAS NCA HEADWATERS
Study Area
10-digit HUC
Towns
Roads
Las Cienegas NCA
ADWR 55 Wells Water Use
DOMESTIC/MUNICIPAL
IRRIGATION
STOCK
COMMERCIAL
INDUSTRIAL
MINING
SUBDIVISION
UTILITY (WATER CO)
MUNICIPAL
OTHER
1 0 1 2 Miles
N
Map by J. Haney
The Nature Conservancy
January 2005



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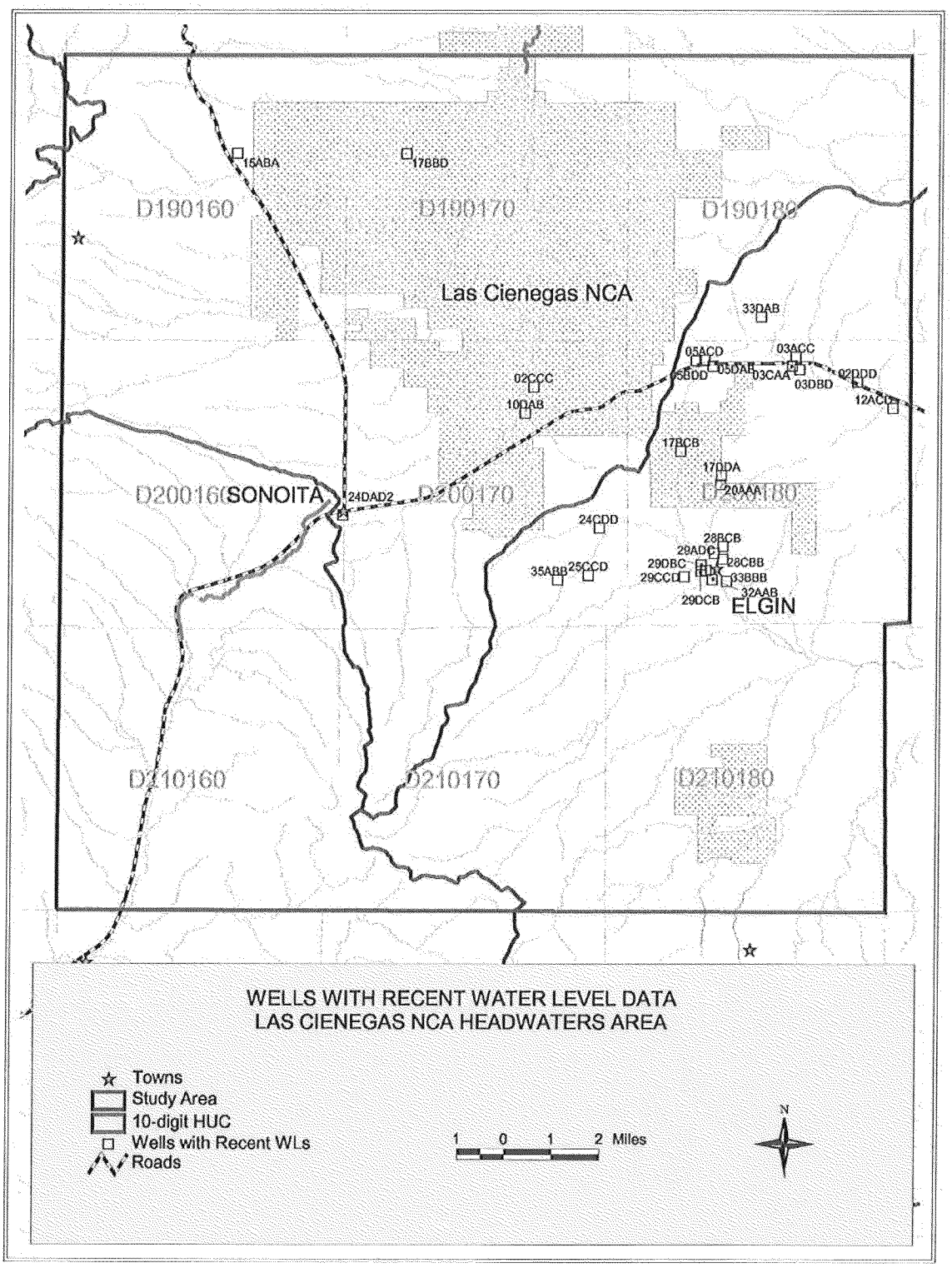
WELLS WITH RECENT WATER LEVEL DATA
LAS CIENEGAS NCA HEADWATERS AREA
Towns
Study Area
10-digit HUC
Wells with Recent WLs
Roads
1 0 1 2 Miles
N
Las Cienegas NCA
D190160
D190170
D190180
D200160
D200170
D200180
D210160
D210170
D210180
SONOITA
ELGIN
15ABA
17BBD
33DAB
05ACD
03ACC
05DDD
05DAB
03CAA
03DBD
02DDD
12ACD
02CCC
10DAB
17BCB
17DDA
20AAA
24DAD2
24CDD
28BCB
29ADC
29DBC
28CBB
35ABB
25CCD
29CCD
33BBB
32AAB
29DCB

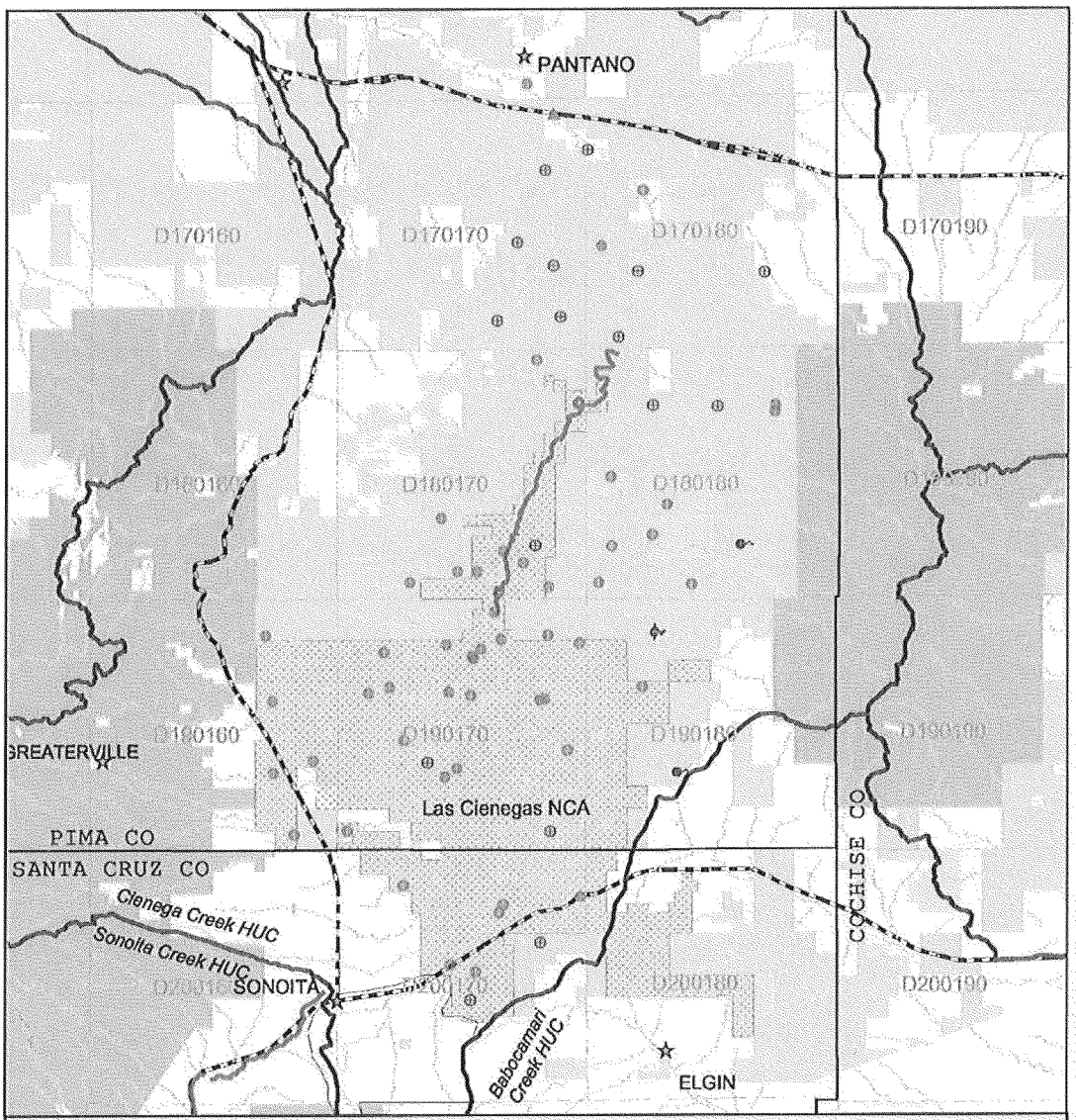

Figure 3. US BLM Hydrologic Features Las Cienegas NCA

BLM Hydrologic Features
- Well
- Windmill
- Spring
- Seep
- Gaging station

Land Manager
- BLM
- BOR
- Military
- NPS
- Private
- State Game and Fish
- State Trust
- USFS
- USFWS

2 0 2 4 Miles

N