Cleath & Associates
Engineering Geologists
Ground Water
(805) 543-1413
1390 Oceanaire Drive
San Luis Obispo
California 93405

Technical Memorandum

Subject: Stream Seepage along the Santa Maria River

Prepared by: Spencer J. Harris, HG 633

Reviewed by: Timothy S. Cleath, HG 81

Date: August 12, 2003

Introduction

The principal source of recharge to the ground water basin is stream seepage along the Santa Maria River. The stream seepage contribution to basin recharge used in published studies for determining safe yield has been based upon stream gage records. It has been assumed by the Santa Barbara County Water Agency and others that recharge from the Santa Maria River over a given hydrologically balanced period will be the same in the future as it has in the past and that no dynamic change due to differences in basin storage takes place. This assumption is incorrect and has led to the underestimation of stream seepage as basin storage is lowered. The following discussion is based on prior work by Cleath & Associates (Status of the Santa Maria Ground Water Basin, April 1996, prepared for USI).

Stream Seepage along the Santa Maria River

A review of stream seepage relationships to gross stream inflow indicates a significant increase in the amount of stream seepage as basin storage (and water levels) drop. For instance, the total ground water basin stream flow input in 1945, 1968, and 1974, and 1982 was between approximately 50,000 and 60,000 acre-feet (Table 2, attached). The outflow at the Guadalupe gage, however, was an order of magnitude higher in 1945 than in the other three years (approximately 5000 acre-feet instead of 200 acre-feet). The rainfall distribution in 1944-45 does not suggest higher flash flood potential than in the other three years. The principal difference between the four years appears to be ground water in storage; in 1944-45 there was about 400,000 to 700,000 acre-feet more ground water in storage than in the other three years. The resulting higher water levels in 1944-45 restricted the amount of stream seepage and produced greater outflow. A similar pattern is found when comparing several other years with equivalent stream inflow, even high flow years, such as 1952 and 1967 (83,000 acre-feet more seepage in 1967 with less ground water storage than 1952).

To have a significant effect on seepage reductions, the water table directly beneath the Santa Maria River would have to rise high enough to alter the steep hydraulic gradient of percolating water. Water levels in several wells near the Santa Maria River have shown that this phenomenon is quite possible. The following historic water levels are from four wells between about 1,000-1,500 feet from the river channel and spread between Fugler Point and the beginning of the confined zone at Bonita School Road:

- 10N/33W-28A1 (near Fugler Point). Water levels as high as 35 feet below ground surface (bgs) in between 1935 and 1975 (SBCWA, 1977).
- 10N34W-02R1 (1 mile east of Highway 101). Water levels as high as 60 feet bgs between 1935 and 1975 (SBCWA, 1977).
- 11N/34W-29R01 (2 miles west of Highway 101). Water level at 18 feet bgs in 1983.
- 11N/34W-30Q01 (3 miles west of Highway 101). Water level at 36 feet bgs in 1941.

With a shallow water table about 1,000-1,500 feet away from the edge of the river channel, it is likely that stream seepage would be reduced by a mound of high ground water directly beneath the channel.

Clearly, the data indicates more stream seepage for equivalent inflow when basin storage is lower. Figure 1 (attached) presents a graph of the percent stream seepage of total inflow for those years between 1935 and 1980 that showed the lowest storage to seepage ratio. It is not surprising that the years with the lowest ratio include some of the biggest rainfall years in the period: 1941, 1952, 1958, 1969, and 1978. This is due to inflow in high rainfall years exceeding maximum channel seepage capacity more often. Figure 1 illustrates how the minimum percentage of stream flow percolating to ground water from the Santa Maria River is increased with lower basin storage.

TABLE 2

SBCWA: 8/15/92

SANTA MARIA GWB MEASURED AND ESTIMATED STREAM SEEPAGE

(All values, not estimated, are from published USGS water resources reports)

Oct–Sep water year	Sisquoc R. Near Sisquoc	LaBrea Crk. Near Sisquoc	Foxen Crk. Near Sisquoc	Tepusquet Cr. Near Sisquoc	Sisquoc R Near Garey	Bradley plus Blosser Ditch**	Cuyama River Below Twitchell	TOTAL GWB INPUT	Santa Maria R. at Guadalupe	GWB STREAM SEEPAGE	TWITCHELL CONTRIB.***	Rounded Unaugmented StreamSeep.
1944	40600	6860	370 *	1520	37800	2200 *	32150 *	83600	13560	70040	0	70000
1945	24080	2960	240 *	867	16980	1650 *	20300 *	50097	4990	45107	0	45100
1946	17400	141	100 *	352	8520	1050 *	11400 *	30443	4880	25563	0	25600
1947	7640	0	60 *	219	2230	800 *	7700 *	16419	2530	13889	0	13900
1948	774	0	40 *	148	0	700 *	2900 *	4562	0	4562	0	4600
1949	3680	0	60 *	222	89	800 *	3000 *	7762	0	7762	0	7800
1950	6880	107	70 *	243	1200	850 *	5700 *	13850	2460	11390	0	11400
1951	1190	0	80 *	268	0	900 *	4700 *	7138	0	7138	0	7100
1952	76660	20670	610 *	2680	73720	3000 *	110400 *	214020	112800	101220	0	101200
1953	11640	1170	200 *	780	5160	1800 *	12900 *	28290	362	27928	0	27900
1954	13720	2110	260 *	917	9920	1700 *	12400 *	31107	1270	29837	0	29800
1955	5260	572	140 *	539	609	1300 *	4200 *	12011	0	12011	0	12000
1956	14060	2070	290 *	1160	8360	1900 *	18600 *	38080	4200	33880	0	33900
1957	3420	0	60 *	197	95	800 *	2400 *	6877	0	6877	0	6900
1958	110600	19200	970 *	4560	99210	3800 *	132800 *	271930	133500	138430	0	138400
1959	9840	13	50 *	157	2410	700 *	4300	15060	0	15060	0	15100
1960	2910	0	50 *	154	52	700 *	1060	4874	0	4874	0	4900
1961	826	0	20 *	45	0	400 *	22	1313	0	1313	0	1300
1962	48750	8120	560 *	2460	46570	2600 *	58560	121250	24260	96870	30300	66700
1963	5580	0	70 *	247	275	850 *	2430	9177	0	9177	0	9200
1964	2510	0	40 *	132	0	650 *	1670	5002	0	5002	0	5000
1965	12720	653	70 *	280	3190	900 *	3010	17613	0	17613	400	17200
1966	24250	1060	45	293	9570	950 *	5350	31968	908	31060	1800	29000
1967	108400	26550	132	3260	95450	3200 *	75100	216642	32040	184602	70000	114600
1968	11530	475	69	246	3280	850 *	44190	57360	104	57256	1300	56000
1969	261400	48620	1610	8070	287800	5200 *	149200	474100	179700	294400	70000	224400
1970	17010	895	347	839	5180	1600 *	111300	131991	131	131860	52300	79600
1971	15630	581	117	311	3930	680	5730	23049	0	23049	0	23000
1972	7260	0	76	199	1020	560	0	8005	0	8005	0	8000
1973	46370	5160	340	3080	36520	3050	42190	100140	9990	90150	17800	72400
1974	19950	4100 *	350 *	1480	5610	1230	33330	60440	209	60231	1800	58400
1975	18310	670 *	120 *	456	8160	1200	5820	26576	307	26269	400	25900
1976	4270	50 *	50 *	181	391	1270	0	5821	0	5821	0	5800
1977	1770	10 *	40 *	122	63	780	0	2722	7	2715	0	2700
1978	135100	8100 *	560 *	2430	106200	4800	82640	233630	49670	183760	70000	113800
1979	34890	1500 *	200 *	752	28360	1500 *	122600	161442	2230	159212	33200	126000
1980	75610	13000 *	730 *	3260	85950	2700	110000	205300	21180	184120		
1981	15010	1000 *	150 *	573	6540	2200	10280	29213	549	28664		
1982	22000	2300 *	250 *	980	14900	2200	26580	54310	322	53988		
1983	139800	45000 *	1600 *	7980	231800	5000	91630	291010	151400	139610		

* Denotes estimated value (see correlation graphs). The 1944 thru 1958 estimates for Cuyama River Below Twitchell equal Twitchell Inflow (Karen Johnson model, 1979) plus 1/3rd Tepusquet Creek.

** Based upon 4 years of correlation, Blosser Ditch is set equal to Bradley Ditch for all years...

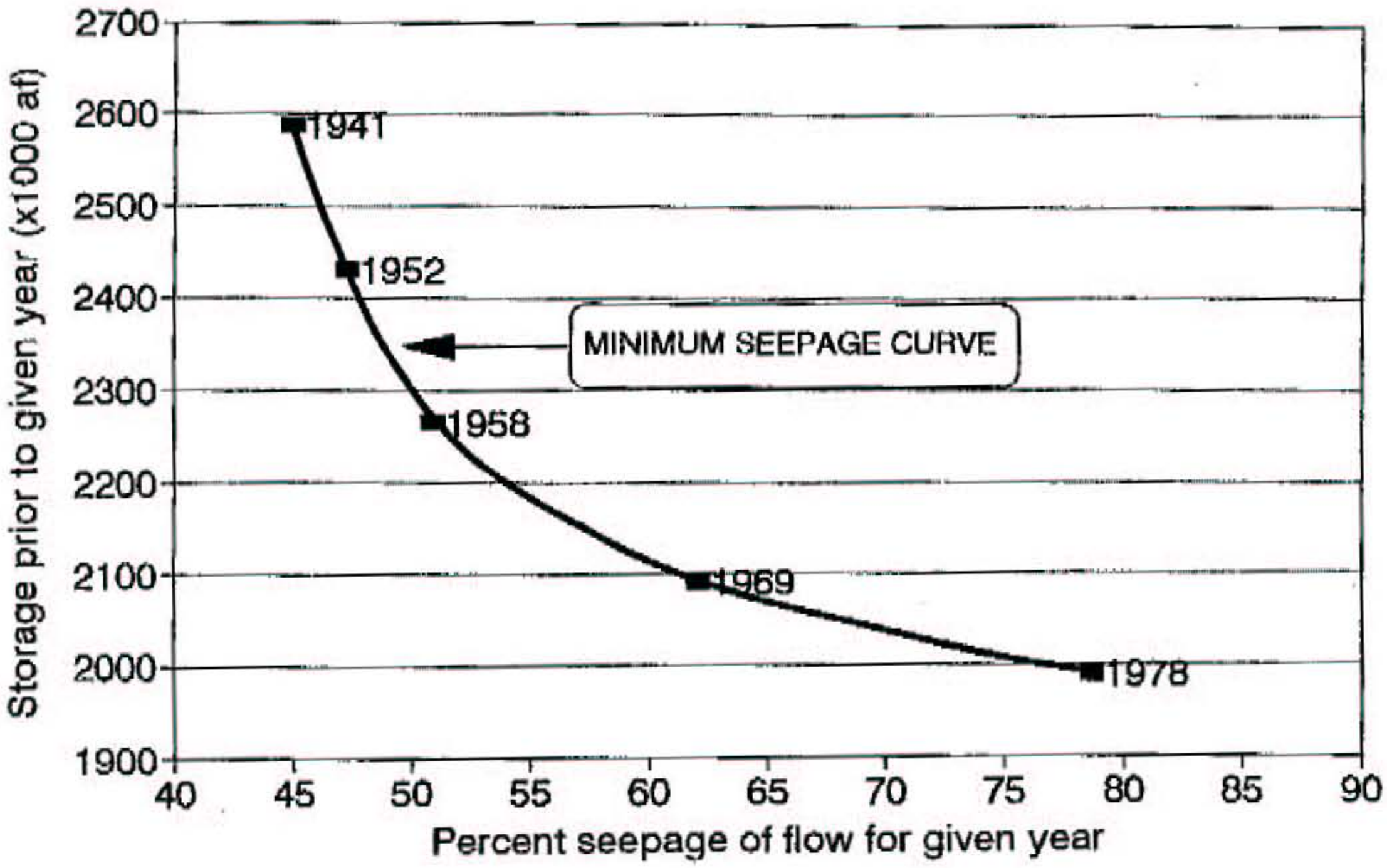
*** Rounded values from SBCWA 18 year daily model of Twitchell Reservoir.

Note that Sisquoc River Near Garey is NOT a GWB input; it is the output flow of the Sisquoc watershed just above Fugler Point (& the confluence with the Cuyama River).

SOURCE: Santa Barbara County Water Agency, 1992

Stream Seepage vs Basin Storage

Santa Maria Ground Water Basin



Source: **Cleath & Associates, April 1996, Status of the Santa Maria Ground Water Basin, prepared for USI.**

FIGURE 1