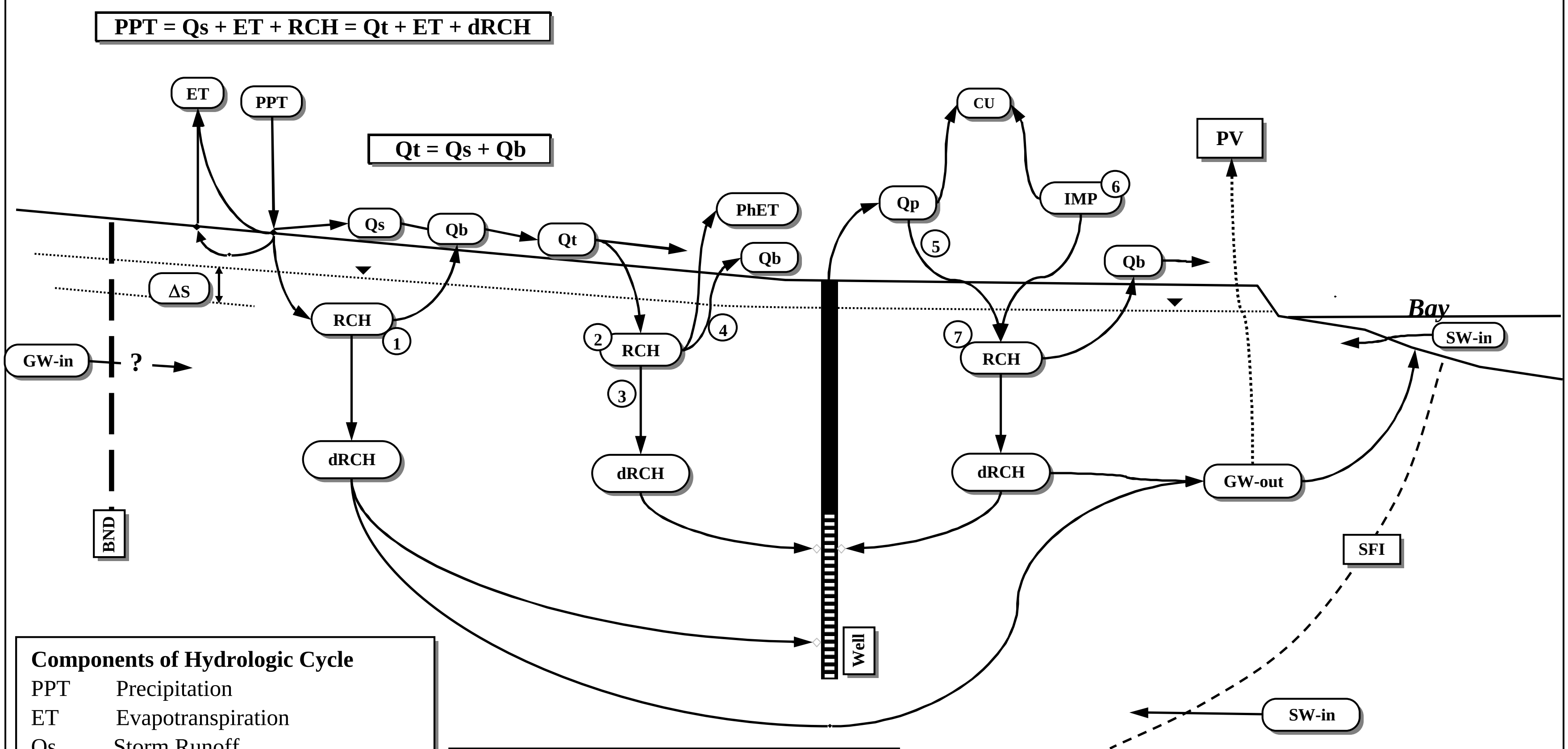


Components of Hydrologic Cycle

PPT Precipitation
ET Evapotranspiration
Qs Storm Runoff
Qb Stream Baseflow and Springs
PhET Phreatophyte ET
Qt Total Streamflow
RCH Groundwater Recharge
dRCH "Deep" Groundwater Recharge*
Qp Groundwater Pumping
CU Consumptive Use
IMP Imported Water
GW-in Subsurface Inflow
GW-out Subsurface Outflow
SW-in Saltwater Inflow
ΔS Change in Storage

Features

BND Basin Boundary (e.g., Zayante fault)
SFI Freshwater-Saltwater Interface
PV Pajaro Valley

Concepts

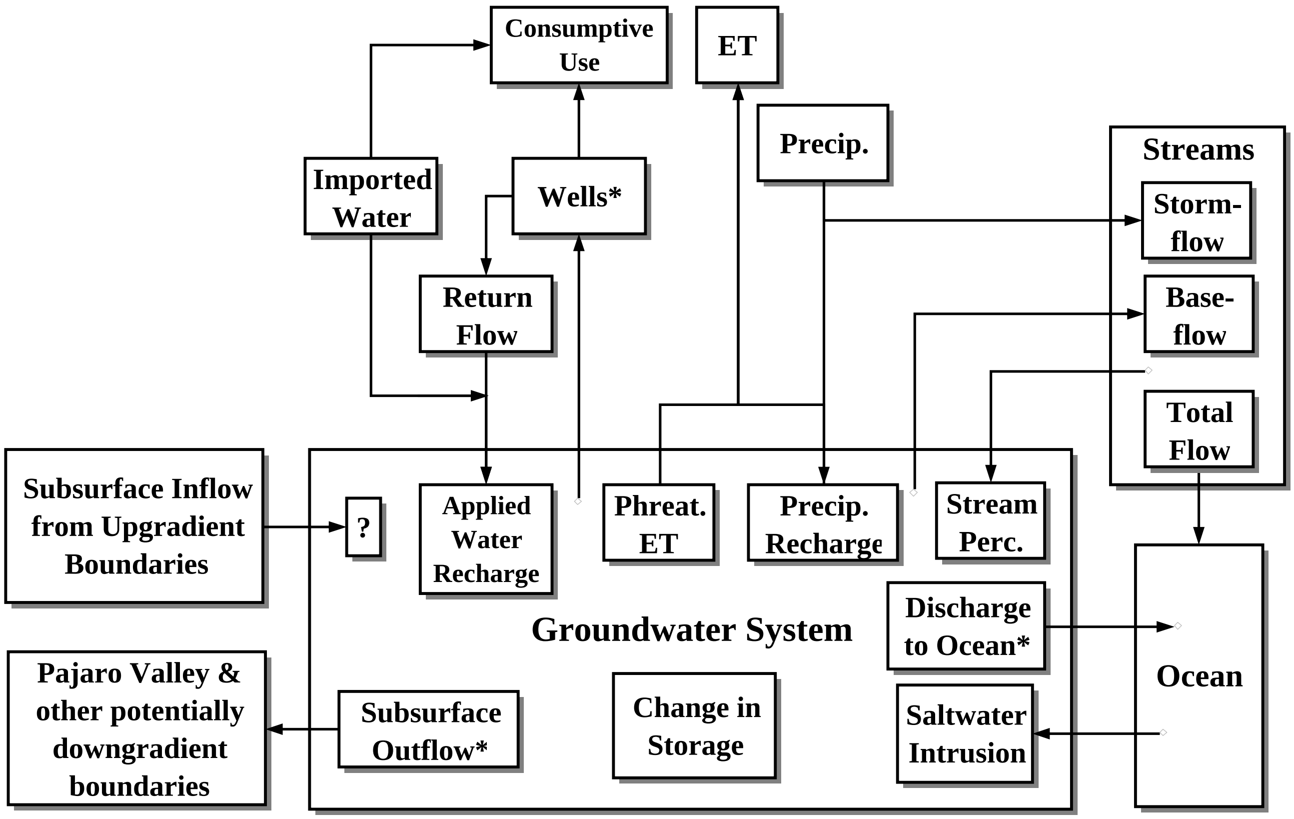
1. Precipitation Recharge
2. Stream Percolation
3. Induced Recharge
4. Rejected Recharge
5. Groundwater Return Flow
6. Non-Beltz water use in Live Oak
7. Applied-Water Recharge

GW-in + RCH + SW-in – ΔS = Qb + Qp + GW-out

Notes

*"Deep" indicates a relative separation from stream-aquifer interactions (not shallow vs. deep aquifers & wells).
For a groundwater budget flow chart see Figure 5-2.

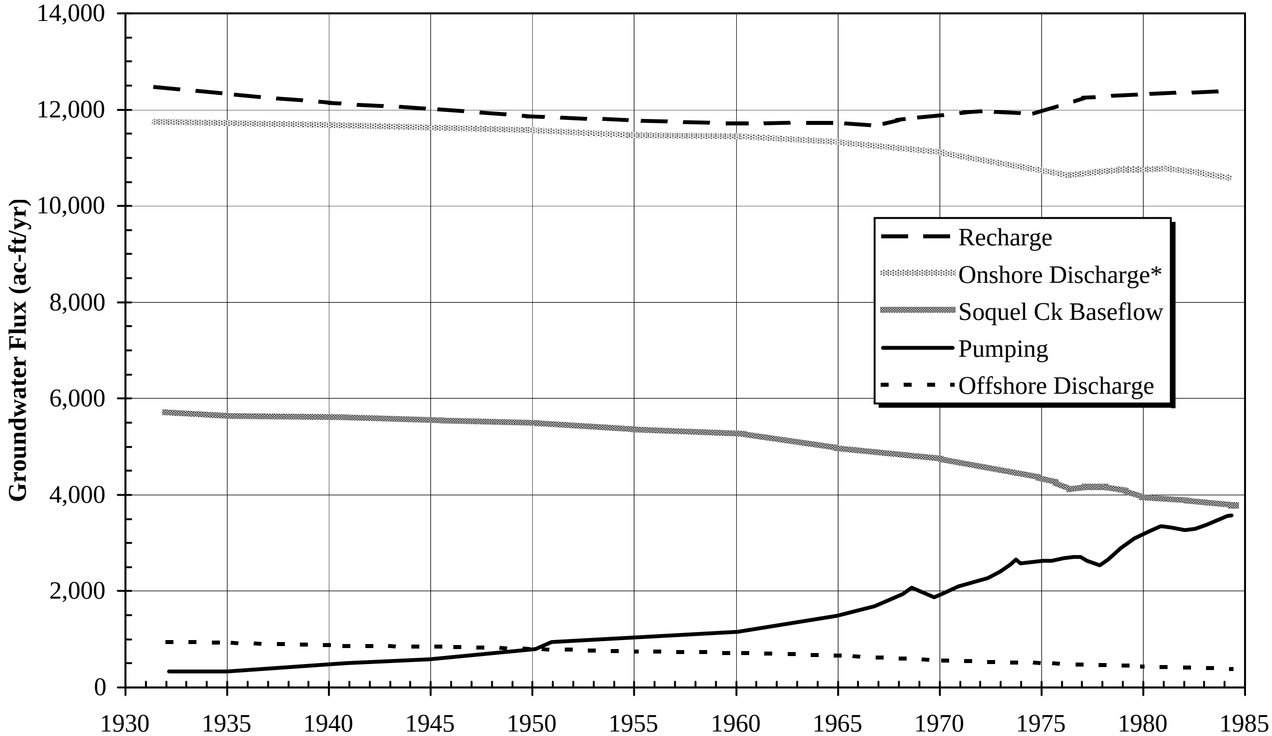
Figure 5-1
Groundwater Aspects of the Soquel-Aptos Hydrologic Cycle



<u>Groundwater Inflows</u>	**<u>Groundwater Outflows</u>**
Precipitation Recharge	Baseflow
Applied-Water Recharge	Wells*
Subsurface Inlfow (if any)	Discharge to Ocean*
Stream Percolation	Subsurface Outflow*
Saltwater Intrusion	Phreatophyte Evapotranspiration

*Discharge of "deep recharge."

Figure 5-2
Soquel-Aptos Conceptual Water Budget



Year	Recharge	Onshore Discharge*	Soquel Ck Baseflow	Pumping	Offshore Discharge	Total Outflow	*Inflow - Outflow*
	(ac-ft/yr)						
1932	12,480	11,760	5,730	330	950	13,040	*-560*
1935	12,320	11,740	5,650	330	930	13,000	*-670*
1940	12,140	11,680	5,620	510	870	13,060	*-920*
1945	12,020	11,630	5,550	590	840	13,060	*-1,050*
1950	11,860	11,580	5,500	790	790	13,170	*-1,300*
1955	11,790	11,480	5,370	970	740	13,190	*-1,410*
1960	11,710	11,450	5,270	1,150	720	13,320	*-1,610*
1965	11,740	11,330	4,990	1,480	660	13,470	*-1,740*
1970	11,890	11,120	4,760	1,940	560	13,630	*-1,740*
1975	11,910	10,710	4,370	2,630	510	13,860	*-1,940*
1980	12,320	10,760	3,960	3,170	430	14,370	*-2,050*
1984	12,370	10,580	3,780	3,580	380	14,550	*-2,170*

* "Discharged onshore to creeks and [groundwater flow into] the overlying Aromas Sands." The fate of the water entering the Aromas in not explained.
- Values estimated from published chart. *Italics* indicate values inferred from provided information.
- Unit rates cannot be calculated because effective model area was not specified.
- No explanation is provided for the non-zero Inflow - Outflow. This could represent use of offshore groundwater storage and/or groundwater outflow to Pajaro Valley.
- No explanation is provided for 1930-1965 decline in recharge.
- Not clear if simulation accounts for historic variations in annual rainfall.
- The simulated 30% decline in 1950-1984 Soquel Ck baseflow is not apparent in the actual historical record (see Table 5-10).

Figure 5-3

Soquel-Aptos Water Budget Simulated by USGS Model (Essaid, 1992)

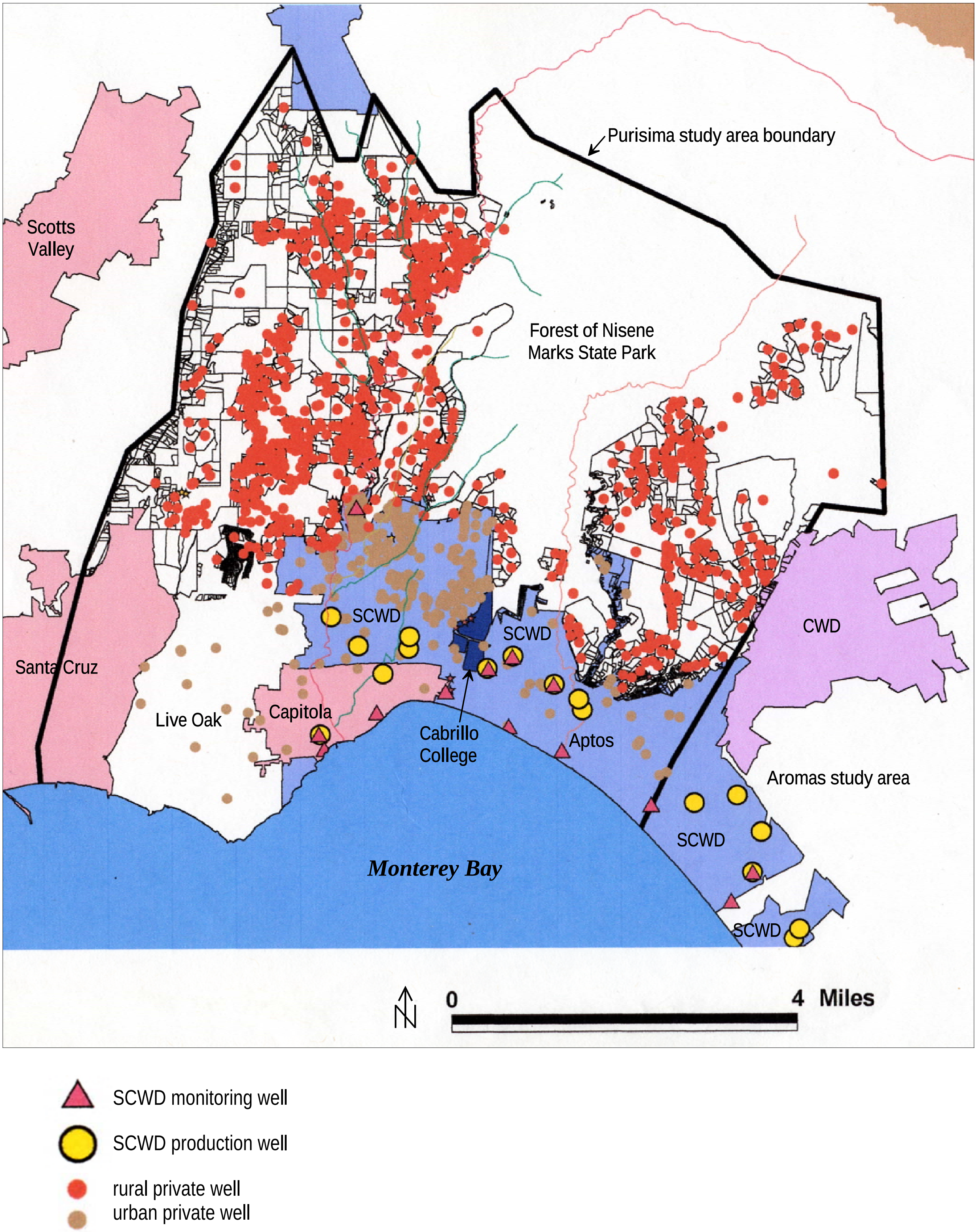


Figure 5-4
Distribution of Private and SCWD Wells in the Soquel-Aptos Area
(adapted from Santa Cruz County Environmental Health Services)

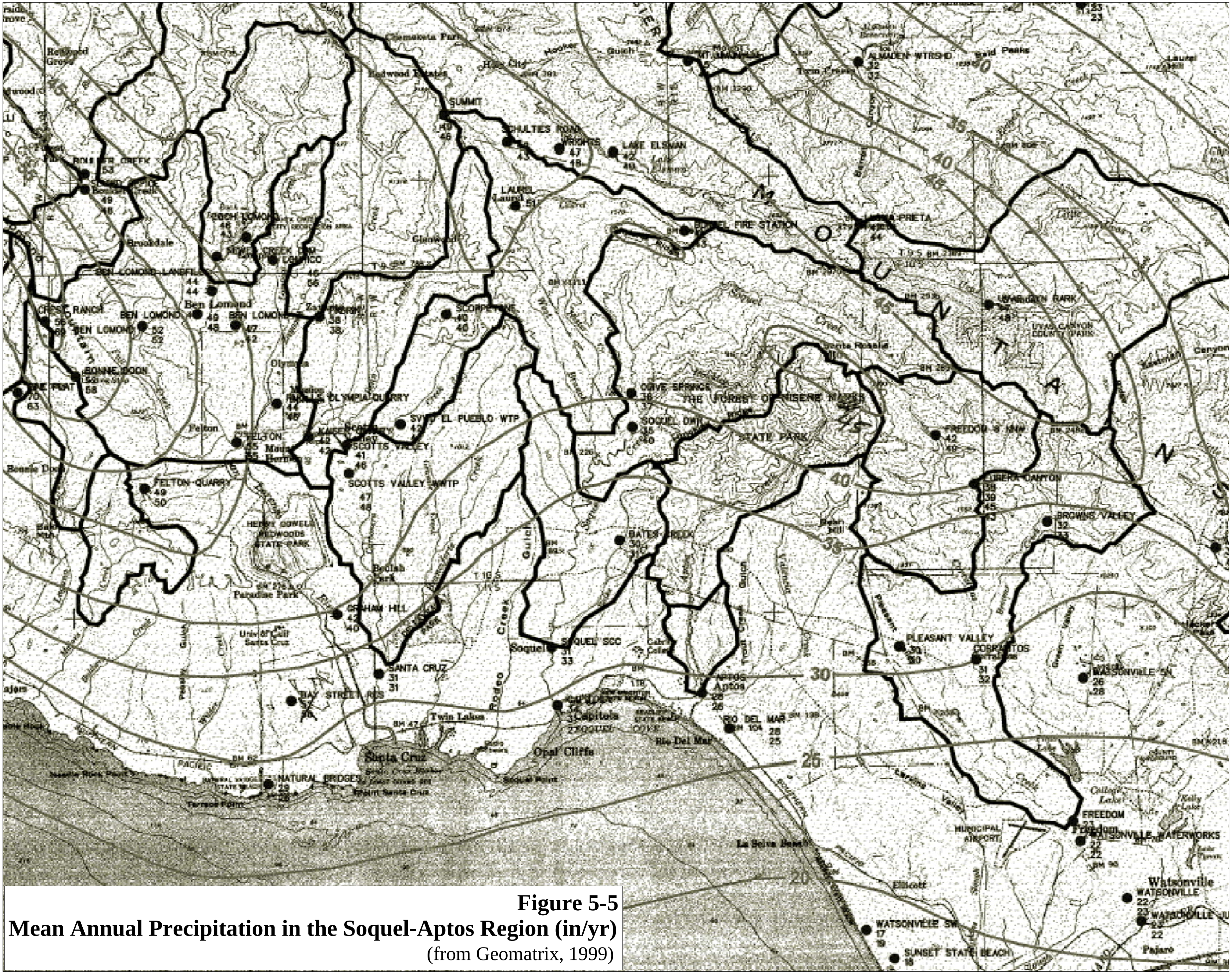


Figure 5-5
Mean Annual Precipitation in the Soquel-Aptos Region (in/yr)
(from Geomatrix, 1999)

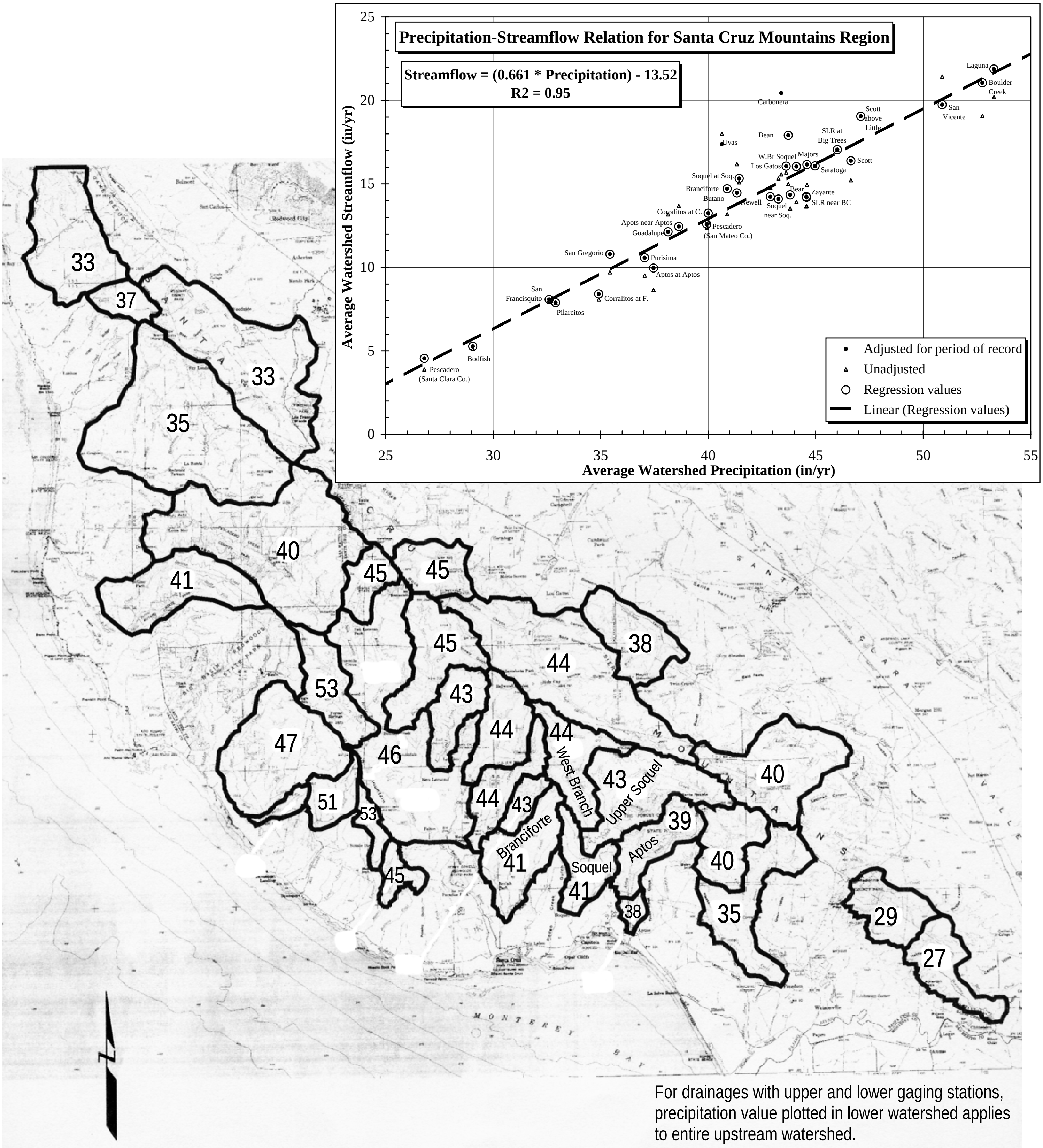
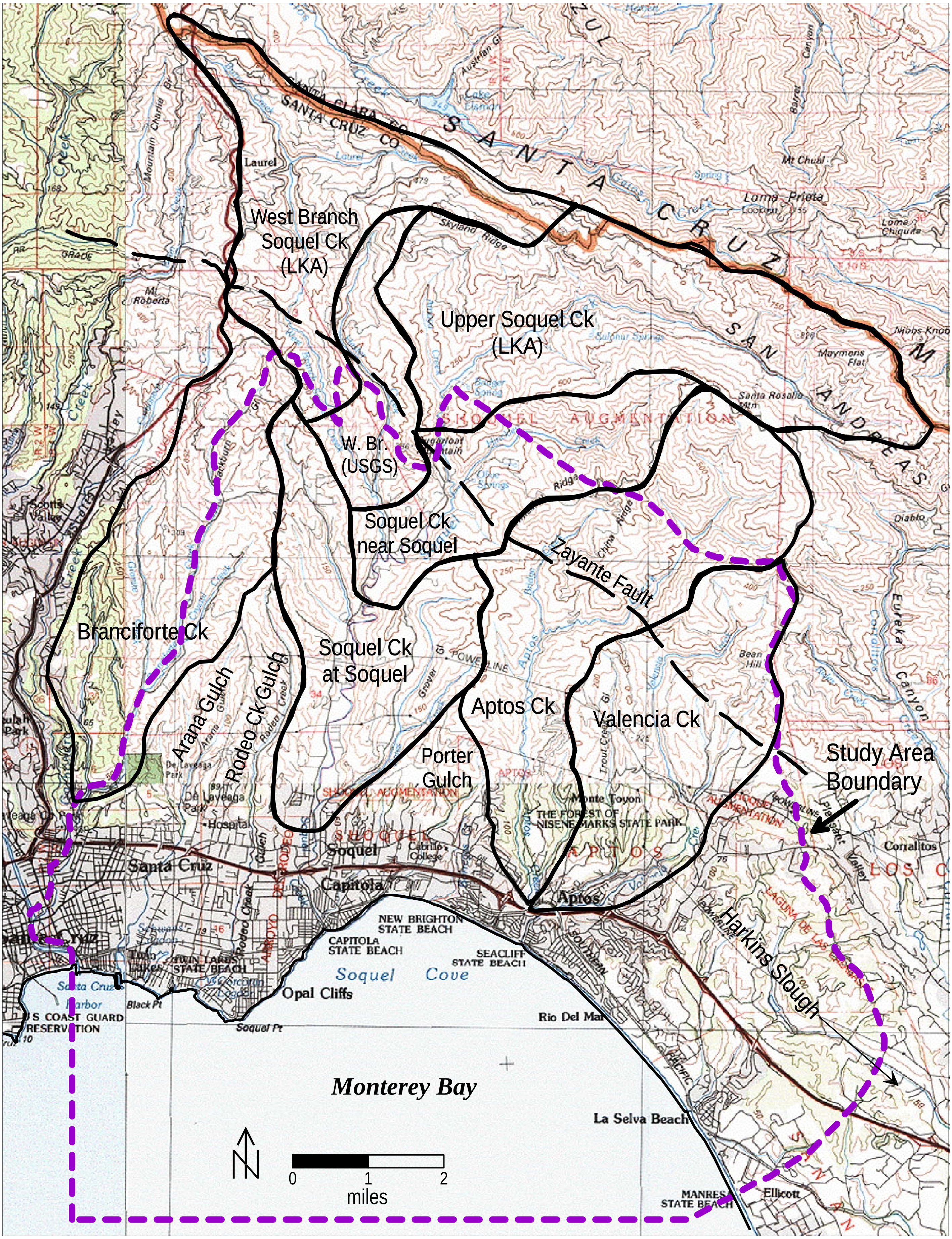


Figure 5-6
Estimated Average Annual Precipitation and Streamflow for USGS Gaged Watersheds in the Santa Cruz Mountains Region (in/yr)
(modified after Geomatrix, 1999)



Watersheds with gaged records are outlined (Table 5-10).

Figure 5-7
Study Area Watersheds

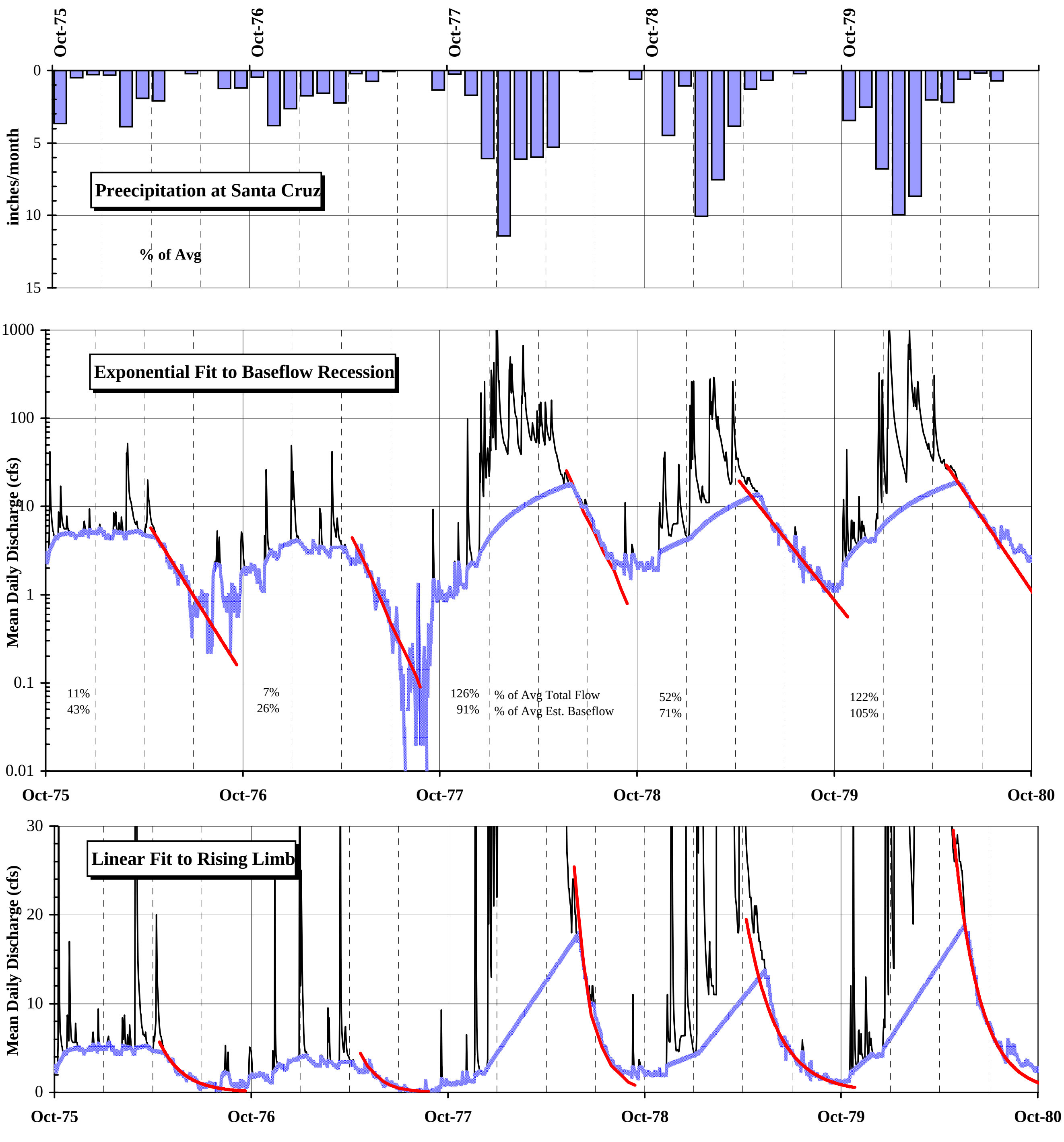


Figure 5-8
Procedure for Stormflow-Baseflow Hydrograph Separation as Demonstrated for Soquel Creek at Soquel, WYs 1976-1981

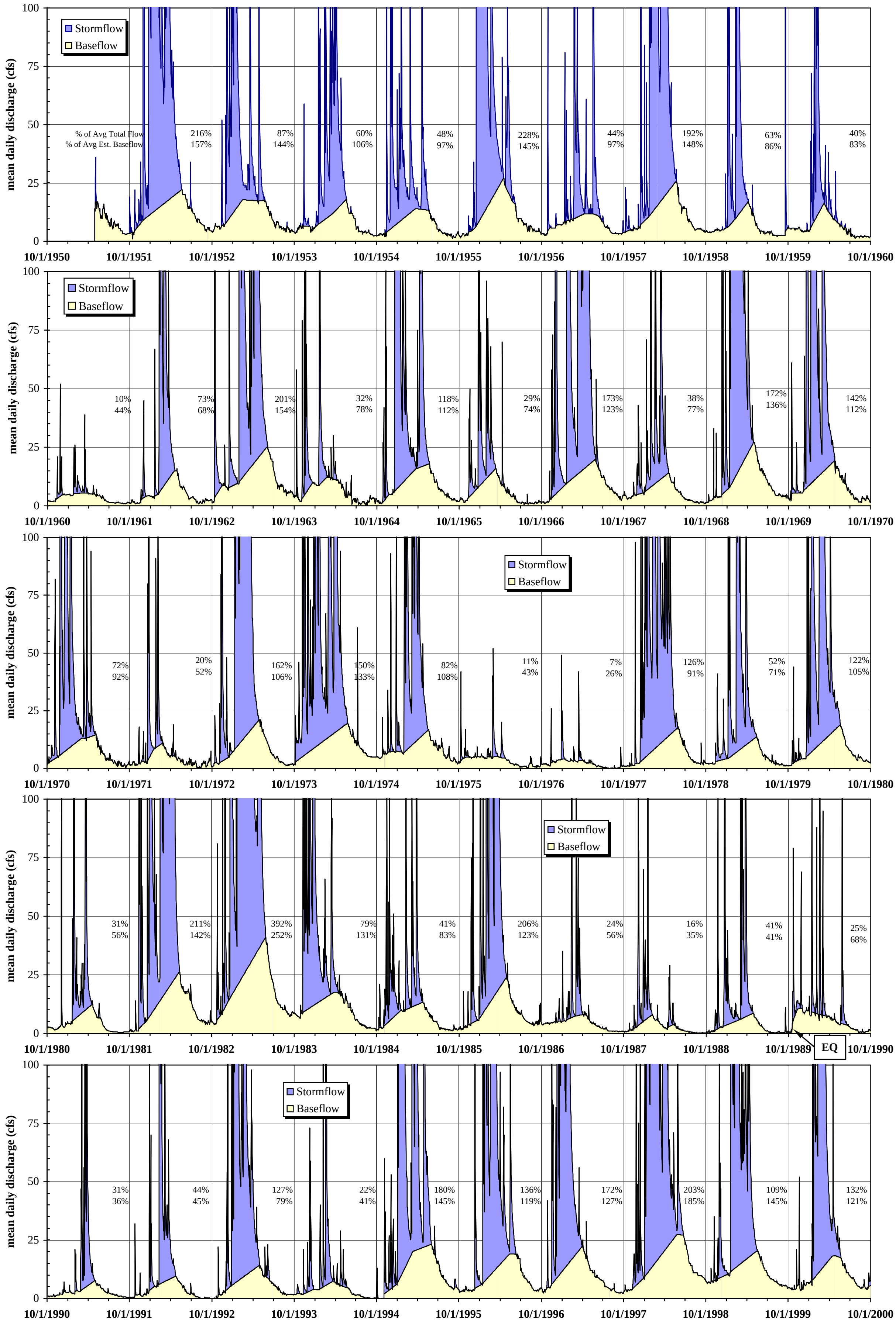


Figure 5-9

Estimated Stormflow-Baseflow Separation for Soquel Creek at Soquel, WYs 1951-2000 (USGS gaged record)

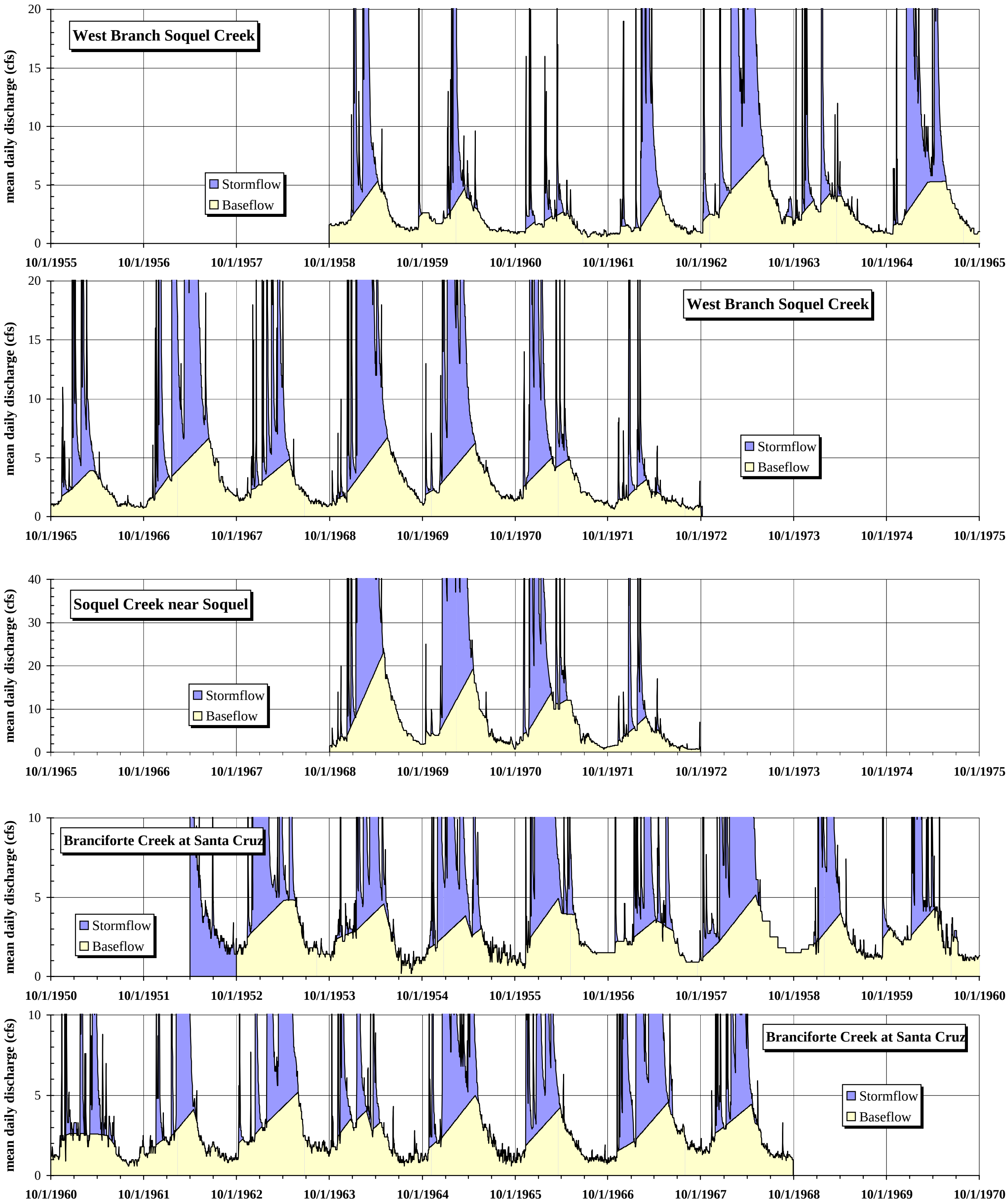


Figure 5-10
Estimated Stormflow-Baseflow Separation for West Branch Soquel Creek, Soquel Creek near Soquel, and Branciforte Creek
(USGS gaged record)

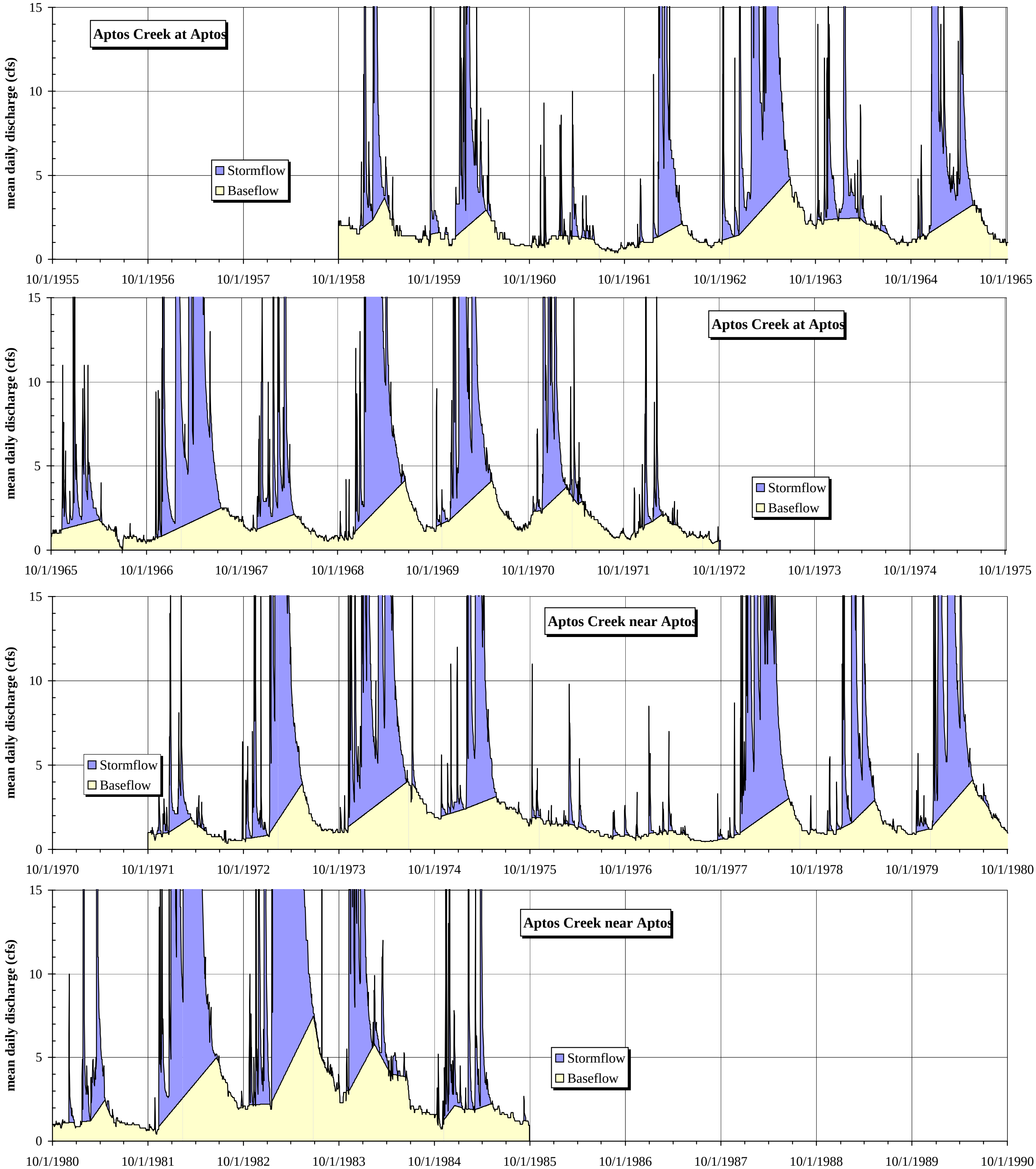
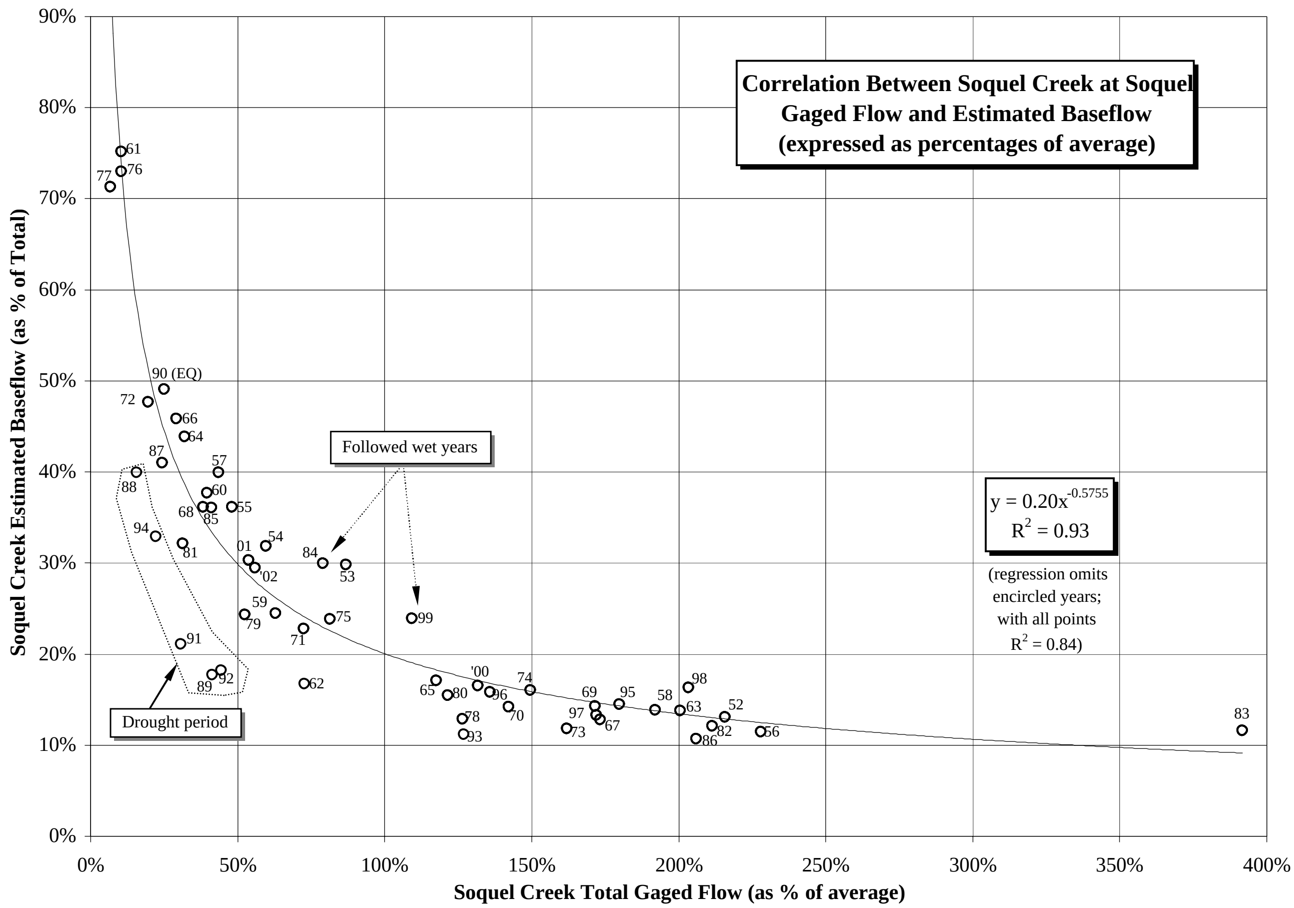


Figure 5-11

Estimated Stormflow-Baseflow Separation for Aptos Creek at/near Aptos, WYs 1959-1985

(USGS gaged data)



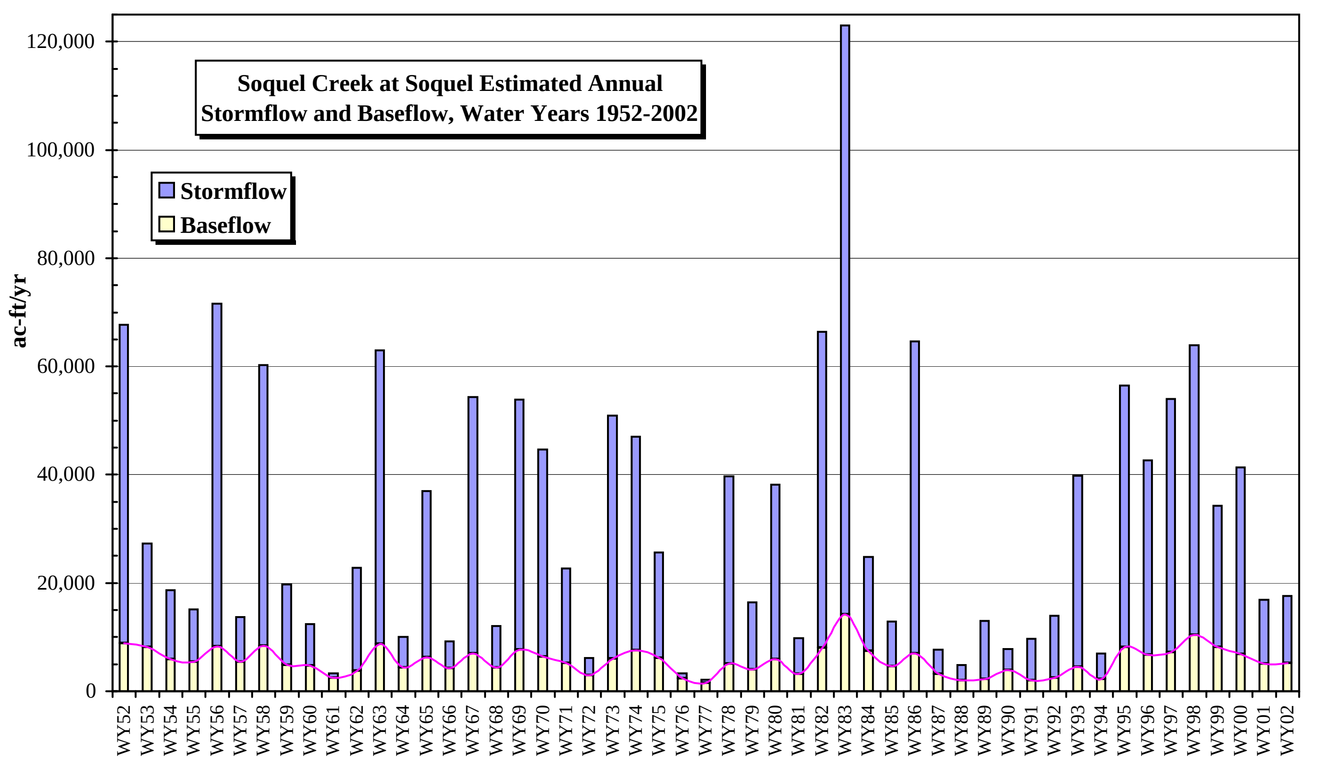


Figure 5-12

Relation Between Total Gaged Flow and Estimated Baseflow, Soquel Creek at Soquel

Reference EvapoTranspiration (ETo) Zones

Zone	Description
1	COASTAL PLAINS HEAVY FOG BELT Lowest ETo in California. Characterized by dense fog
2	COASTAL MIXED FOG AREA Less fog and higher ETo than zone 1
3	COASTAL VALLEYS AND PLAINS AND NORTH COAST MOUNTAINS More sunlight than zone 2
6	UPLAND CENTRAL COAST AND LOS ANGELES BASIN Higher elevation coastal areas
8	INLAND SAN FRANCISCO BAY AREA Inland area near San Francisco with some marine influence

Monthly Average Reference Evapotranspiration by ETo Zone (inches/month)

Zone	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0.93	1.40	2.48	3.30	4.03	4.50	4.65	4.03	3.30	2.48	1.20	0.62	33.0
2	1.24	1.68	3.10	3.90	4.65	5.10	4.96	4.65	3.90	2.79	1.80	1.24	39.0
3	1.86	2.24	3.72	4.80	5.27	5.70	5.58	5.27	4.20	3.41	2.40	1.86	46.3
6	1.86	2.24	3.41	4.80	5.58	6.30	6.51	6.20	4.80	3.72	2.40	1.86	49.7
8	1.24	1.68	3.41	4.80	6.20	6.90	7.44	6.51	5.10	3.41	1.80	0.93	49.4

STATE OF CALIFORNIA
GRAY DAVIS GOVERNOR
THOMAS M. HANNIGAN, DIRECTOR, DEPARTMENT OF WATER RESOURCES

Lambert Conformal Conic Projection
1927 North American Datum

Developed as a cooperative project between the

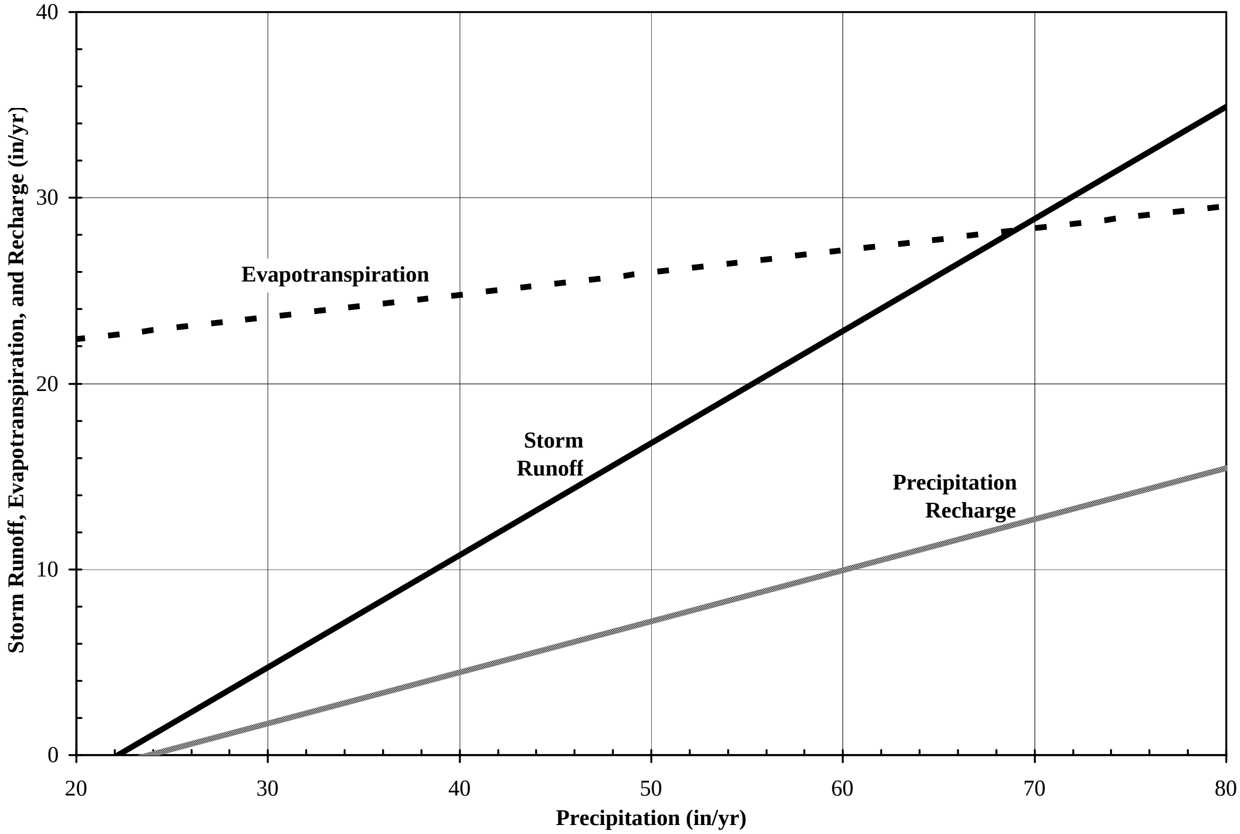
Department of Land, Air and Water Resources
University of California, Davis
And
Water Use Efficiency Office
California Department of Water Resources
Baryohay Davidoff, California Irrigation Management Unit

Map Prepared by David W. Jones 1999
Data developed by Richard L. Snyder, Simon Eching, and Helena Gomez-MacPherson
Background Data from Teale and USGS Sources

Figure 5-13

California Irrigation Management Information System (CIMIS)

REFERENCE EVAPOTRANSPIRATION



Water Year (Oct-Sep)	Precipitation (in/yr)	Precipitation (% of avg.)	Storm Runoff (in/yr)	ET (in/yr)	Precip. Recharge (in/yr)
1974	58	135%	22	27	9
1975	33	77%	6	24	3
1976	21	49%	0	22	0
1977	20	47%	0	22	0
1978	52	121%	18	26	8
1979	40	93%	11	25	5
1980	51	119%	17	26	8
1981	30	69%	4	24	2
1982	66	155%	27	28	12
1983	75	174%	32	29	14
1984	33	76%	6	24	3
1985	41	95%	11	25	5
1986	56	132%	21	27	9
1987	21	50%	0	23	0
1988	25	59%	2	23	1
1989	33	77%	6	24	3
1990	23	53%	0	23	0
1991	28	65%	3	23	1
1992	38	88%	9	25	4
1993	50	118%	17	26	7
1994	31	72%	5	24	2
1995	59	138%	22	27	10
1996	43	101%	13	25	5
1997	50	117%	17	26	7
1998	83	194%	37	30	16
1999	46	108%	14	26	6
2000	50	117%	17	26	7
Avg	43	100%	12	25	5
Min	20	47%	0	22	0
Max	83	194%	37	30	16

This is a hypothetical exercise presented as a possible intial assumption for transient calibration of a groundwater model. The relation between storm runoff and precipitation is estimated from Tables 5-8 and 5-10. The relation between ET and rainfall is hypothetical. The precipitation-recharge relation is constrained by an attempt to approximately match average recharge with estimated average recharge (Table 5-11).

Figure 5-14
Annual Recharge Variability as a Function of Precipitation, Storm Runoff, and Evapotranspiration (inches/year)