Title: *HYDROGEOLOGY AND WATER RESOURCES OF THE PLACITAS AREA SANDOVAL COUNTY, NEW MEXICO*

Author(s): Peggy S. Johnson and Andrew Campbell

Publication Date: August 2002, Updated January 2008

Publisher: New Mexico Bureau of Geology and Mineral Resources

Key Topics: Placitas, Albuquerque Basin, San Francisco-Placitas fault zone, hydrologic systems, Mezozioc ramp, Madera Group limestone, Las Huertas Creek, potentiometric surface,

Summary:

- Scope and Objective: To describe "the availability of ground water and surface water in the Placitas area…" (p. 1)
- Hydrogeologic Framework
    - Geographic, Physiographic, and Geologic Setting
        - Mountain Zone – higher elevations in the Sandia Mountains, east of the San Francisco fault and south of the Placitas fault (p. 6)
        - Mesozoic ramp – the foothills between the Placitas fault and the Cretaceous-Tertiary unconformity (south of Las Huertas Creek after its turn to the northwest, southeast of Lomos Altos, and northwest of Arroyo Agua Sarca) (p. 6)
        - Albuquerque Basin – area north and west of the major rift-margin faults
    - Stratigraphy and Hydrostratigraphic Units
        - Figure 5. Composite stratigraphic chart for the Placitas area (after Anderson et al., 1995)
        - Cenozoic Formations:
            - Upper Santa Fe Group fluvial deposits (most productive aquifers in the Albuquerque Basin) (p. 7)
            - Santa Fe Group piedmont deposits (generally lower porosity and permeability than the fluvial deposits but still substantial quantities of water) (p. 8)

        - Loma Barbon member of the Arroyo Ojito Formation , beneath the current Rio Grande floodplain (does not produce as high quantity of water as other Santa Fe Group deposits) (p. 8)
        - Volcanic dike 0.6 miles north of the Village of Placitas (relatively impermeable and acts as a barrier to ground-water movement) (p. 8)
    - Mesozoic Formations:
        - Cretaceous units (the Harmon Sandstone, the Point Lookout Sandstone, the Hosta-Dalton Sandstone, and the Dakota Sandstone exhibit moderate aquifer potential) (p. 9)
        - Jurassic formations (the jackpile Sandstone and Westwater Canyon Sandstone have the greatest aquifer potential)
        - Triassic formations (the middle Petrified Forest sandstone has aquifer potential and the Agua Zarca Formation where it is highly fractured, in and near the Placitas fault zone, and transmits significant quantities of water) (p. 10)
    - Paleozoic Formations:
        - Permian Abo Formation (generally acts as a stratigraphic barrier to ground water flow although at the northern end of Las Huertas Canyon are ground-water wells entirely within the Abo) (p. 10)
        - Pennsylvanian Madera Limestone (dominant aquifer of the Sandia Mountains with fractured aquifers in the limestone units) (p. 11)
    - Proterozoic Formations:
        - Proterozoic crystalline rocks (high permeability zones in the faults, fractures, and weathered zones only) (p. 11)
- Structural Elements:
    - The San Francisco and Placitas fault: “act as either localized barriers, combined barrier-conduit, or distributed conduit faults, depending on location” (p. 13).
    - Las Huertas fault system: the north-south faults generally enhance ground-water flow though cross-fault permeability may be reduced (p. 14)
    - Caballo fault: causes compartmentalization of aquifers in the Mesozoic ramp though it also creates permeable pathways where it cuts the Placitas fault zone (p. 14)

    - Basin faults: the Valley View and Escala faults generally act as barriers to ground-water flow (p. 15)
    - South Montezuma fault: likely restricts movement of ground water north along the Cuchilla de San Francisco (p. 15)

- Surface Water Hydrology
  - Drainage Basins and Springs: (Figure 9)
    - Las Huertas Creek:
      - 48% of stream flow in the upper reach recharges ground water between the Las Huertas picnic area and the ditch association diversion (p. 25)
      - Stream flow from 30 ft^3/sec to less than 2 ft^3/sec (898 gal/min) (at 0.3 miles south of Sandia Man Cave) (p. 25)
      - Perennial flow in a 1.25-mile reach between Tecolote and the Escala fault
    - Arroyo del Ojo del Orno and the Placitas Village Springs:
      - 5 major perennial springs of the Las Acequias of the Community of Placitas (Figure 14)
        - discharge from Madera Limestone at the base of Cuchilla Lupe (p. 25)
        - supply 500 domestic users in the Village of Placitas and irrigation for Village gardens and orchards (via an acequia system) (p. 25)
      - channel-bed infiltration near Lomos fault during normal and subnormal flow
    - Arroyo de San Francisco
      - Perennial flow is from perennial springs discharging from the Madera Formation near the San Francisco fault (p. 27)
      - Channel-bed infiltration recharges the Santa Fe Group aquifer
- Ground-Water Hydrology
  - Potentiometric surface: generally follows topography, sloping north and west from the Sandia Mountains (Plates 6 and 7)

- Mountain Hydrologic System
    - Potentiometric surface:
        - North trending ground-water mounds coincide with the limestone ridges Cuchilla Lupe and Cuchilla de San Francisco (p. 29)
        - Ground-water troughs associated with the unnamed fault along the east face of Cuchilla Lupe and the Spillway fault east of the Crest of Montezuma (indicating the faults are acting as drains, directing ground-water flow along the fault) (p. 29)
    - Ground Water Movement
        - The Abo and Madera Formations in Las Huertas Canyon are recharged by stream flow infiltration and snowmelt (p. 29)
        - Ground water discharge from the Madera Formation through the damage zone adjacent to the San Francisco fault (p. 30)
        - The San Francisco fault "transmits ground water from east of Las Huertas Canyon through the Madera Formation to its truncation at the north end of Cuchilla de San Francisco" (p. 30)
        - The upper Madera aquifer, underlying Cuchilla de San Francisco, seems to be isolated from the fault-zone pathway and from the Madera aquifers near Cuchilla Lupe and Las Huertas Canyon (p. 31)
        - The Abo Formation, east of Cuchilla de San Francisco, appears to be isolated from the Madera Formation and a short-term recharge source (p. 31)
        -
    - Madera Group limestone
        - Dual-porosity, fractured carbonate aquifer (moderate potential)
        - GW flow is along fractures, fracture systems, or bedding planes making it highly variable
        - High transmissivity, low storage, recharge at limestone outcrops
- Mesozioc ramp
    - GW limited to confined sandstone aquifers in specific formations with limited recharge

        - Recharge occurs near streams, arroyos, along Caballo-Pomecerro faults, and contacts with Madera Group limestone (abstract)
    - Albuquerque Basin
-
- "Because water-level monitoring for this study began at the end of the 1995-1996 drought, many wells reflect a steady rise in water levels, in addition to a seasonal fluctuation, as the hydrologic systems recovered from the drought" (29).
- There is a high variability of the aquifers within the Mesozoic ramp.

Useful Figures:

References:

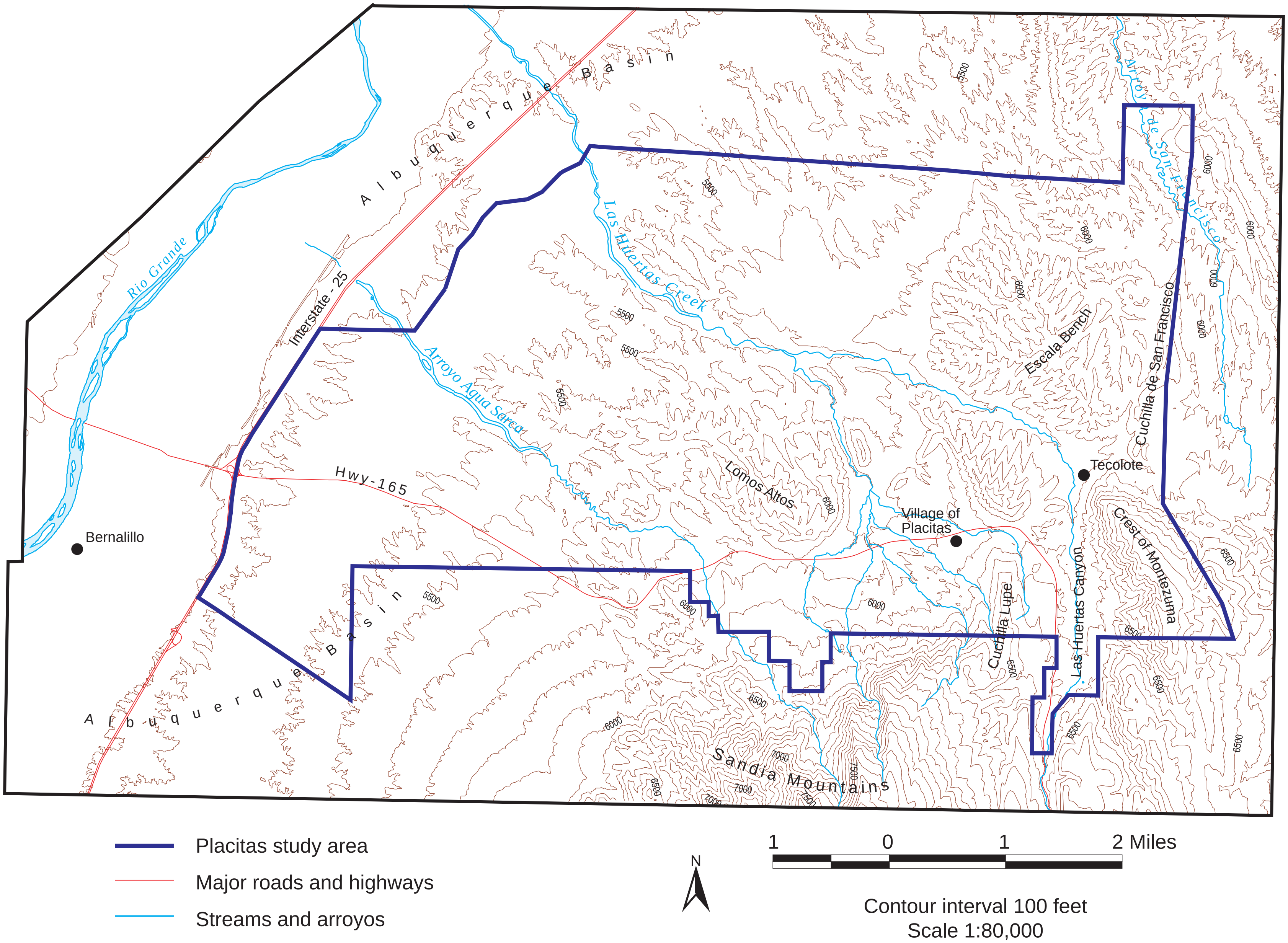

Figure 3. Physiographic and geographic features of the Placitas area.

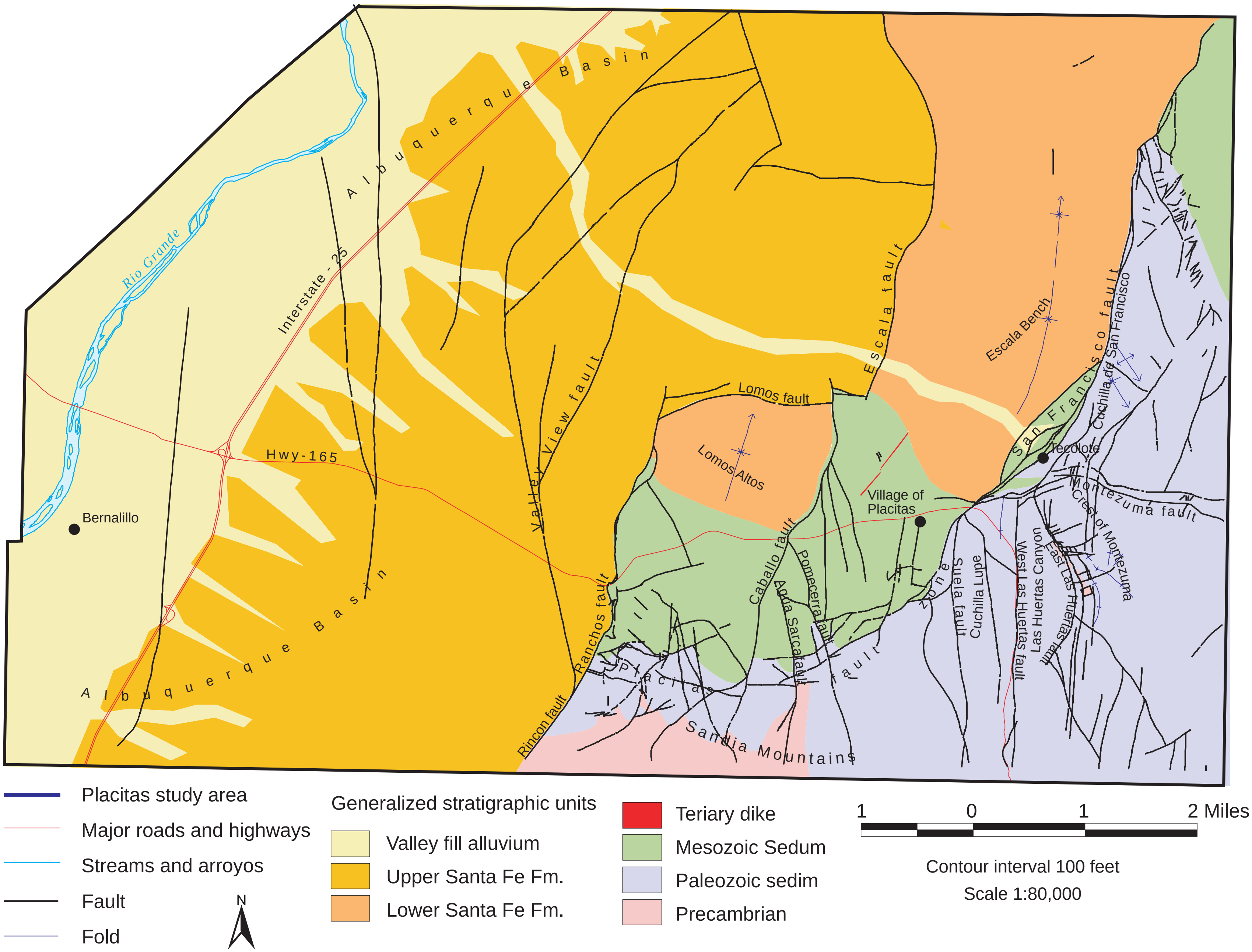

Figure 4. Generalized geologic map of the Placitas area (modified from Connell et al. (1995) and Connell (1998)).

Figure 5. Composite stratigraphic chart for the Placitas area (after Anderson et al., 1995)

Age (ma)	Period	Epoch	Stratigraphic Units	Approx. Thickness (ft)	Location of Measured Section in Figure 6 (T.R.S.1/4,1/4,1/4)	Thickness Data Source
0.01	Quaternary	Holocene	Valley-fill alluvium-Qal, Qv	0-20	none	Connell et al., (1995)
0.25		Pleistocene – late	Piedmont-slope alluvium- Qaf, Qf, Qp	0-120		
0.7		Pleistocene – middle				
1.6		Pleistocene – early	Travertine-QTtv			
	Tertiary	Pliocene	Santa Fe Group: Upper Santa Fe Group QTsa, QTst, QTspcs, QTspc	600-4000		
5.3		Miocene	Santa Fe Group: Lower Santa Fe Group Tsps, Tspcs, Tspc	~400-2400		
23.7		Oligocene	Espinaso Fm. Te; Mafic Dike, Tmi	≤1300	none- not exposed	Smith et al., (1991)
36.6		Eocene	Galisteo Fm. Tg	≤2800	none- not exposed	Gorham and Ingersoll, (1979)
57.8		Paleocene	Diamond Tail Fm. Td	≤1450	none- not exposed	Lucas et al., (1997)
66.4	Cretaceous	Upper	Mesa Verde Grp.: Upper Menefee Fm. / Harmon Sandstone / Lower Menefee Fm. — Kmf	740 / 140 / 324	13.5.33.110	Menne, 1989
			Mesa Verde Grp.: Point Lookout Sandstone Kpl	240-315	13.5.32.220	Menne, 1989; Picha, 1982
			Mesa Verde Grp.: Upper Mancos Shale Km_2	240-360	12.4.1.120; 13.6.32.220	Menne, 1989; Picha, 1982
			Mesa Verde Grp.: Hosta Dalton Sandstone Khd	210-370	13.5.32.210; 13.6.32.320	Menne, 1989; Picha, 1982
			Lower Mancos Shale Km_1	850-1850	12.4.1.120; 13.6.32	Menne, 1989; Picha, 1982
			Dakota Fm. Kd	25-75	12.4.1.240	Picha, 1982; Menne, 1989
		Lower				
144	Jurassic	Upper	Morrison Fm. Jm: Jackpile Sandstone Mbr.	70	13.5.32.430	Menne, 1989
			Morrison Fm. Jm: Brushy Basin Mbr.	240		
			Morrison Fm. Jm: Westwater Cyn/Saltwash	215		
		Middle	Morrison Fm. Jm: Recapture Sh/Summerville	325		
			San Rafael Grp.: Todilto Fm. Jt	50-65	12.5.6.320; 13.5.24.140	Picha, 1982; Menne, 1989
			San Rafael Grp.: Entrada Fm. Je	120	12.5.6.320	Menne, 1989
208	Triassic	Upper	Chinle Grp.: Petrified Forest Fm. T̄Rcp	1590	13.5.24.140	Picha, 1982
			Chinle Grp.: Agua Zarca Fm. T̄Rz	220	12.5.6.330	Menne, 1989
		Middle-Lower	Moenkopi Fm. T̄Rm	45-100	12.4.5.320; 12.6.19.200	Menne, 1989; Picha, 1982
245	Permian	Guadalupian	San Andres Fm. Ps	80-130	12.4.5.320	Menne, 1989; Picha, 1982
			Glorieta Ss. Pg	50	West of Pomecerro Cyn	Menne, 1989
		Leonardian	Yeso Fm. Py: San Ysidro Mbr. / Meseta Blanca Mbr. / Lower Yeso Mbr.	680	13.5.26	Picha, 1982
		Wolfcampian	Abo Fm. Pa	1070	Cuchilla de San Francisco	Picha, 1982
286	Pennsylvanian	Upper	Madera Fm. IPm: Upper Arkosic Ls.	614	Crest of Montezuma	Picha, 1982
		Middle	Madera Fm. IPm: Lower Gray Ls.	646		
		Lower	Sandia Fm. IPs	193	Crest of Montezuma	Picha, 1982
320	Mississippian		Arroyo Peñasco Grp Ma.	103	13.5.34.140	Menne,1989
360						
1,400	Proterozoic	Middle	Sandia Granite	–	none	
		Early	Various Supracrustal Rocks	–	none	

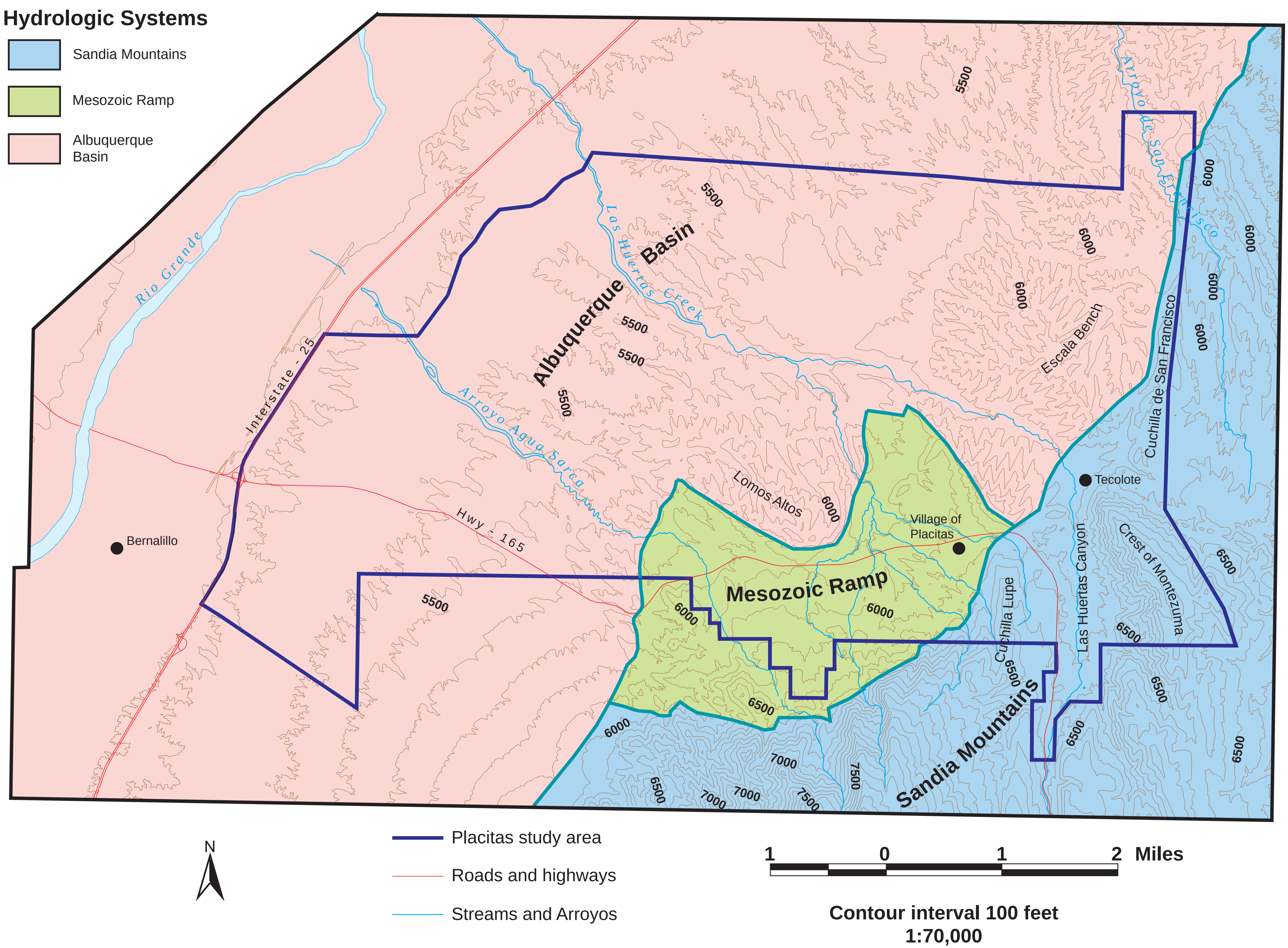

Figure 7. Hydrologic systems in the Placitas area.

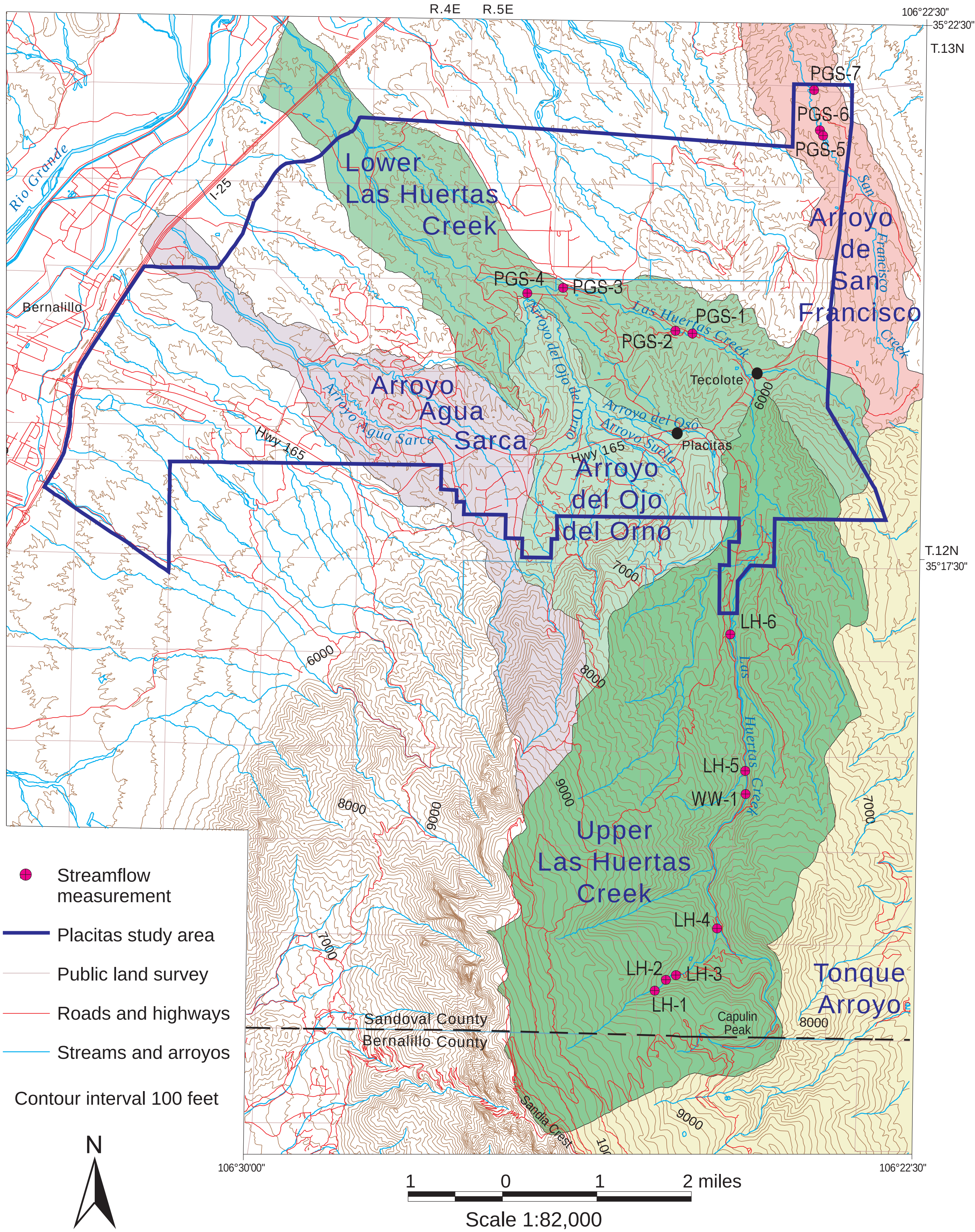

Figure 9. Surface water drainages and streamflow measurements in the Placitas area.

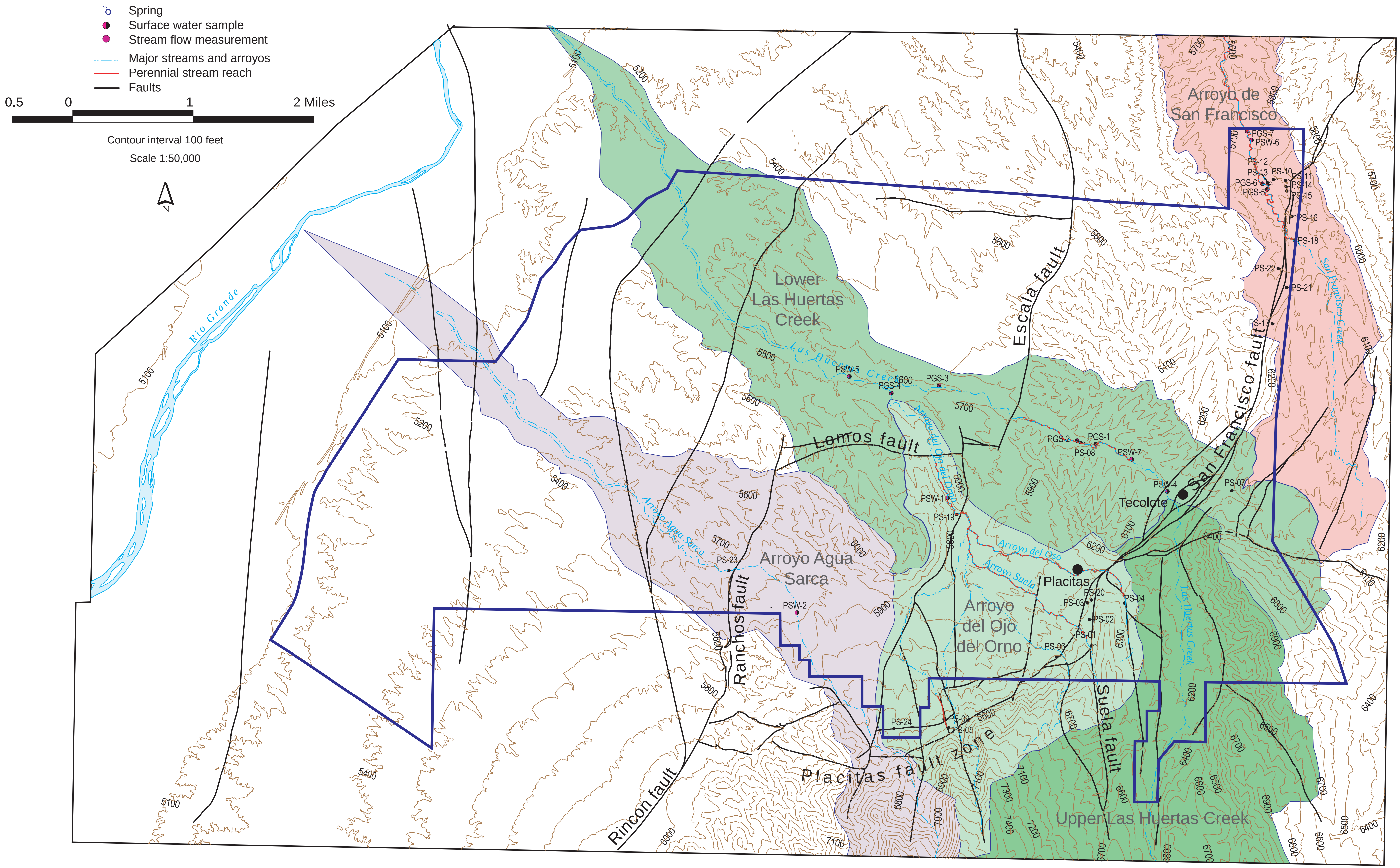

Figure 14. Streams and springs in the Placitas area.

Table 2. Inventory of springs and stream discharge by drainage (see also Figures 9, 14, 15, 16; Appendix D) (page 1 of 2).

Drainage Basin	Spring or Stream Gage	Name	Discharge (gpm)	Date Measured	Method	Water Quality (App F-H)	Data Source for Discharge
	PS-01	Ciruela Spring	133	Avg 1999①	flume③/flow meter	X	L.Gonzales (unpubl. 1999)
	PS-02	Placitas Spring #3	32	Avg 1999①	flume③	X	L.Gonzales (1999)
	PS-03	Placitas Spring #5	13	Avg	flume③	X	L.Gonzales (1999)
	PS-04	El Oso Spring	156	Avg 1999①	flume④	X	L.Gonzales (1999)
	PS-05	Tunnel Spring	---			X	
	PS-06	Escarcida Spring	1	5/29/96	bucket/stopwatch	X	NMBMMR
	PS-07	Tecolote Spring	---			X	
	PS-08	Rosa de la Castilla Spring	100	1/27/98	estimated	X	NMBMMR
	PS-09	Pomecerro Fault Spring	---			X	
	PS-19	Harris Spring	---			X	
	PS-20	Placitas Spring #7	2.8	Avg	bucket/stopwatch		L.Gonzales (1999)
	PS-24	unnamed	---				
Las Huertas Creek	PGS-1	Las Huertas Creek below Tecolote	101	1/27/98	bucket/stopwatch	PSW-7	NMBMMR
	PGS-2	Las Huertas Creek at Tres Amigos	215	1/27/98	bucket/stopwatch	PSW-7	NMBMMR
	PGS-3	Las Huertas Creek @ Camino de las Huertas	38.6	1/27/98	bucket/stopwatch	PSW-5	NMBMMR
	PGS-4	Arroyo del Ojo del Orno at Cedar Crk Rd	3.5	1/27/98	bucket/stopwatch	PSW-5	NMBMMR
	LH-1	Las Huertas Crk above springs at Sandia Conference Grounds	0.0	6/18/91	observation		J.Brekhus et al. (unpubl. report for UNM, 1991)
	LH-2	Below highest spring at Sandia Conference Grounds	11.7	6/18/91	V-notch flume		J.Brekhus et al. (1991)
	LH-3	Culvert at Sandia Conference Grounds	40.4	6/18/91	bucket/stopwatch		J.Brekhus et al. (1991)
	LH-4	Las Huertas picnic area	319	6/18/91	current meter		J.Brekhus et al. (1991)
	LH-5	Las Huertas-La Jara ditch diversion	166	6/18/91	V-notch flume		J.Brekhus et al. (1991)
	LH-6	Las Huertas-La Jara ditch split	40.4	6/18/91	V-notch flume		J.Brekhus et al. (1991)
	WW-1	Las Huertas Creek at NM 165 mile 12	1250	Avg②	unknown		D.Shaw (unpubl. 1999)
Arroyo de San Francisco	PS-10	Lobo Spring	6.4	7/17/97	bucket/stopwatch	X	NMBMMR
			7.3	9/27/97	bucket/stopwatch		R.Cohen (unpubl. 1998)
	PS-11	Lady Spring	1.4	7/17/97	bucket/stopwatch	X	NMBMMR
			1.7	9/27/97	bucket/stopwatch		R.Cohen (1998)
	PS-12	Belle Spring	3.0	9/27/97	bucket/stopwatch		R.Cohen (1998)
	PS-13	Rambi Spring	---				

Table 2. Inventory of springs and stream discharge by drainage (see Figures 9, 14, 15, 16; Appendix D) (page 2 of 2).

Drainage Basin	Spring or Stream Gage	Name	Discharge (gpm)	Date Measured	Method	Water Quality (App. F-H)	Data Source
Arroyo de San Francisco	PS-14	Kas Spring	seep				
	PS-15	Bundes Spring	seep				
	PS-16	BD Sprng	seep				
	PS-17	Galves Spring	---			X	
	PS-18	Johnsonbaugh Spring	---				
	PS-21	Old San Francisco Spring	---				
	PS-22	Upper San Francisco Creek Spring	---				
	PGS-5	San Francisco Creek south of Wessely	200	1/28/98	bucket/stopwatch	PSW-6	NMBMMR
			30	8/11/98	bucket/stopwatch		NMBMMR
	PGS-6	San Francisco Creek at Wessely	146	1/28/98	bucket/stopwatch	PSW-6	NMBMMR
			60	8/11/98	bucket/stopwatch		NMBMMR
	PGS-7	San Francisco Creek at San Felipe Pueblo	142	1/28/98	bucket/stopwatch	PSW-6	NMBMMR
			45	8/11/98	bucket/stopwatch		NMBMMR
Arroyo Agua Sarca	PS-23	Ranchos Fault Spring	seep				

① Average instantaneous discharge for water year 1999 (April 1998 through March 1999) (see Figure 14 and Appendix D).
② Average instantaneous discharge, September 26, 1995 through April 9, 1999 (see Figure 13 and Appendix D).
③ 0.45 cfs (202 gpm) ramp flume
④ 2 cfs (898 gpm) ramp flume

Table 3. Discharge estimates for Placitas Village springs for water years 1998, 1999, and 2000 derived from spring hydrograph separation (see Figure 16) (Johnson, 1999).

Spring	Water Year ①	Quick flow discharge 10^3 m^3	Quick flow discharge ac-ft	Quick flow discharge % of total	Base flow discharge 10^3 m^3	Base flow discharge ac-ft	Base flow discharge % of total	Total discharge 10^3 m^3	Total discharge ac-ft
El Oso	1998	215	174	70	91	74	30	306	248
	1999	159	129	54	135	109	46	294	238
	2000	46	37	28	118	96	72	164	133
#3	1998	13	10	29	32	26	71	45	36
	1999	20	16	33	41	33	67	61	49
	2000	6	5	14	38	31	86	44	36
Ciruela	1998	68	55	33	136	110	67	204	165
	1999	91	74	35	172	139	65	263	213
	2000	16	13	9	171	139	91	187	152

① From March 1 of previous year.
② Partial year record from 4/10/97 through 3/1/98.

Table 7. Ground-water availability and water quality characteristics by hydrogeologic zone; see Plate 5 (page 1 of 2).

Zone (Plate 5)	Description	Hydrostratigraphic Units (Figure 6, Plate 2)	Aquifer Potential (Figure 6)	Ground-water Age/Mean Residence Time* (VI.A.2 Table 6)	Recharge Sources	Water Quality** (Figs. 17, 18; App. F, G, H)	Representative Wells and Springs
M1	Sandia north slope, Upper Las Huertas Canyon, Cuchilla Lupe	Madera Fm.	*Moderate*: fractured aquifer; high transmissivity, low storage; fault and bedding controlled	Modern/ 1 to 10 years	Infiltration from Las Huertas Creek, snowmelt, precipitation	*Excellent*: TDI 270-310 ppm; $Ca-HCO_3$	PW-37, 66, 70, 83, 100, 101, 208, 209; PS-1, 4
M2	Cuchilla de San Francisco	Upper Madera Fm.	*Moderate*: fractured aquifer; high transmissivity, low storage; fault and bedding controlled	Submodern-Holocene and Fossil mix/ 100s to 1000s of years	Interaquifer flow; minor infiltration of local precipitation	*Good*: TDI 320-490 ppm; Ca/Na- to $Ca/Na/Mg-HCO_3$ to HCO_3/SO_4	PW-71, 89, 91, 96, 98, 102, 111, 114, 116, 139; PS-16, 17, 18, 21
	Crest of Montezuma	Madera Fm.		Submodern(?)/ 10s to 100s of years	Interaquifer flow; infiltration of local precipitation	*Unknown:* probably excellent to good $Ca-HCO_3$	none
	San Francisco fault zone	Abo through Upper Mesozoic Fms.	*Poor to none*: isolated fault blocks with low permeability, locally enhanced by fracturing	Submodern-Holocene and Fossil mix/ 100s to 1000s of years; ground water extremely localized	Interaquifer flow localized at Tecolote and San Francisco Springs	*Excellent to good:* TDI 285-340 ppm; Ca/Na- to $Ca/Na/Mg-HCO_3$	PW-76, 87, 115, 157, 207; PS-7
M3	Las Huertas Canyon	Abo Fm. (Pa)	*Moderate to poor*: variable permeability; fault and bedding controlled	Modern-Submodern/ 1 to 10s of years	Infiltration from Las Huertas Creek, snowmelt, precipitation	*Excellent*: TDI 250-320 ppm; $Ca-HCO_3$	PW-3, 50, 51, 88, 92, 93, 94, 154, 155, 156, 164
M4	Highlands east of Cuchilla de San Francisco	Abo, Yeso, Glorieta, San Andres, Moenkopi, Agua Zarca, Petrified Forest Fms.	*Moderate to none*: north-south strip aquifers isolated by aquitards; fault and bedding controlled	Submodern-Fossil/ 100s of years to >10,000 years	Interaquifer flow with long residence time	*Moderate*: TDI 400-1000 ppm; $Na/Mg/Ca-HCO_3/SO_4$	PW-95, 118, 119, 120, 161
R1	Placitas fault zone; western base of Cuchilla Lupe	Abo, Yeso, Glorieta, San Andres, Moenkopi, and Agua Zarca Fms.	*Moderate*: fractured sandstone aquifers; high transmissivity, low storage; fault controlled	Modern-Submodern and Holocene mix/ 10s to 100s of years; highly variable; localized along fault zones	Infiltration of snow melt, precipitation, arroyo and acequia channel flow; interaquifer flow	*Excellent to Good*: TDI 260-340 ppm; $Ca-HCO_3$ to $Ca/Mg-HCO_3/SO_4$	PW-4, 5, 61; PS-2, 3, 5, 20
R2	Southern Mesozoic ramp	Upper and Lower Petrified Forest Fm. (Trcpu, Trcpl)	*None*: primarily shale aquitard	Modern to Holocene and Fossil mix/ 10s to 1000s of years; localized along faults and arroyos	Interaquifer flow along fault zones; infiltration from Arroyo Agua Sarca	*Moderate to very poor:* TDI 560-5950 ppm; $Ca-SO_4$ $Na-SO_4$ and $Na-HCO_3$	PW-6, 10, 40, 44, 46, 107, 113, 140, 141, 171; PS-6, 9
		Middle Petrified Forest Fm. (Trcpm)	*Poor:* thin sandstone strip aquifer bounded by siltstone/shale aquitards		Interaquifer flow along fault zones; infiltration from Arroyo Agua Sarca	*Good to very poor:* TDI 390-3230 ppm; $Na-HCO_3$ $Na-SO_4$ $Ca-HCO_3$	PW-7, 30, 45, 73, 112, 122
R3	Mid Mesozoic Ramp	Upper Mancos Fm. (Km_2)	*Poor to none*: primarily fine grained siltstone and shale aquitard	Submodern to Holocene/ 100s to 1000s of years or more; localized	Interaquifer flow; Caballo-Pomecerro fault; arroyo channel infiltration	*Poor to very poor:* TDI 2250 ppm; $Na-SO_4$	PW-13, 14, 26, 158
		Lower Mancos Fm. (Km_1)	*Poor to none*: primarily fine grained siltstone and shale aquitard	Modern-Holocene and Fossil mix/ <10 to 1000s of years or more; very localized		*Excellent to very poor:* TDI 300 - >3000; $Na-SO_4$ $Ca-HCO_3$ $Ca-SO_4$	PW-1, 8, 12, 16, 31, 43, 47, 48, 56, 57, 58, 75, 126
		Dakota Fm. (Kd)	*Poor to none:* isolated sand aquifers separated by Mancos shale	Modern-Holocene and Fossil mix/ <10 to 1000s of years; localized		*Good:* TDI 300-400 ppm; $Ca-HCO_3$	PW-2, 38, 129
		Morrison Fm.(Jm) [Brushy Basin and Recapture Sh]	*Moderate to none:* isolated strip aquitards and aquifers	Modern-Holocene and Fossil mix/ <10 to 1000s of years; localized		*Excellent to moderate:* TDI 230-700 ppm; $Ca-HCO_3$ and $Na-SO_4$	PW-39, 53, 55, 85, 86, 99, 124, 128, 145
		Todilto Fm. (Jt)	*Poor:* isolated limestone/gypsum aquifer	Submodern to Holocene/ 10s to 1000s of years; localized		*Unknown:* probably poor to very poor $Ca-SO_4/HCO_3$	PW-160
		Point Lookout Fm. (Kpl)	*Moderate to poor:* isolated fine sand aquifer	Submodern-Holocene and Fossil mix/10s to 1000s of years; localized	Interaquifer flow; Caballo-Pomecerro fault; arroyo channel infiltration	*Poor to very poor:* TDI 1490-3140 ppm; $Ca/Na-SO_4$	PW-63, 127, 200, 212
		Hosta-Dalton (Khd)	*Moderate:* isolated sand aquifer	Submodern-Holocene/ 10s to 1000s of years; localized		*Unknown:* probably moderate to poor $Ca-HCO_3/SO_4$	PW-25, 27, 159
		Morrison Fm(Jm) [Jackpile and Westwater Canyon]	*Moderate to poor:* isolated sand aquifers	Modern-Holocene and Fossil mix/ 10s to 1000s of years; localized		*Moderate to poor:* TDI 810-1540 ppm; $Ca-SO_4/HCO_3$	PW-41, 42, 79, 109, 148, 183
		Entrada/U. Petrified Forest (Je)	*Moderate to poor:* isolated sand aquifers	Submodern to Holocene/ 10s to 1000s of years; localized		*Unknown:* probably moderate to poor $Ca/Na-HCO_3/SO_4$	PW-11, 17, 18, 28, 60
R4	Northern Mesozoic Ramp	Menefee Fm. (Kmf)	*Moderate to none*: primarily shale aquitard; isolated Harmon sandstone	Holocene to Fossil/ 1000s to >10,000 years	Infiltration from Arroyo del Ojo del Orno or small ephemeral arroyos	*Moderate to very poor:* TDI 850-3820 ppm; $Na/Ca-SO_4$	PW-21, 23, 33, 59, 78, 80, 103, 123, 147, 149, 174; PS-19

Table 7. Ground-water availability and water quality characteristics by hydrogeologic zone; see Plate 5 (page 2 of 2).

Zone (Plate 5)	Description	Hydrostratigraphic Units (Figure 6)	Aquifer Potential (Figure 6)	Ground-water Age/Mean Residence Time* (VI.A.2 Table 6)	Recharge Sources	Water Quality** (Figs. 17, 18; App. F, G, H)	Representative Wells and Springs
B1a	Escala bench	Lower Santa Fe Group piedmont deposits	*Good*: thick sequence of moderate to high transmissivity gravels and sands	Modern to Fossil/ <10 to >10,000 years; modern at Tecolote and Las Huertas Creek	Infiltration from Las Huertas Creek, San Francisco Creek; subsurface flow at Tecolote and Cuchilla de San Francisco	*Excellent to good:* TDI 280-500 ppm; Ca/Na-HCO_3/SO_4	PW-77, 82, 84, 90, 97, 110, 143, 150, 186
B1b	Lomos Altos (Overlook)	Lower Santa Fe Group piedmont deposits	*Good*: thin sequence of moderate transmissivity gravels and sands, with some mudstone	Modern-Holocene/ annual to 100s of years or more; localized along arroyos	Infiltration from Arroyo del Ojo del Orno	*Good*: TDI ~530 ppm; Ca/Mg- SO_4/HCO_3	PW-184
B2a	Eastern basin adjacent to Rincon and Escala faults	Upper Santa Fe Group piedmont deposits	*Good*: thick sequence of moderate transmissivity gravels and sands	Modern-Holocene and Fossil mix/ annual to 1000s of years; localized along arroyos	Infiltration from Las Huertas Ck, Arroyo del Ojo del Orno, Arroyo Agua Sarca	*Excellent to good*: TDI 240-420 ppm; Ca-HCO_3	PW-9, 22, 24, 29, 105, 108, 130, 135, 137, 142, 151, 152, 162, 163, 169, 202, 203, 214, 217, 219
B2b	Eastern basin between Ranchos and Valley View faults	Upper Santa Fe Group piedmont deposits	*Good*: thin sequence of moderate transmissivity gravels and sands	Modern-Holocene/ 10s to 1000s years; localized along arroyos	Infiltration from Arroyo Agua Sarca and	*Excellent:* TDI 220-270 ppm, Ca-HCO_3	PW-165, 179, 191
B3	Central basin	Upper Santa Fe Group axial river and transitional axial/piedmont deposits	*Excellent*: thick sequence of high transmissivity sands and gravels with some mudstone	Submodern-Fossil and Fossil mix/ 10s to 1000s of years; localized along arroyos	Infiltration along distal reaches of arroyos; interaquifer flow with long residence time	*Excellent to good:* TDI 240-640 ppm (degrades with depth); Ca/Na/Mg-HCO_3	PW-132, 138, 166, 167, 168, 173, 197, 204, 205, 211, 213, 215, 218
B4	Western basin	Loma Barbon member of Upper Santa Fe Group	*Good to moderate*: thick sequence of fine sand, silt, and minor gravel	Submodern?-Holocene and Fossil mix/ 10s to 1000s of years	Infiltration along distal reaches of arroyos, and limited reaches of Rio Grande; interaquifer flow with long residence time	*Excellent*: TDI ≤ 300 ppm; Na/Ca-HCO_3/Cl	PW-198, 210

* **Ground-water age/mean residence time**
Modern: ground-water residence time is ≤ 50 years
Submodern: ground-water residence time is approximately 50 to 1000 years
Holocene: ground-water residence time is approximately 1000 to 10,000 years
Fossil: ground-water residence time > 10,000 years

** **Water Quality**
Excellent: water has less than 300 ppm total dissolved solids (TDI)
Good: water has 300 to 500 ppm TDI
Moderate: water has 500 to 1000 ppm TDI
Poor: water has 1000 to 2000 ppm TDI
Very poor: water has greater than 2000 ppm TDI

Table 8. Aquifer parameters for various hydrostratigraphic units in the Placitas area.

Well I.D.	NMOSE File	Location	Subdivision	Geologic Formation	Specific Capacity (gal/day ft)	Transmissivity T (ft^2/d)	Storage Coefficient	Hydraulic Conductivity K (ft/d)	Data Source
PW-89	RG-64529	13.5.22.4413		325MDERU/fractured	-	76	-	4	Turner Environmental Consultants (1996)
	RG-69572	9.6.6.144		325MDER/fractured	-	20-460	0.0003 - 0.0014	0.09-2	Clay Kilmer & Assoc., Ltd. (1998)
PW-208	RG-66702-ex	12.5.4.1424	San Antonio de las H.	325MDER/fractured	-	1840-2160	*	60-108	Johnson (1999)
PW-96	RG-60484	13.5.23.3342	Diamond Tail	318ABOL/325MDERU	173	126-566	-	36200	John Shomaker & Assoc., Inc. (1995)
PW-95	RG-60484	13.5.23.1124	Diamond Tail	318ABO	720	38-55	-	0.7-1	John Shomaker & Assoc., Inc. (1995)
PW-118	RG-60485	13.5.35.1434	Diamond Tail	318ABO	14	4.4-44	-	0.1-1	John Shomaker & Assoc., Inc. (1995)
PW-119	RG-60066	13.5.35.2144	Diamond Tail	318ABOU	115	30-60	-	0.5-1	John Shomaker & Assoc., Inc. (1995)
PW-120	RG-60067	13.5.35.2122	Diamond Tail	318ABOU	418	176-705	-	36231	John Shomaker & Assoc., Inc. (1995)
	RG-57988CLW	13.5.32.224	Los Pastores	211PNLK	-	23	-	1.1	Turner Environmental Consultants (1998)
PW-212	RG-57988	13.5.32.2244	Los Pastores	211MENF[HARN]	0.2	21	-	0.52	Turner Env.Con. (1998); Newcomer (1994)
PW-157	RG-64551-ex2	13.5.22.4211	Colinas dela Aurora	Fault Material	-	3.6-13.2	-	0.042	Turner Environmental Consultants (1998)
PW-185	RG-64551-ex	13.5.22.4211	Colinas dela Aurora	122SNTFPC		4.4-9.9	0.019	0.11	Turner Environmental Consultants (1998)
PW-206	RG-40708	13.5.22.2323	San Francisco Hills	122SNTFPC	-	140	-	3.5	Turner Environmental Consultants (1996)
	RG-42802	13.5.22.344	Linda Placitas	122SNTFPC	-	178	-	4.4	Turner Environmental Consultants (1996)
	RG-59635	13.5.22.344	Linda Placitas	122SNTFPC	-	2068	0.11	3.4	Turner Environmental Consultants (1996)
PW-191	RG-12871-CD	13.4.25.3413	N Ranchos de Placitas	112SNTFPCS	690	72	-	-	Geohydrology Assoc. Inc. (1995)
PW-214	RG-65081	13.5.19.442	Brenner	112SNTFPCS	317	62	-	-	John Shomaker & Assoc., Inc. (1997)
PW-219	RG-64470	13.5.19.443		112SNTFPCS	-	280	-	7	Glorieta Geoscience, Inc. (1996)
PW-192	RG-12871-CDS	13.4.25.3112	N Ranchos de Placitas	112SNTFT	2376	226	-	-	Geohydrology Assoc. Inc. (1995)
PW-194	RG-10032-S	13.4.26.4433	Ranchos de Placitas	112SNTFT	1008	93	-	-	John Shomaker & Assoc., Inc. (1987)
PW-197	RG-42562	13.4.34.2314	Placitas Trails	112SNTFT	-	4095	-	204	Turner Environmental Consultants (1997)
PW-198	RG-42562-S2	13.4.33.2121	Placitas Trails	112SNTFT[A]	-	13,690	-	456	Turner Environmental Consultants (1997)
PW-205	RG-49516	13.4.27.1244		112SNTFA	44,640	-	-	-	John Shomaker & Assoc., Inc. (1993)

* $(S_f + S_m)$ = 0.20 to 0.26
S_f = 0.003 to 0.012
S_m = 0.197 to 0.228, where S_f is storativity of fractures, and S_m is storativity of matrix