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MEMORANDUM

TO: Julia Fonseca, Pima County Regional Flood Control District
FROM: Staffan Schorr SS
SUBJECT: Fiscal Year 2005-2006 Cienega Creek Natural Preserve Surface Water and Groundwater Monitoring Results
DATE: August 17, 2006

Pima Association of Governments (PAG) has been monitoring the hydrology of the Cienega Creek Natural Preserve since 1989. PAG staff continued to monitor surface water and groundwater at the Preserve during the 2005-2006 Fiscal Year, July 2005 to June 2006. This work was completed under PAG's 2005-2006 Overall Work Program, which includes monitoring in Cienega Creek and other areas with priority aquatic and riparian resources. Data tables and figures showing results from the 2005-2006 monitoring year are attached. Some of the figures and tables also include data from previous fiscal years for comparison purposes.

Stream discharge and groundwater monitoring methods and locations remained the same as in years past, except three wells (Davidson #2, PS-1 and PS-2) were added to the monitoring program. The locations of the monitoring sites are shown on Figure 1. Please refer to previous year-end reports and the 1998 comprehensive report for background and methodology information on discharge and groundwater level monitoring.

In addition to implementing the hydrologic monitoring program this year, PAG staff began coordinating with the Bureau of Land Management (BLM), which manages the upper reaches of Cienega Creek within the Las Cienegas National Conservation Area, to ensure that their hydrologic monitoring programs are consistent with the PAG/Pima County monitoring program. Coordinating with other land managers and employing consistent monitoring methods will lead to comparable data and opportunities for a more holistic approach to managing the watershed. While all components of the PAG program were discussed, the mapping of surface flows was the primary interest of the BLM. The discussions were with BLM staff and personnel of The Nature Conservancy who are assisting the BLM.

Streamflow

Monthly streamflow measurements were taken at the Tilted Beds site and the Marsh Station site. A USGS Pygmy Flow Meter was used for all streamflow measurements taken this fiscal year, except for July 2005 when streamflow was interrupted at the Marsh Station site and was too low to measure. All stream discharge measurements reflect base flow conditions; measurements were not taken during or immediately after heavy rain storms. When heavy rainfall did occur at the Preserve or in the surrounding area, staff allowed at least three consecutive days of dry weather to occur before measuring streamflow.

Streamflow data are shown on Table 1, and on Figures 2 and 3. Stream discharge at the Marsh Station site ranged from less than 0.05 cfs (July 2005) to 2.16 cfs (September 2005). The annual average base discharge at Marsh Station was 0.71 cfs, which is higher than the previous year's average of 0.49 cfs (Table 1). The Tilted Beds site was dry (zero cfs) during every monthly visit this monitoring year. This was the third consecutive year when no base flow was observed at this site for the entire monitoring year.

Figure 2 shows the streamflow trends for this monitoring year and for FY 2004-05. Figure 3 shows discharge data from 1993 to the present. In general, the rise-and-fall patterns of streamflow during the last two years were less peaked than in years past. This was probably due to the overall decrease in recharge events and lack of significant snowpack in the surrounding mountains.

Groundwater Levels

Depths to groundwater were measured on a monthly basis at seven wells: Empirita 2, O'Leary Windmill, Jungle, Cienega, Del Lago 1, Davidson 2 (new), PS-1 (new) and PS-2 (new). The Davidson 2 well is an abandoned well located in Davidson Canyon outside the Cienega Creek Natural Preserve. Davidson Canyon is a major tributary to Cienega Creek. The PS-1 and PS-2 monitor wells were installed in December 2005 and are located along the creek channel between the diversion dam and Colossal Cave Road (Figure 1).

As mentioned previously, three wells were added to the monitoring program during the 2005-06 monitoring year. Davidson 2 was monitored each month this monitoring year, while PS-1 and PS-2 were added to the monthly monitoring program in January 2006. Water levels at Davidson 2 behaved similarly to water levels in wells along Cienega Creek. They rose sharply during August 2005 and then gradually declined through the Winter and Spring months of 2006. The average depth to water this year was about 23 feet below land surface (bls) at the Davidson 2 well. The water levels at both PS-1 and PS-2 steadily declined between January 2006 and June 2006; however PS-2 declined at a faster rate than PS-1. Between January and June 2006, the average depth to water was about 57 feet bls at PS-1 and about 222 feet bls at PS-2. The difference in depths to water at these wells is due to changes in bedrock surface elevation.

Only minor seasonal variations in water levels were observed at most monitoring wells during this monitoring year. Water level data for the seven monitoring wells are included on Table 2, and shown in Figures 4 and 5. As seen on Table 2, in most wells the FY05-06 annual average groundwater level was within one foot of the average in FY04-05. The water levels at the Del Lago well, which generally respond quickly to recharge events, remained fairly stable throughout the last two years. Figure 4 shows water level data for this monitoring year and the previous year, while Figure 5 shows water level data from 1994 to the present.

Extent of Surface Flow

The extents of surface flow along Cienega Creek and Davidson Canyon were monitored on a quarterly basis this year. During the quarterly walk-throughs, PAG staff mapped the extent of each flowing stream reach along Cienega Creek, from Jungle Rd. to the Pantano diversion dam (a distance of about 8 miles), and along Davidson Canyon near its confluence with Cienega

Creek. In addition to mapping the flows in the Preserve, PAG mapped streamflow in Upper Davidson Canyon, which is south of Interstate 10 on the county's recently acquired Bar V property. The walk-through effort was completed by walking the length of the creek and marking on an aerial photograph the locations of beginning and end of flow for each flowing stream reach. The results were then digitized into a GIS. The walk-throughs were conducted during the months of September, December, March, and June.

Annual walk-throughs were conducted during the month of June from 1999 to 2001; the current quarterly walk-through monitoring program began during the 2001-2002 monitoring year. Outside agency staff and other interested individuals were invited to accompany PAG staff on these quarterly walk-throughs to provide an opportunity for them to learn about Cienega Creek and Davidson Canyon and to become more familiar with some of the management issues that face the Preserve and the surrounding region. The invited agencies include Pima County Regional Flood Control District, Pima County Natural Resources, Arizona Game and Fish Department, Arizona Department of Environmental Quality, U.S. Fish and Wildlife Service, The Nature Conservancy, Sonoran Institute, University of Arizona, Cienega Corridor Conservation Council and the Master Watershed Stewards program.

As seen on Table 3 and in Figures 6 and 7, the total length of streamflow within the Preserve during this monitoring year ranged from 2.3 miles (June 2006) to 3.5 miles (March 2006).

As seen in Figure 7, during recent years, the total length of flow in the Preserve is generally highest during the winter and spring months (December and March) and lowest in the summer (June). The largest change (decline) in streamflow extent generally occurs between the months of March and June, which coincides with the time period when evapotranspiration rates increase and recharge rates decrease. While the patterns are relatively consistent from year to year, the lengths of flow continue to decrease (Figures 7). The average annual lengths of flow, based on quarterly results, have decreased three of the last four years. This gradual drying trend is probably the results of the current drought. Figure 8 shows the lengths of flow in Cienega Creek since 1984.

Table 4 presents lengths of flows during summer months from 1984 to 2005; data were not collected from 1993 through 1998. The summer months (May, June, July) generally represent the driest time of the year in the Preserve. Mapping stream flow during this time of the year conservatively identifies the perennial reaches in the Preserve. Summer flow extents have declined substantially since the 1980s. In July 1984, the creek flowed continuously from I-10 to the Pantano Dam; a distance of 9.5 miles. In June 2006, the creek flowed for 2.5 miles and was segmented into several short flowing reaches separated by dry reaches. Flow in June was longer this year than in recent past years, probably due to rains received in May and early-June. Refer to the FY2004-05 year-end memorandum (dated July 22, 2005) for a description of the historic data collected by Errol L. Montgomery & Associates.

Upper Davidson Canyon, located south of Interstate 10, is outside the Cienega Creek Natural Preserve and therefore its flowing reaches are discussed separately from Cienega Creek and Lower Davidson Canyon in this memorandum. The lengths of flowing reaches in Upper Davidson Canyon are shown on Table 5 and in Figure 6. While streamflow along this reach has

been recorded during earlier PAG studies, this was the first year that surface flows were systematically mapped. Streamflow is generally associated with a spring at a bedrock outcrop. Native fish and frogs have been observed in this reach in the past. However, the channel and pools completely dried out during the summer of 2005 and no native fish have been seen there since that time. Lowland leopard frogs are still present along the reach. This reach of the creek is currently under stress from off-road vehicle and cattle use, but the county is making efforts to exclude these activities from the riparian area and channel. PAG staff observed that the extent of streamflow in Upper Davidson Canyon has declined substantially over the last few years. During this monitoring year, the channel was dry at the location where PAG collected surface water samples on a quarterly basis in 2002 and 2003, a distance of about three-quarters of a mile downstream from the current flow extent.

Other observations

Pools were present at various locations along Cienega Creek during each quarterly walk-through this year. Native fish and frogs were commonly seen in most flowing stream reaches and pools. Gila topminnow were present in the railroad horseshoe reach and the Davidson/Marsh Station reach; gila chub were present in pools in the railroad horseshoe reach. Other wildlife, such as coati, javalina, hawks, herons, owls, and numerous bird and reptile species, were also commonly seen along the creek. In June, fresh mountain lions tracks were seen in the mud at Tilted Beds.

The formation and migration of headcuts were also observed during the quarterly streamflow mapping exercises. Between July 2005 and September 2005, the large headcut at the railroad horseshoe reach migrated approximately about 400 feet upstream and expanded in width. This presumably occurred during the large flood flows in mid-August. PAG staff also noted many smaller headcuts (18 inches or less) along the length of the creek. This suggests that the creek is out of equilibrium and is going through a period of entrenchment. The impacts these headcuts are having on the resources of the Preserve are unknown. PAG will continue to observe these features to gain a better understanding of the situation. In addition, PAG submitted a grant proposal to the Arizona Water Protection Fund for research on the relationships between riparian habitat and headcutting along Cienega Creek. If funded, the two-year project will begin in Spring 2007.

If you have any questions or comments about the monitoring data or monitoring plan, please feel free to contact Claire Zucker by phone at 792-1093 or by email at czucker@pagnet.org.

Attachments

cc: David Scalero
Amy Loughner

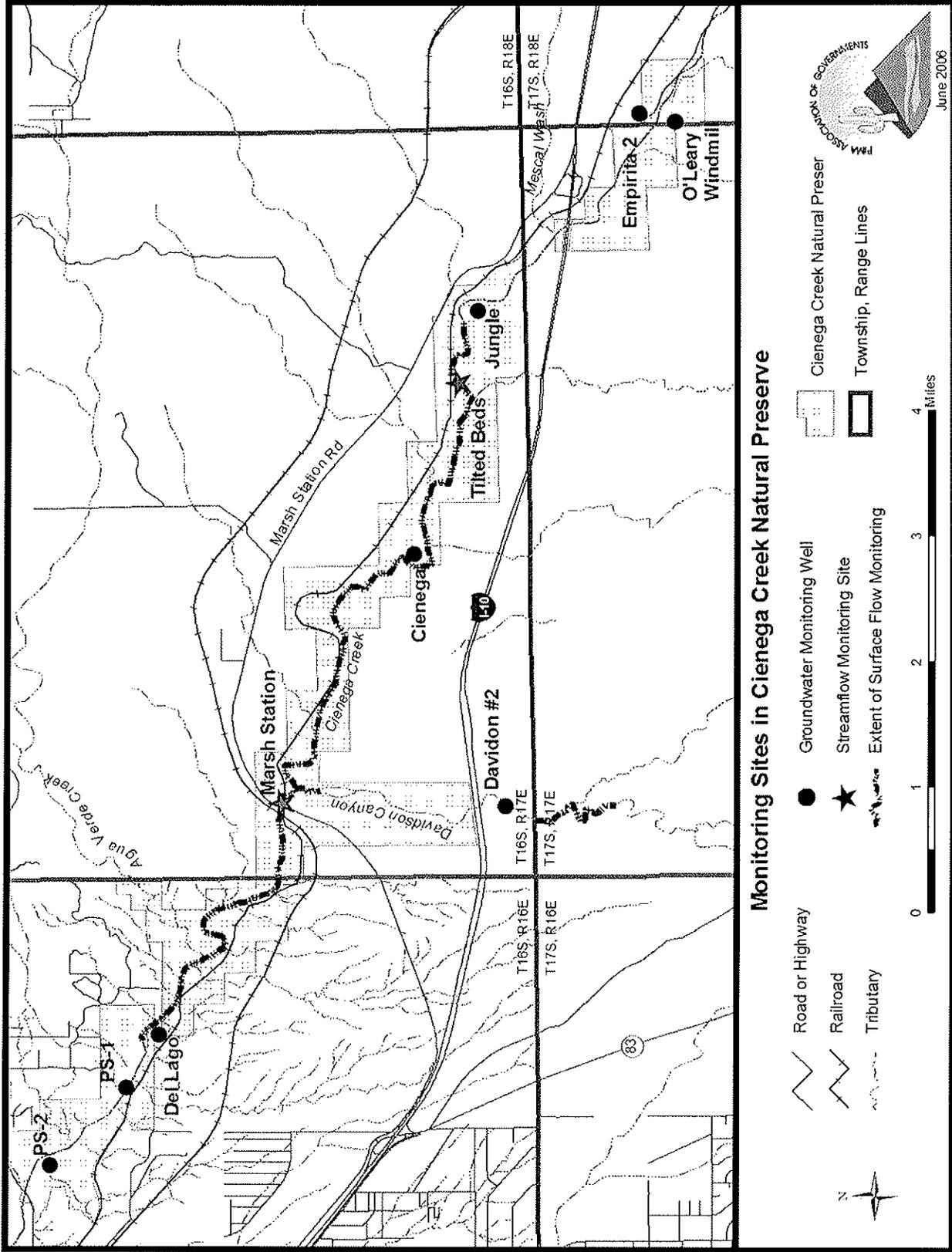


Figure 1. Monitoring Sites in Cienega Creek Natural Preserve

Table 1. Cienega Creek Discharge, July 2005 – June 2006

DATE	FLOW (cfs) Marsh Station	FLOW (cfs) Tilted Beds
7/8/05	<0.05 ⁽¹⁾	0
8/2/05	0.34	0
9/1/05	2.16	0
10/6/05	0.56	0
11/9/05	0.58	0
12/5/05	0.77	0
1/6/06	0.77	0
2/10/06	0.98	0
3/7/06	0.82	0
4/6/06	0.75	0
5/4/06	0.51	0
6/6/06	0.28	0
2005-2006 AVERAGE	0.71	0
2004-2005 AVERAGE	0.49	0
CHANGE ⁽²⁾	+0.22	0

All flows were measured with USGS Pygmy Flow Meter.

⁽¹⁾ Interrupted flow, too low for flow meter measurement.

⁽²⁾ Difference between 2004-2005 average and 2005-2006 average.

“+” = increase in discharge

“-” = decrease in discharge

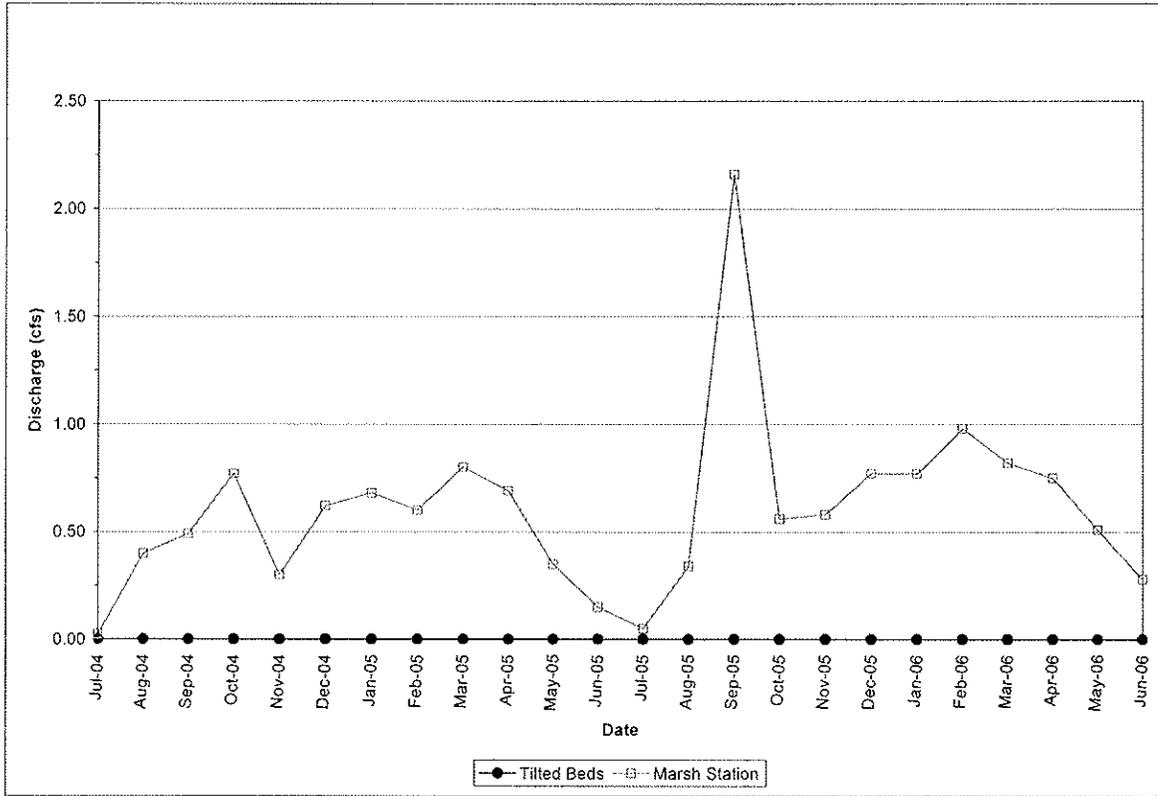


Figure 2. Cienega Creek Streamflow, July 2004 – June 2006.

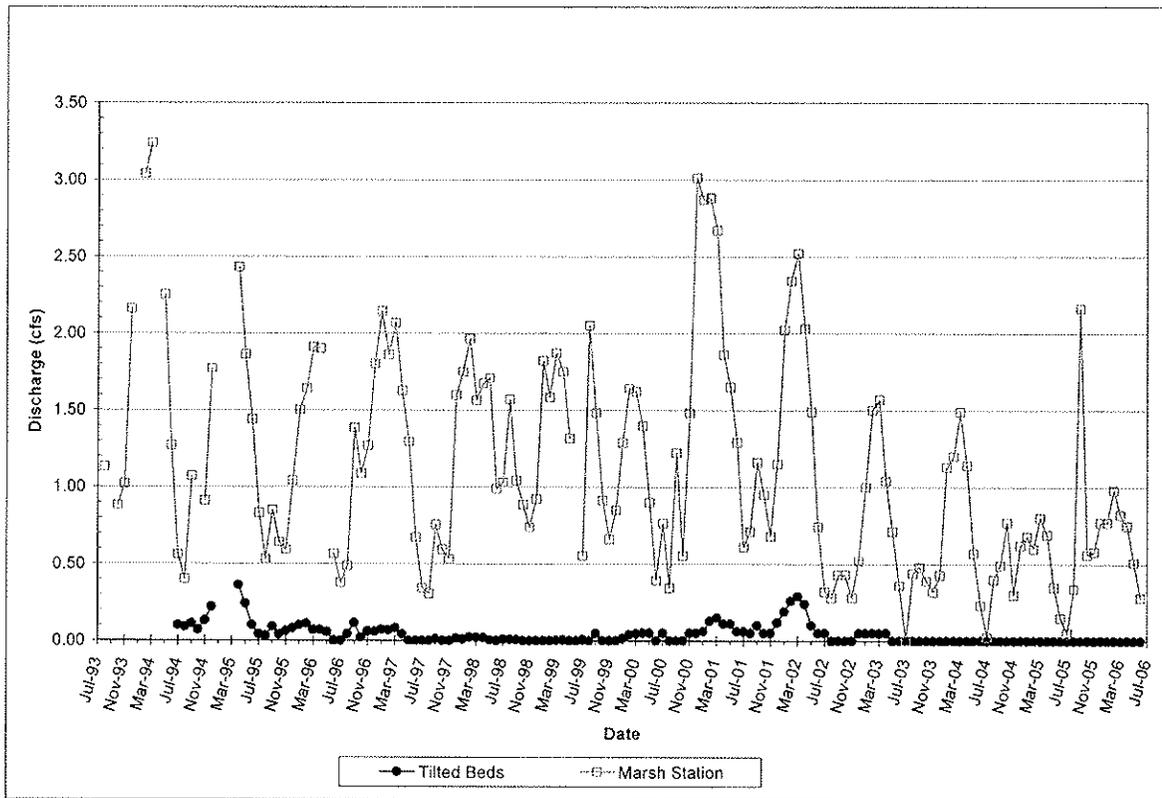


Figure 3. Cienega Creek Streamflow, July 1993 – June 2006.

Table 2. Depths to Water in Cienega Creek Natural Preserve Monitor Wells, July 2005 – June 2006

DATE	DEL LAGO 1 (feet)	CIENEGA (feet)	JUNGLE (feet)	EMPIRITA 2 (feet)	O'LEARY WINDMILL (feet)	DAVIDSON #2 (feet)	PS-1 (feet)	PS-2 (feet)
7/8/05	77.61	21.18	40.81	84.90	64.03	26.18		
8/2/05	75.94	20.92	41.31	85.00	64.10	24.61		
9/1/05	69.21	16.00	38.75	84.90	63.05	16.75		
10/6/05	74.62	17.32	38.91	84.74	62.73	19.04		
11/9/05	76.61	19.00	39.41	84.65	62.95	21.40		
12/5/05	77.10	19.20	39.46	84.74	62.96	22.42		
1/6/06	75.92	17.87	39.40	84.87	62.93	23.71	56.32	219.17
2/10/06	75.65	16.70	39.26	84.95	62.83	24.20	56.39	220.42
3/7/06	75.28	16.40	39.20	85.05	62.83	24.02	56.87	221.62
4/6/06	75.75	16.72	39.19	83.65	62.96	24.33	56.52	223.12
5/4/06	76.72 ⁽¹⁾	17.96	39.61	85.15	63.22	25.03	57.20 ⁽¹⁾	224.27
6/6/06	77.12	20.23	40.39	85.27	63.63	22.77	57.91	225.42
2005-2006 AVERAGE	75.63	18.29	39.64	84.82	63.19	22.87	56.87	222.34
2004-2005 AVERAGE	77.29	18.53	38.75	83.90	63.32	NA	NA	NA
CHANGE ⁽²⁾	+1.66	+0.24	-0.89	-0.92	+0.13	NA	NA	NA

Note: All depths are feet below land surface

⁽¹⁾ Measured on 5/15/06 instead of 5/4/06 due to site accessibility issues.

⁽²⁾ Difference between 2004-2005 average and 2005-2006 average.

“+” = rise in water level

“-” = drop in water level

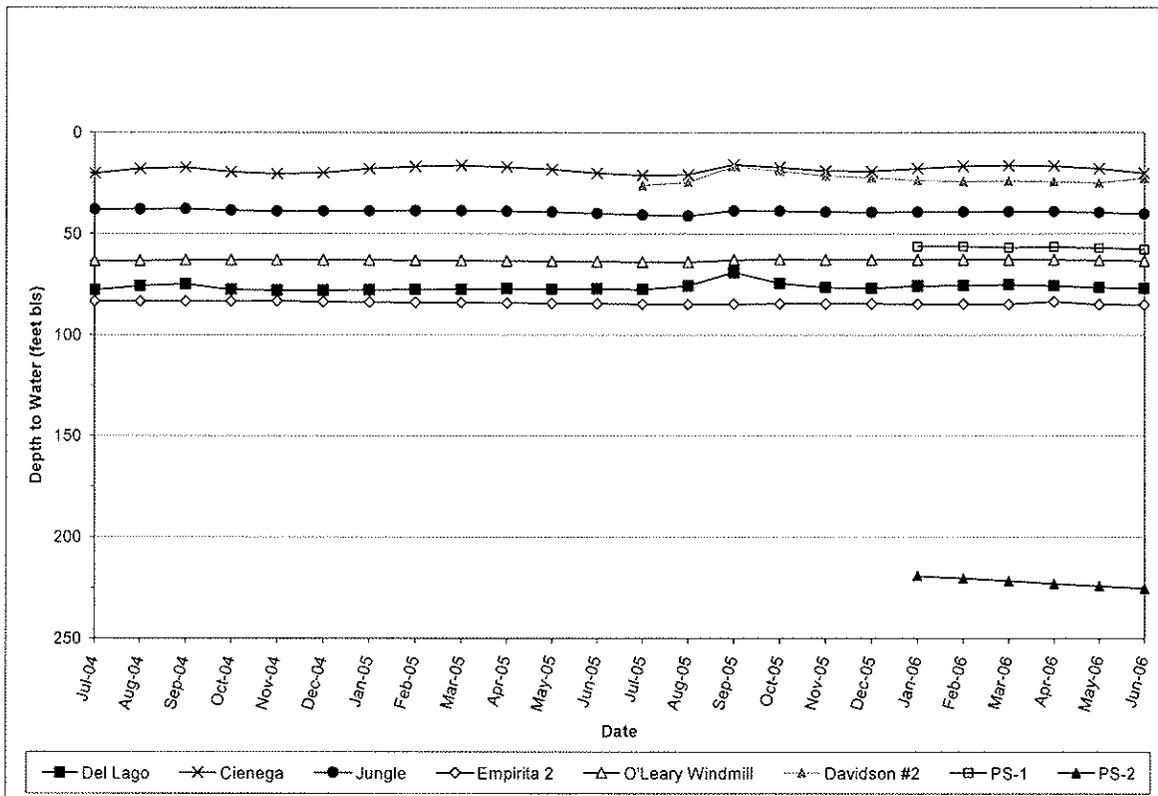


Figure 4. Depths to Groundwater in Cienega Creek Natural Preserve, July 2004 – June 2006.

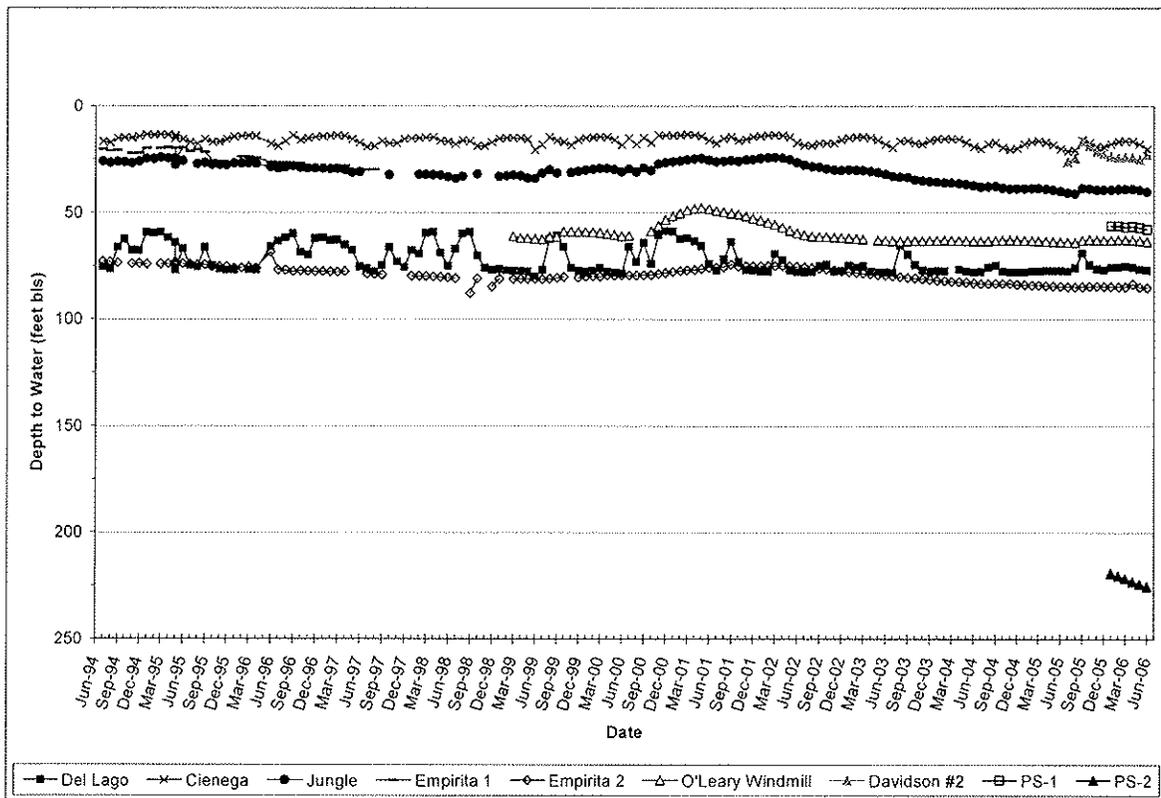


Figure 5. Depths to Groundwater in Cienega Creek Natural Preserve, July 1994 – June 2006.

Table 3. Lengths of Flowing Reaches in Cienega Creek Natural Preserve,
Measured Quarterly, July 2005– June 2006

Flowing Reach	Length of Flowing Reach (feet)			
	September (9/28/05)	December (12/21/05)	March (3/31/06)	June (6/23/06)
Cienega Creek Reach 1	4750	6155	6280	3735
Cienega Creek Reach 2	355	4605	440	4825
Cienega Creek Reach 3	555	4005	335	205
Cienega Creek Reach 4	4460	1115	2415	565
Cienega Creek Reach 5	4055		4390	1180
Cienega Creek Reach 6	460		3825	1290
Cienega Creek Reach 7	185		180	525
Cienega Creek Reach 8	265		695	
Cienega Creek Reach 9	685			
Lower Davidson Canyon Reach 1	0	0	0	0
TOTAL	15,770 ft. (3.0 miles)	15,880 ft. (3.0 miles)	18,560 ft. (3.5 miles)	12,025 ft. (2.3 miles)

Reaches numbered in sequence as observed while walking downstream; they are not associated with any one fixed portion on the creek. Lower total number of reaches generally indicates less interrupted flow.

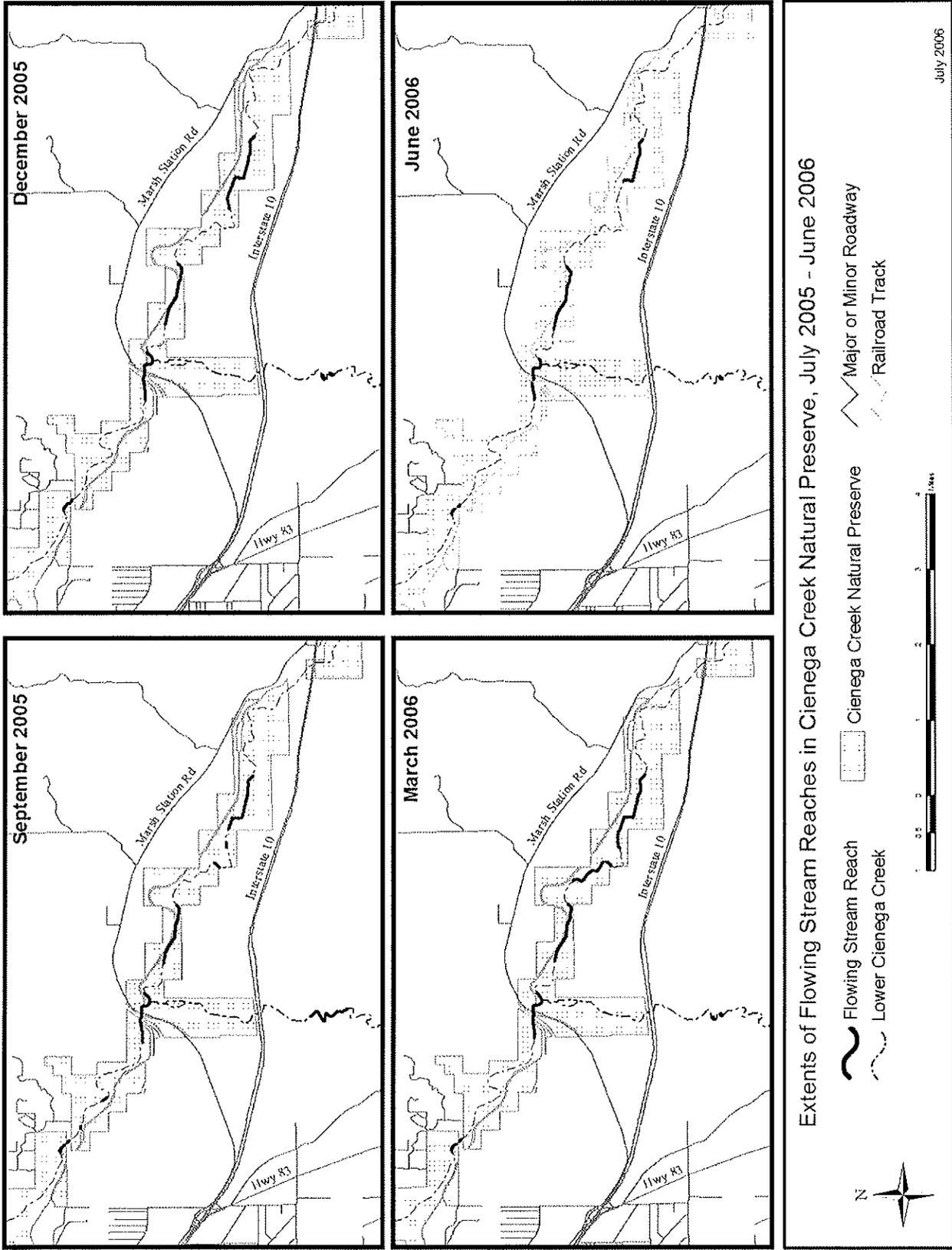


Figure 6. Extents of Flowing Stream Reaches in Cienega Creek Natural Preserve and Davidson Canyon, July 2005 – June 2006.

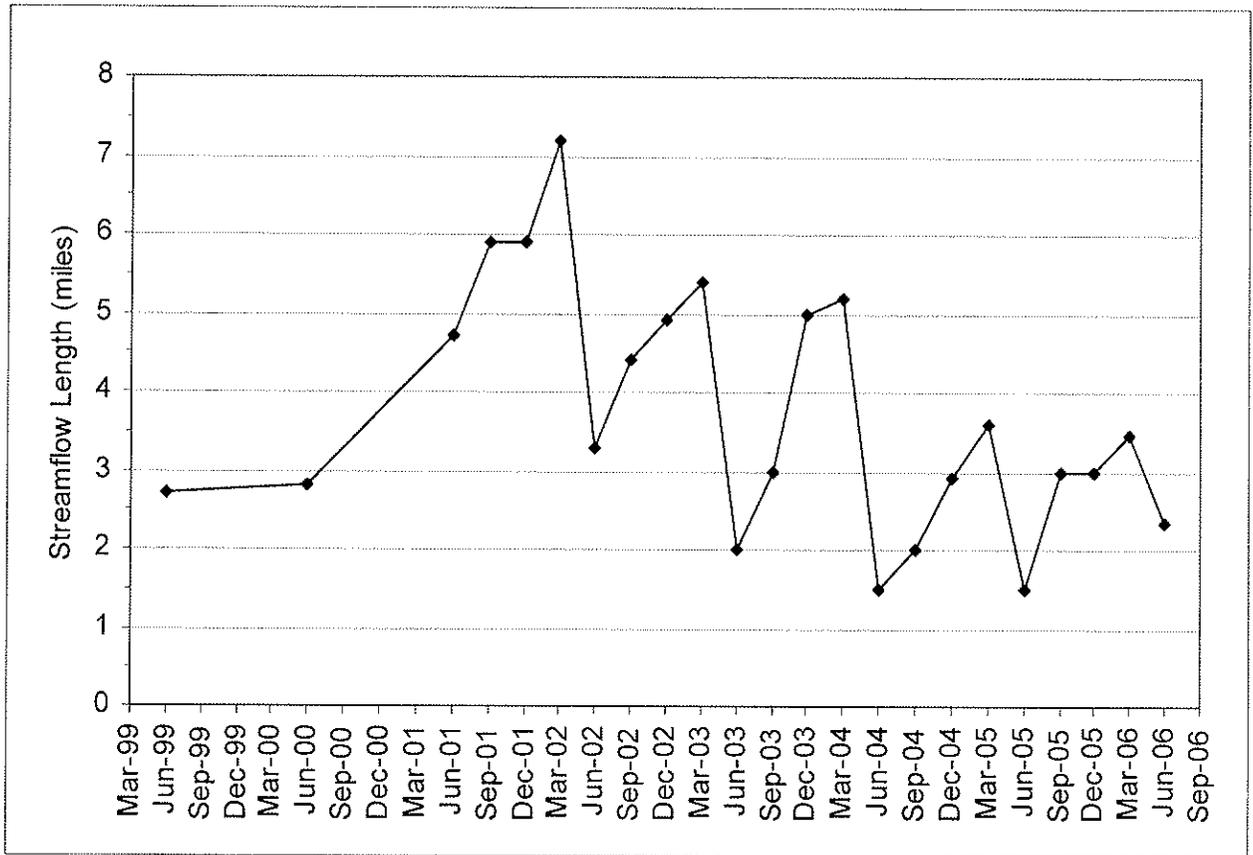


Figure 7. Lengths of Streamflow in Cienega Creek Natural Preserve, 1999-2006.

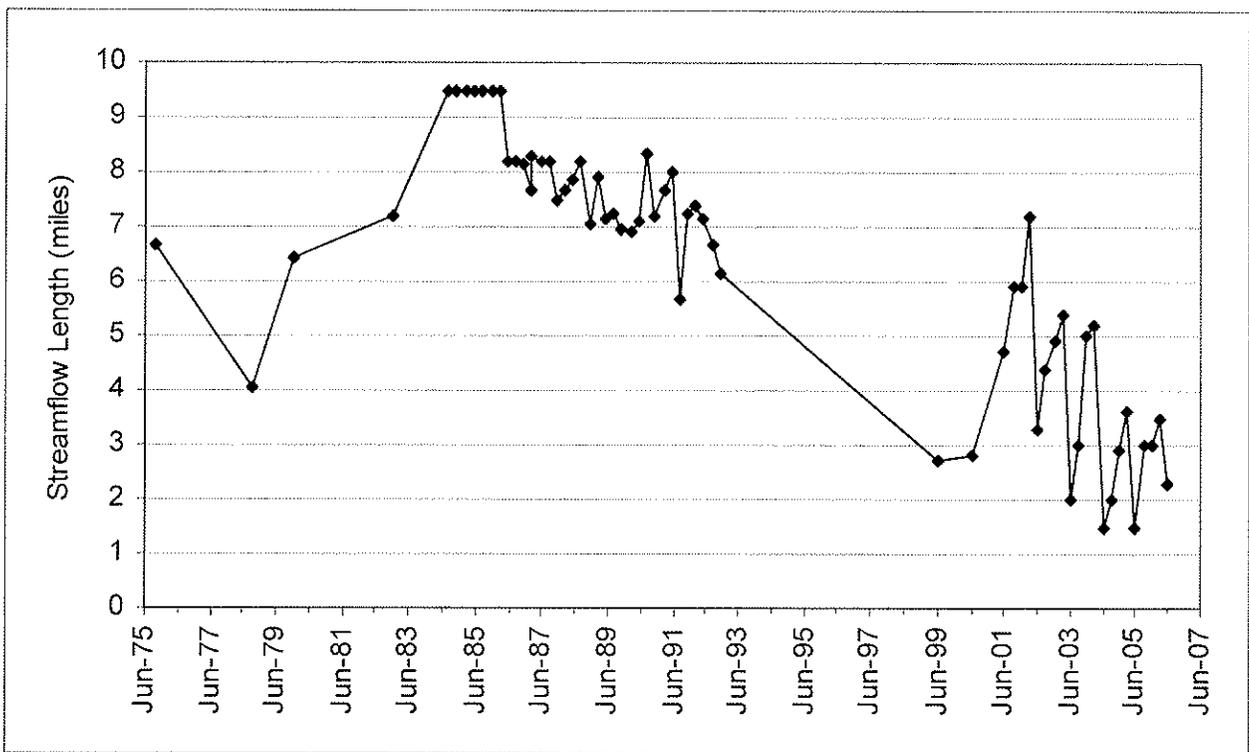


Figure 8. Lengths of Streamflow in Cienega Creek Natural Preserve, 1975-2006.

Table 4. Total Lengths of Flow in Cienega Creek Natural Preserve, Summer months, 1984 – 2005

Year	Length	Source
July 1984	50,000 ft. (9.5 miles)	Errol L. Montgomery & Associates, Inc.
May 1985	50,000 ft. (9.5 miles)	
May 1986	43,140 ft. (8.2 miles)	
May 1987	43,200 ft. (8.2 miles)	
May 1988	41,500 ft. (7.9 miles)	
May 1989	34,640 ft. (6.6 miles)	
May 1990	37,400 ft. (7.1 miles)	
May 1991	42,160 ft. (8.0 miles)	
May 1992	37,740 ft. (7.1 miles)	
<i>No data 1993-1998</i>		
June 1999	14,290 ft. (2.7 miles)	PAG
June 2000	14,590 ft. (2.8 miles)	
June 2001	24,950 ft. (4.7 miles)	
June 2002	17,220 ft. (3.3 miles)	
June 2003	10,630 ft. (2.0 miles)	
June 2004	8,145 ft. (1.5 miles)	
June 2005	7,865 ft. (1.5 miles)	
June 2006	12,025 ft. (2.3 miles)	

Length of creek channel from Interstate 10 to Pantano Dam equals 50,000 ft. (9.5 miles).

Table 5. Lengths of Flowing Reaches along Upper Davidson Canyon, Measured Quarterly, July 2005– June 2006

Flowing Reach	Length of Flowing Reach (feet)			
	September (9/1/05)	December (12/5/05)	March (3/7/06)	June (6/6/06)
Upper Davidson Canyon Reach 1	3935	455	115	170
Upper Davidson Canyon Reach 2			65	

Reaches numbered in sequence as observed while walking downstream; they are not associated with any one fixed portion on the creek. Lower total number of reaches generally indicates less interrupted flow.

Upper Davidson Canyon reaches mapped on different dates than Cienega Creek and Lower Davidson Canyon reaches due to the length of time required to complete both streams.

