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WATER RESOURCES ANALYSIS
AND INFORMATION SECTION

Office Report No. 40

A REVIEW OF THE WATER RESOURCES
OF THE WENATCHEE BASIN

by

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(For Use by the Water Resources Management Division)

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Department of Ecology
Olympia, Washington

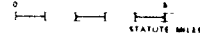
INTRODUCTION

The purpose of this report is to present a brief review of the water resources of the Wenatchee Basin, with emphasis upon water use, irrigated acres, and water rights. This report is not considered complete and will be updated with additional information when the time is warranted.

LAND USE

Figure I shows the Basin and its subdivisions. These subdivisions have been determined by the SCS for convenient inventory purposes, and usually follow natural watershed boundaries. A very small portion of Chelan County is not part of the river basin, but will be included in this report for convenient data purposes. A good breakdown on land use, by subbasin, is given in Table I. The information is a few years old (1968) but is the best available at this time. The biggest change will be in the amount of irrigated acres, which may be a little higher than indicated in 1967.

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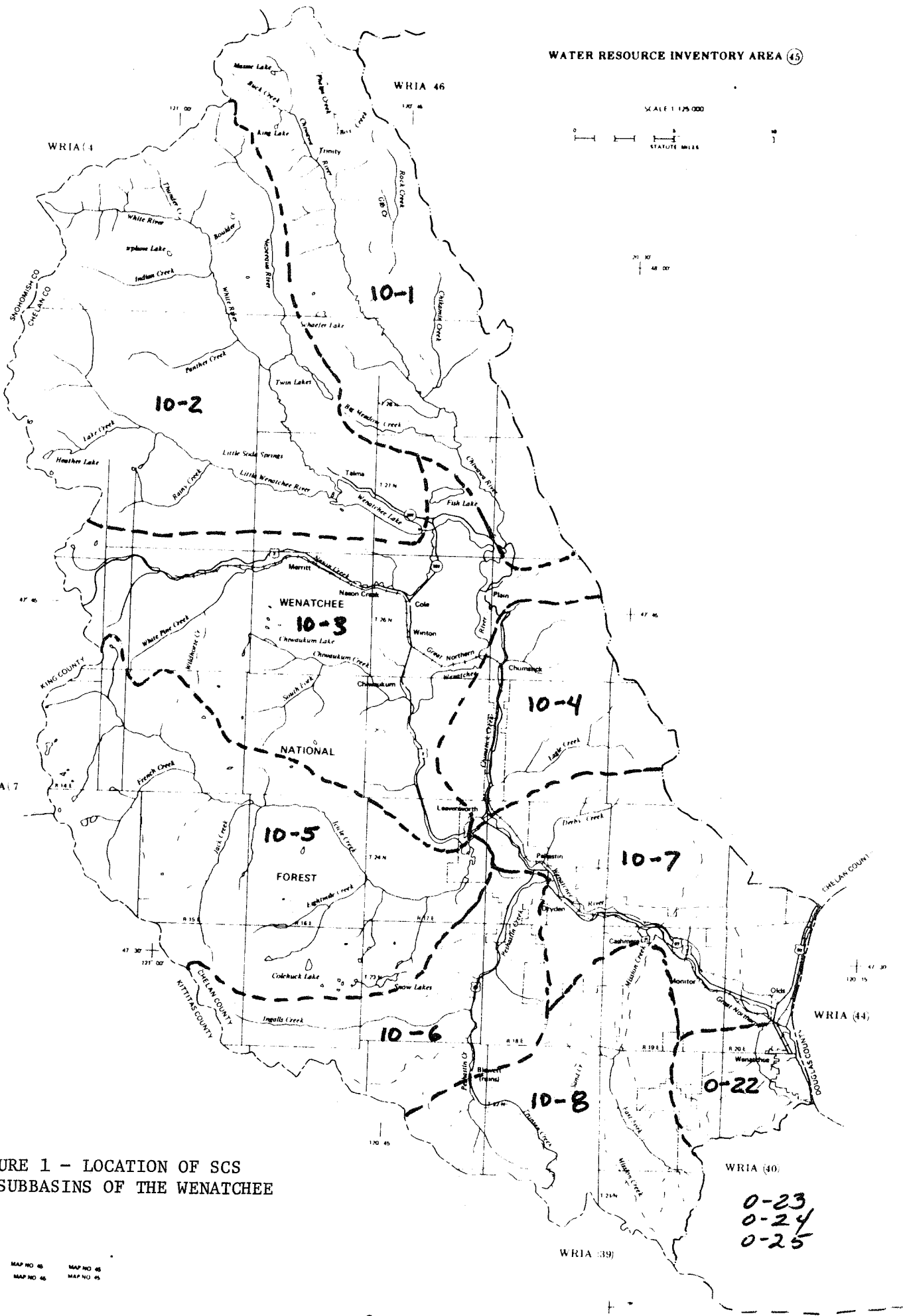


FIGURE 1 - LOCATION OF SCS SUBBASINS OF THE WENATCHEE

MAP NO 46 MAP NO 45
MAP NO 46 MAP NO 45

TABLE 1 - LAND USE AND IRRIGATED ACRES
 WENATCHEE BASIN
 SCS - 1967
 (in acres)

Subbasin	Map No.	Forest Land		Cropland	Rangeland	Other	Total	Irrigated Acres			
		Grazed	Not Grazed					Surface	Ground	Potential	
Chiawa River	10-1	0	114,758	220	0	1,789	116,767	20	0	20	0
Lake Wenatchee	10-2	2,000	167,805	210	0	3,849	173,864	10	0	10	0
Wenatchee River	10-3	6,000	144,242	1,050	0	4,196	155,488	650	0	650	0
Eagle-Chumstick Creek	10-4	48,509	0	1,250	0	580	50,339	250	0	250	0
Icicle Creek	10-5	0	134,451	500	0	1,305	136,256	300	0	300	0
Peshastin Creek	10-6	59,535	0	1,800	0	1,281	62,616	1,500	0	1,500	0
Lake Wenatchee River	10-7	55,056	0	8,000	13,000	4,952	81,008	6,000	0	6,000	0
Mission Creek	10-8	60,542	14,000	3,900	0	735	79,177	2,700	0	2,700	0
West Wenatchee Area	0-22	1,228	0	1,700	13,500	2,997	19,425	800	0	800	0
Squillchuck Creek	0-23	5,000	0	1,100	13,068	319	19,487	1,000	0	1,000	300
Stemilt Creek	0-24	11,683	0	1,100	8,683	474	21,940	1,000	0	1,000	300
Colockum Creek	0-25	7,000	0	1,600	82,711	8,996	100,307	900	0	900	3,500
TOTAL		256,553	575,256	22,430	130,962	31,473	1,016,674	15,130	0	15,130	4,100

WATER USE

Based on the available information, the estimated water use in the Wenatchee Basin in 1970 was:

<u>Use</u>	<u>Surface Water</u> (acre-ft/year)	<u>Ground Water</u> (acre-ft/year)	<u>Total</u> (acre-ft/year)
Irrigation	59,600	2,200	61,800
Industrial	15,000	570	15,570
Municipal	3,500	11,150	14,650
Domestic	0	2,000	2,000
Stock	200	100	300
TOTAL	78,300	16,000	94,300

Water Rights

A summary of water rights and water right claims is given in Tables 2 and 3.

Irrigated Acres

The largest use of water in the Wenatchee Basin is for irrigation. Naturally, the amount of irrigated acres is an important factor in determining actual use and predicting future use. Because there is such a large number of irrigated acres, determining the exact amount can be a tricky business. Following is a discussion of the different sources of information we have on irrigated acres and water use.

County Data

Much information is on a county basis. This is not really inconvenient, however, because Chelan County is made up of the Wenatchee, Chelan, and Entiat river basins. According to the Census of Agriculture, in 1969, 24,266 acres were irrigated in Chelan County. Of these, 22,537 acres (93%) were in orchards; 1,597 acres (6%) were in hay or pasture; and 132 (1%) were in small grains.

The U.S. Geological Survey has estimated 28,400 acres were irrigated in the County in 1970.

TABLE 2. SUMMARY OF WATER RIGHTS - WENATCHEE BASIN (1975)
(in cfs)

Use	Surface	Ground	Total
Municipal	22.3	5.51	27.8
Irrigation	502.2	17.6	519.8
Domestic	10.5	4.8	15.3
Industrial & Commercial	232.9	9.1	242.0
Stock	<u>0.3</u>	<u>0.1</u>	<u>0.4</u>
TOTAL	768.2	37.11	805.31
Irrigated Acres	30,597	765	31,362
Total Number of Rights	262	133	395

TABLE 3. WATER RIGHT CLAIMS - WENATCHEE BASIN

January, 1975

Number of Claims

	Domestic	Stock	Irrigation	Other	Total	Irrigated Acres
Surface Water	201	92	134	28	455	11,986
Ground Water	644	62	101	21	828	701
TOTAL	845	154	235	49	1,283	12,687

Note: A high degree of reliability should not be placed upon these figures; there is no accurate way to assess the human error involved while filing a claim.

Basin Data

Many sources give irrigated acres by basin, and the county figure can be obtained by adding the three basins together. Among these sources are: The Soil Conservation Service, which estimated irrigated acreage in 1967; the Irrigation Districts (totals were tabulated for all districts in the county - perhaps the most accurate source); Water Supply Bulletin Number 1220 (published in 1945, the estimates appear too high); and Water Rights - which are far in excess of the actual amount irrigated.

Table 4 sums up these different sources on a historical basis. Figure 2 is a graph showing the different figures on a comparative format.

Irrigation District figures are the most accurate. In 1975, there were 17,021 irrigated acres in the Wenatchee Basin. This is the figure that will be used in computing water use in this report.

TABLE 4. IRRIGATED ACRES IN CHELAN COUNTY

Source	1930	1940	1950	1960	1965	1967	1970	1975
Water Rights (Surface & Ground)*								
Wenatchee Basin	29,270	29,382	29,717	29,929		30,580		31,362
Entiat Basin	410	490	521	589		656		775
Chelan Basin	8,865	9,450	11,156	11,852		14,371		21,750
Chelan County	38,545	39,332	41,394	42,370		45,607		53,888
Census of Agriculture**	29,311	26,626	27,019	30,985	31,530		24,266	
U.S. Geological Survey					26,815		28,400	
Soil Conservation Service								
Wenatchee Basin						15,130		
Entiat Basin						3,700		
Chelan Basin						6,700		
Chelan County						25,530		
Irrigation Districts								
Wenatchee Basin								17,021
Entiat Basin								760
Chelan Basin								6,590
Chelan County								24,371
Water Supply Bulletin 1220		34,310						

*In 1975, irrigated acres by ground-water rights constituted only 7 percent of the Chelan County total.

**It is not totally understood why these figures should be so much higher in earlier years; the data base is probably incorrect.

FIGURE 2. Irrigated Acres, Chelan County

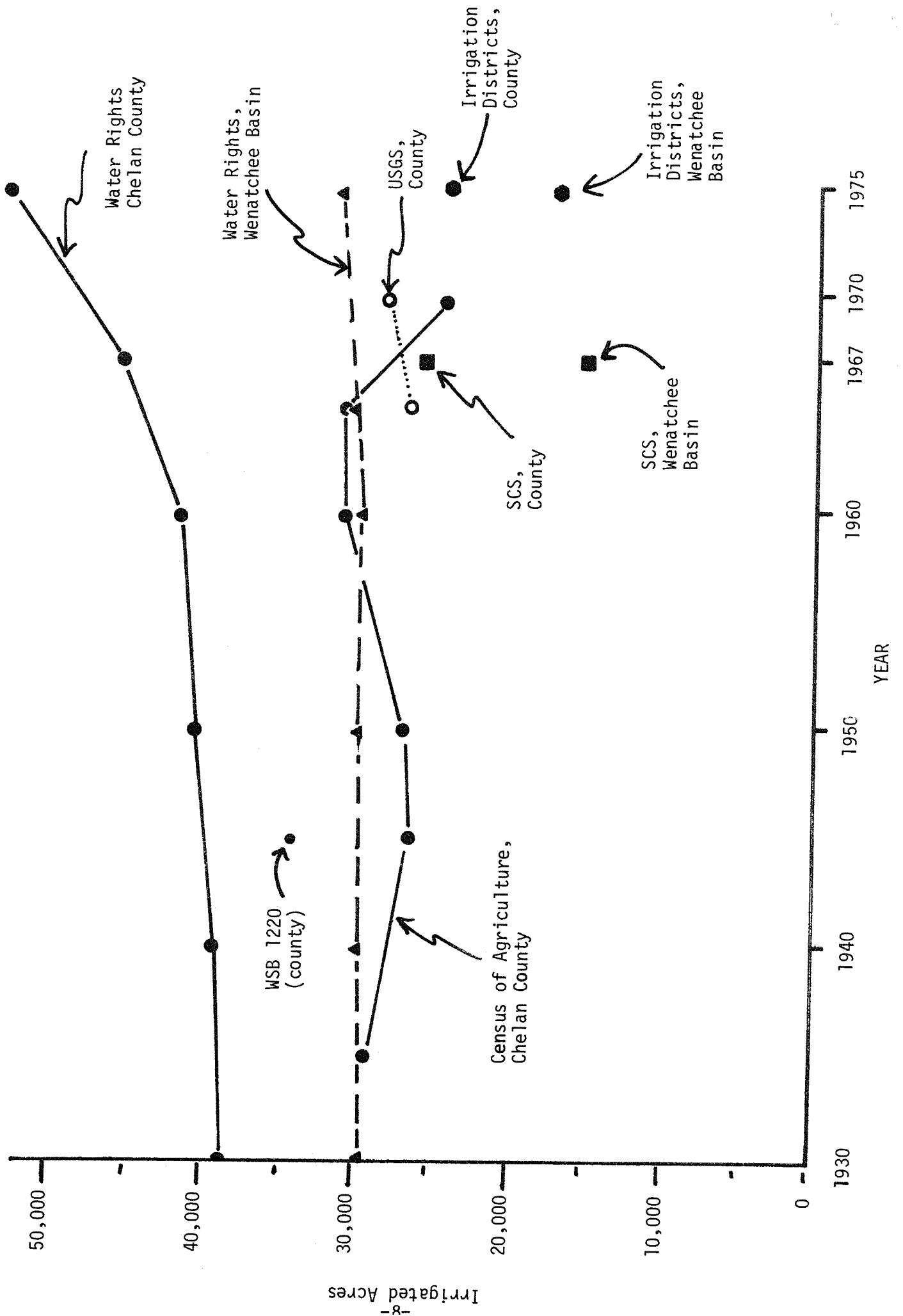


Table 5 is a breakdown of irrigated acres by Irrigation District for the whole county, and Figure 3 shows irrigated lands in the Wenatchee Basin. Figure 4 shows where the major diversions take place in the Basin.

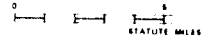
TABLE 5. CHELAN COUNTY IRRIGATED ACRES BY IRRIGATION DISTRICT

Irrigation District	Irrigated Acres	Total Acres
Wenatchee Basin		
Wenatchee Reclamation District	6,700	6,700
Wenatchee Heights I. D.	650	656
Wenatchee-Chiwawa I.D.	1,190	1,200
Icicle I.D.	3,836	4,262
Peshastin I.D.	3,530	3,560
Stemilt I.D.	500	500
Millerdale I.D.	91	118
Lower Squillchuck I.D.	124	124
Beehive I.D.	400	400
TOTAL	17,021	17,520
Chelan Basin		
Lake Chelan Rec. Dist.	4,750	6,600
Chelan Falls I.D.	320	361
Chelan River I.D.	361	381
Isenhart I.D.	246	246
Greater Wenatchee I.D.	913	913
TOTAL	6,590	8,501
Entiat Basin		
Entiat I.D.	760	800
TOTAL CHELAN COUNTY	24,371	26,821

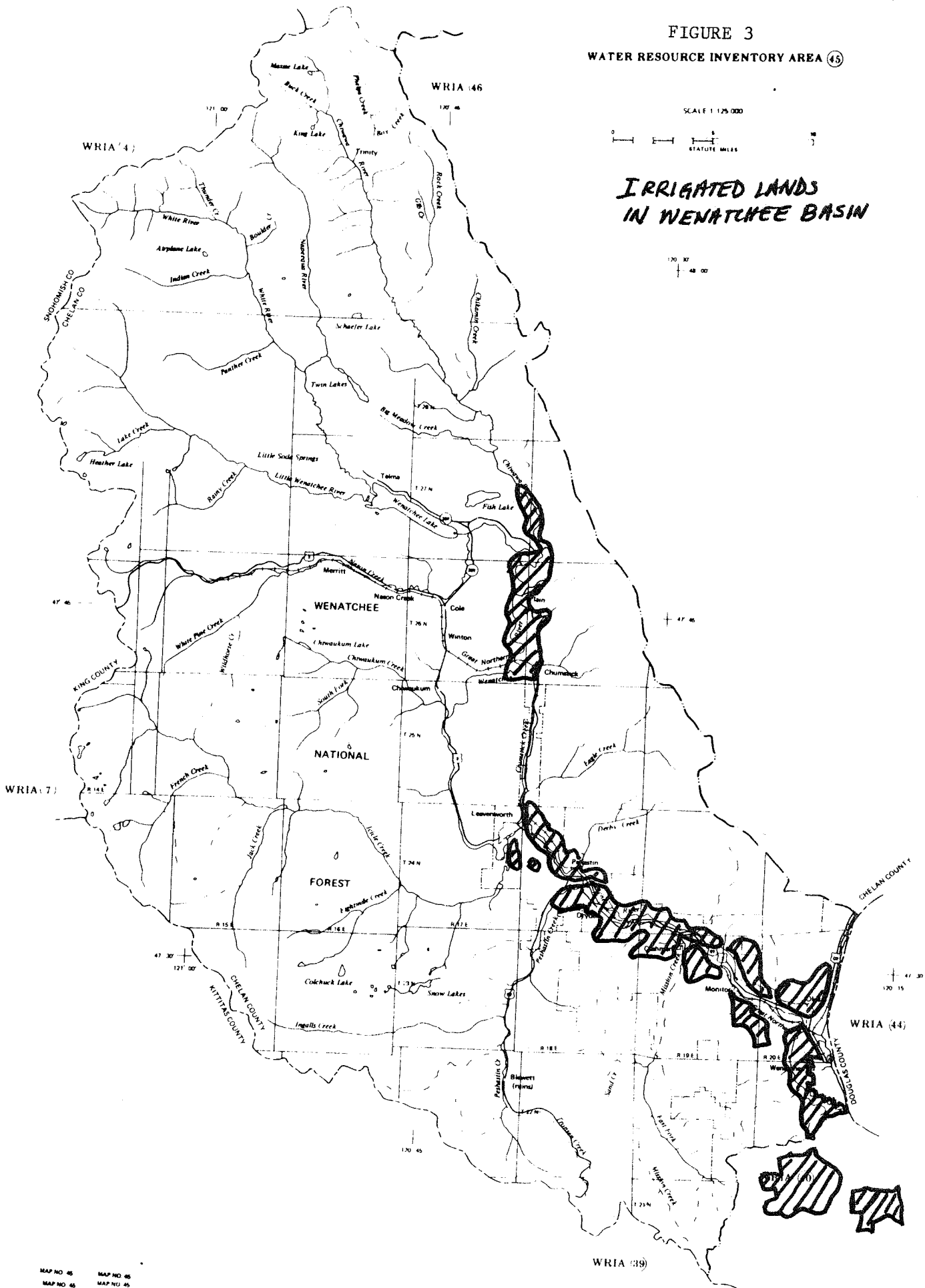
Note: 3,300 acres (Wenatchee R.D.) and 5,708 acres (Greater Wenatchee I.D.) lie outside the county. These were not included in this report.

FIGURE 3
 WATER RESOURCE INVENTORY AREA (45)

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**IRRIGATED LANDS
 IN WENATCHEE BASIN**

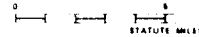


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 MAP NO 45 MAP NO 46

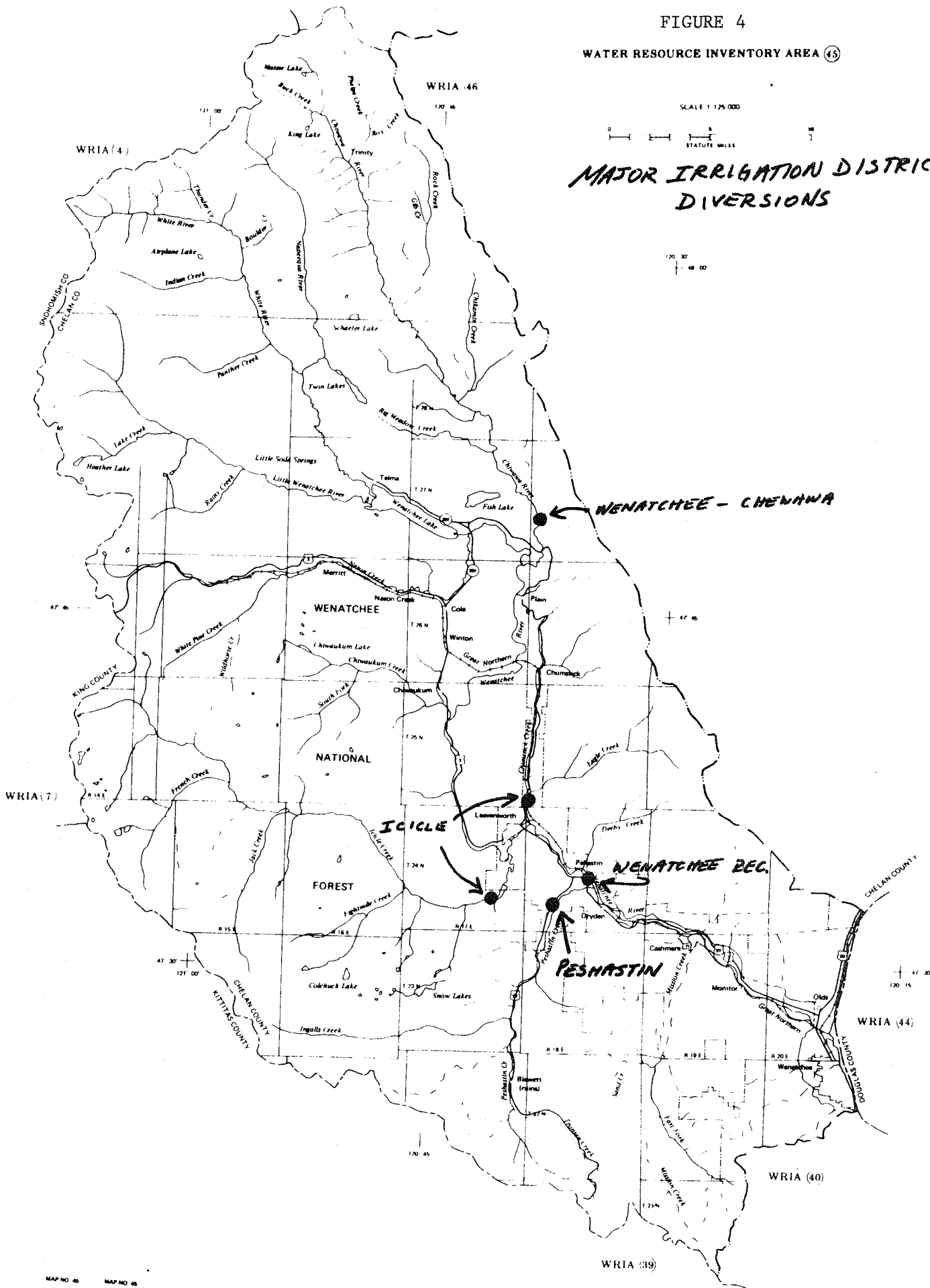
FIGURE 4

WATER RESOURCE INVENTORY AREA (45)

SCALE 1:125,000



MAJOR IRRIGATION DISTRICT DIVERSIONS



MAP NO 45
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Irrigation Water Use

To arrive at an estimation of water use, the Blaney-Criddle method was used to determine evapotranspiration of crops. Table 6 lists the variables used in this analysis. Since rainfall varies by a substantial amount from the upper basin to the lower basin, two different precipitation stations were used in the calculations. The crop requirements (water) for the different crop types is given in Tables 7 and 8.

Table 9 gives the average amount of water used for the major crops in the county. The monthly amount of water is expressed in feet, and by knowing the amount of irrigated acres in that crop, you can arrive at the amount of acre-feet of water.

Table 10 shows the monthly consumptive use, diversions, and return flows in Chelan County. Table 11 gives a summary of the monthly water balance in the Wenatchee Basin. In Table 11, the following formulae were used:

Amount of water in storage is the water into the system minus the water out of the system.

Amount of water into the system = Diversion + Precipitation.

Amount of water out of the system = Evapotranspiration + Return Flow - runoff.

The estimated runoff for the area is 10,250 acre-feet per year.

TABLE 6. FACTORS USED IN COMPUTING CROP REQUIREMENTS

Factor	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual
P (Precipitation, inches)													
Wenatchee	1.15	0.97	0.56	0.41	0.41	0.47	0.5	0.16	0.24	0.40	1.02	1.09	7.38
Chelan	1.40	1.10	0.89	0.72	0.86	1.07	0.24	0.31	0.56	0.98	1.50	1.60	11.23
Leavenworth	3.56	2.69	2.16	0.72	0.57	0.52	0.16	0.30	0.55	1.58	4.06	3.93	20.80
T (Temperature, °F)													
Wenatchee	26.6	33.9	42.4	51.7	60.3	67.0	73.6	71.9	63.7	50.8	38.7	31.2	51.0
Chelan	25.5	30.4	40.6	50.6	59.4	65.6	72.9	71.2	62.8	50.9	37.3	30.3	49.8
P (% Daylight Hours)	6.21	6.43	8.26	9.15	10.49	10.68	10.78	9.86	8.45	7.53	6.27	5.80	
K _t (Climatic Coefficient)	0.30	0.30	0.42	0.58	0.73	0.85	0.96	0.93	0.79	0.56	0.36	0.30	
K _p (Crop Coefficient)													
Orchards	0.6	0.7	0.9	1.0	1.4	1.5	1.4	1.4	1.4	0.9	0.8	0.7	
Hay-Pasture	0.5	0.6	1.0	1.2	1.2	1.0	1.0	1.0	1.1	1.1	0.8	0.6	
Small Grains	0	0	0.6	1.0	1.4	1.4	1.3	1.3	1.3	0	0	0	

Blaney-Criddle formula: $ET_p = (T)(p)(K_t)(K_p)$

TABLE 7. WENATCHEE BASIN CROP REQUIREMENTS

Wenatchee Area*

Factor	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG.	SEP	OCT	NOV	DEC	Annual
P (Wenatchee gage) (inches)	1.15	0.97	0.56	0.41	0.41	0.47	0.05	0.16	0.24	0.40	1.02	1.09	
Orchards ET _p	0.29	0.45	1.36	2.74	6.45	9.08	10.63	9.21	5.97	1.91	0.68	0.38	
ET _p -P	-0.86	-0.52	0.80	2.33	6.04	5.61	10.58	9.05	5.73	1.51	-0.34	-0.71	(41.65") ¹ (2.43") ²
% of Irr.			1.9	5.6	14.5	13.5	25.4	21.7	13.7	3.6			100
Hay-Pasture ET _p	0.24	0.39	1.47	3.26	5.50	6.08	7.61	6.59	4.68	2.31	0.68	0.32	
ET _p -P	-0.91	-0.58	0.91	2.85	5.09	5.61	7.56	6.43	4.64	1.91	-0.34	-0.77	(35.0") ¹ (2.6") ²
% of Irr.			2.6	8.1	14.5	16.0	21.6	18.4	13.3	5.5			100
Small Grains ET _p	0	0	0.87	2.74	6.45	8.51	10.32	9.21	5.49	0	0	0	
ET _p -P	-1.15	-0.97	0.31	2.33	6.44	8.04	10.27	9.05	5.25	-0.40	-1.02	-1.09	(41.69") ¹ (4.63") ²
% of Irr.			0.7	5.6	15.4	19.3	24.6	21.7	12.6				100

*Of the 17,000 irrigated areas in the basin, 13,200 (approximately 3/4) are in the "Wenatchee area." Acre-feet can be determined by applying the ET_p-P figures to the acres in each category. The amount of acres in each crop category can be determined by using the Census of Agriculture percentages, see page ____.

¹Summer Irrigation

²Winter Recharge

TABLE 8. WENATCHEE BASIN CROP REQUIREMENTS

Leavenworth Area²

Factor	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual
P (Leavenworth gage) (in.)	3.56	2.69	2.16	0.72	0.57	0.52	0.16	0.30	0.55	1.58	4.06	3.93	20.80
Orchards ET _p	0.29	0.45	1.36	2.74	6.45	9.08	10.63	9.21	5.97	1.91	0.68	0.38	
ET _p -P	-3.27	-2.24	-0.80	2.02	5.88	8.56	10.47	8.91	5.42	0.33	-3.38	-3.55	(41.59") ¹ (13.24") ²
% of Irr.				4.8	14.1	20.6	25.2	21.4	13.0	0.8			
Hay Pasture ET _p	0.24	0.39	1.47	3.26	5.50	6.08	7.61	6.59	4.68	2.31	0.68	0.32	
ET _p -P	-3.32	-2.30	-0.69	2.54	4.93	5.56	7.45	6.29	4.13	0.73	-3.38	-3.61	(30.9") ¹ (13.30") ²
% of Irr.				8.2	15.9	17.9	24.1	20.4	13.4	2.3			
Small Grains ET _p	0	0	0.87	2.74	6.45	8.51	10.32	9.21	5.49	0	0	0	
ET _p -P	-3.56	-2.69	-1.29	2.02	5.88	7.99	10.16	8.91	4.94	-1.58	-4.06	-3.93	(39.90") ¹ (17.11") ²
% of Irr.				5.1	14.7	20.0	25.5	22.3	12.4				

*4,300 acres in the Leavenworth area.

¹Summer Irrigation

²Winter Recharge

TABLE 9. AVERAGE CROP CONSUMPTION FOR CHELAN COUNTY

Crop-ET _p	Consumption* (in feet)											
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Orchards (x 93%)	0.15	0	0	0	0	0	0.16	0.45	0.66	0.81	0.69	0.42
Hay-Pasture (x 6%)	0	0	0	0	0	0	0.01	0.02	0.03	0.04	0.03	0.02
Small Grains (x 1%)	0	0	0	0	0	0	0.002	0.005	0.006	0.008	0.007	0.004
TOTAL	0.15	0	0	0	0	0	0.172	0.475	0.696	0.858	0.727	0.464

*Evapotranspiration minus precipitation, when evapotranspiration exceeds precipitation. Otherwise it is zero.

TABLE 10. IRRIGATION USE IN CHELAN COUNTY

Month	Consumptive Use* (in feet)	Diversion** (in feet)	Return Flow***									Return Flow Sum	Actual**** Consumptive Use	
			1	2	3	4	5	6	7	8	9			
OCT	0.15	0.30	0.07	0.05	0.07	0.07	0.07	0.04	0.03	0.01	0	0	0.34	-0.04
NOV	0	0	0	0.02	0.04	0.04	0.06	0.05	0.04	0.02	0.01	0	0.24	-0.24
DEC	0	0	0	0	0.01	0.04	0.04	0.04	0.05	0.04	0.02	0.01	0.21	-0.21
JAN	0	0	0	0	0	0	0.01	0.03	0.04	0.04	0.04	0.02	0.18	-0.18
FEB	0	0	0	0	0	0	0	0.01	0.03	0.04	0.04	0.03	0.15	-0.15
MAR	0	0	0	0	0	0	0	0	0.01	0.02	0.04	0.03	0.10	-0.10
APR	0.17	0.34	0.08	0	0	0	0	0	0	0.01	0.02	0.03	0.14	+0.20
MAY	0.48	0.96	0.23	0.02	0	0	0	0	0	0	0.01	0.02	0.28	+0.68
JUN	0.70	1.40	0.33	0.05	0.02	0	0	0	0	0	0	0.01	0.41	+0.99
JUL	0.86	1.72	0.40	0.07	0.04	0.04	0.01	0	0	0	0	0	0.52	+1.20
AUG	0.73	1.46	0.34	0.09	0.06	0.04	0.04	0.01	0	0	0	0	0.54	+0.92
SEP	0.46	0.92	0.22	0.07	0.07	0.06	0.06	0.03	0.01	0	0	0	0.46	+0.46
TOTAL	3.55	7.10												+3.53

*Consumptive use (ET_p-P) is averaged for all crops in the basin; orchards - 93%, Hay-Pasture - 6%, small grains - 1%. The Wenatchee area ET_p information was used as a base.

**Diversion is double the consumptive use; assuming a 50% efficiency rate.

***The continuous return rate varies with each month, and the percentages were determined by Gene T. Thompson in "Irrigated Agriculture Water Use." For the months 1 thru 9, the percent of return flow is: 47, 10, 9, 8, 6, 6, 5, 5, 4.

****The actual consumptive use is the diversion minus the sum return flow.

TABLE 11. MONTHLY WATER BALANCE FOR IRRIGATED LANDS
IN THE WENATCHEE BASIN

(in acre-feet)

Month	Diversion	Evapo- transpiration	Precipitation	Return Flow	Net (ΔS)
OCT	5,100	2,800	1,400	5,800	-2,100
NOV	0	1,000	3,600	5,000	-2,400
DEC	0	500	3,600	3,600	-500
JAN	0	400	3,300	3,100	-200
FEB	0	650	2,600	2,600	-650
MAR	0	1,950	1,900	1,700	-1,750
APR	5,800	3,700	800	2,400	500
MAY	16,300	8,850	700	4,800	3,350
JUN	23,800	12,600	700	7,000	4,900
JUL	29,300	14,800	150	8,850	5,800
AUG	24,900	12,750	300	9,200	3,250
SEP	15,700	8,450	600	7,800	50
TOTAL	120,900	68,450	19,650	61,850	10,250

Surface Water Supply

The mean monthly discharge for streams in the Basin were determined by frequency analysis. In addition, other flows were calculated, including the two-in-three-year discharge, the one-in-two-year discharge, and the one-in-ten-year discharge. Gaging stations with a period of record of at least five years were selected for analysis. Information on the stations and stream characteristics are listed in Table 12. Figure 5 shows their location.

For some of the stations, water use (for irrigation) has been determined for lands above that station (using the crop requirement data on previous pages). Only irrigation water use was calculated because it is by far the largest user in the Basin; with domestic and municipal users being relatively small. Water supply for the City of Wenatchee comes entirely from the Columbia, and other communities in the Basin rely mostly upon ground water supplies.

Tables 13 through 26 give the discharge mentioned above for the stations. For some of the stations, the flows have been corrected for depletions or correlated with other stations to extend the period of record. For Peshastin and Mission creeks, flows were estimated at the mouth. The methods are described in Tables 27 and 28.

Table 29 gives a summary of monthly discharge for streams in the Basin. The stream segments used are shown in Figure 6. The discharges were determined by subtracting the flows at upstream gages from downstream stations. The figures for gage 4625 (Wenatchee at Monitor) are

misleading. This is partly due to the accumulation of error by subtracting all the stations. Also, during the months of May and June, bank storage in this highly permeable area could store water in May which is then discharged to the stream during June and July. The higher flow in March in the Lower Wenatchee is possibly due to lower elevation snowmelt.

A summary of total depletions is given in Table 30. The gage at Monitor was used because of its proximity to the mouth. Approximately 2,700 acres are irrigated below the gage.

TABLE 12. BASIN AND STREAMFLOW CHARACTERISTICS - WENATCHEE BASIN

Station Name	Number	Basin Characteristics					Streamflow Characteristics						Period of Record
		Drainage Area (sq mi)	Percent of Area Lakes	Mean Basin Elevation (ft)	Annual Precipitation		Mean Annual Flow (cfs)	Q/P (%)	20-year 7-day Mean Low Flow	2-year Flood	50-year Flood		
					(inches)	(cfs)							
White River near Plain	12-4540	150	0.08	4,590	112	8.26	817	98.9	103	4,790	-	1911-12 1913-14 1954-71	
Wenatchee River below Wenatchee Lake	12-4550	273	2.30	4,720	105	7.75	1,317	169.9	132	6,990	11,900	1932-58	
Chiwawa River near Plain	12-4565	172	0.41	4,440	78	5.75	488	84.9	58	2,760	-	1911-14 1936-49 1954-57	
Wenatchee River at Plain	12-4570	591	1.07	4,540	66	4.87	2,246	461.2	251	11,700	20,200	1910-29 1931-70	
Icicle Creek above Snow Creek near Leavenworth	12-4580	193	0.49	5,260	74	5.46	620	113.5	61	4,380	10,000	1936-71	
Wenatchee River at Peshastin	12-4590	1,000	0.94	4,590	78	5.75	3,090	537.4	321	16,000	27,000	1928-71	

Source: A Proposed Streamflow-Data Program for Washington State - United States Department of the Interior, U.S. Geological Survey

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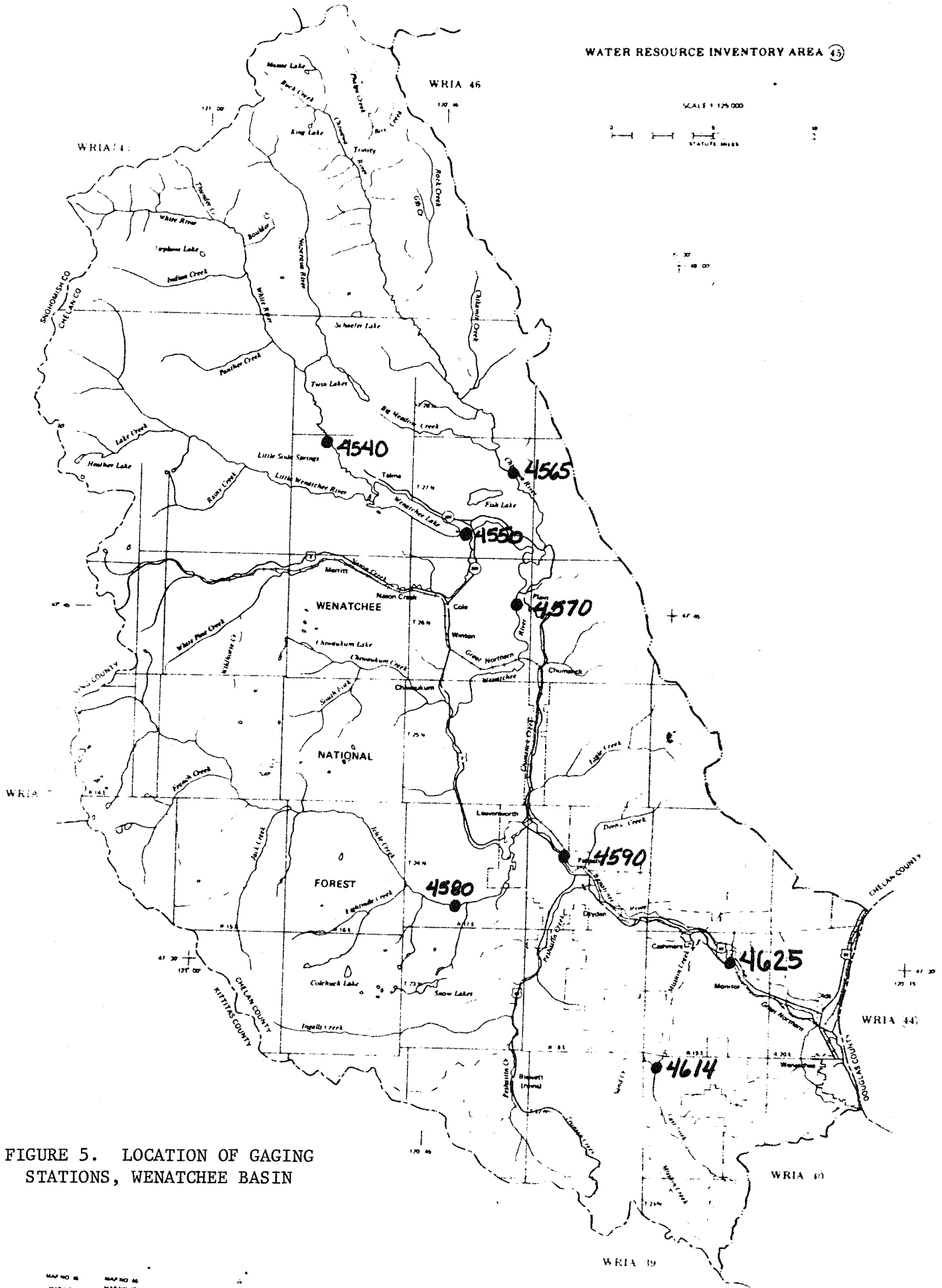
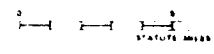


FIGURE 5. LOCATION OF GAGING STATIONS, WENATCHEE BASIN

MAP NO. 46 MAP NO. 46
MAP NO. 46 MAP NO. 46

Table 13

FREQUENCY AND WATER USE DATA

FOR WHITE RIVER, U.S.G.S. GAGE 12-4540
near Plain

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean Discharge	408	484	424	330	317	313	732	1891	2556	1493	527	300
One in Three Year Discharge (Q_3)	446	531	466	363	346	343	812	2061	2748	1648	575	325
One in Two Year Discharge (Q_2)	373	422	367	298	273	285	679	1809	2499	1393	505	286
One in Ten Year Discharge (Q_{10})	219	214	181	166	134	164	399	1225	1882	844	342	196
$Q_2 - Q_{10}$	154	209	186	132	139	121	281	583	617	549	163	90
Water Use (Depletions)												

Period of Record: 1955 - 70. Remarks: Measured data

Table 14

FREQUENCY AND WATER USE DATA

FOR WENATCHEE RIVER, U.S.G.S. GAGE 12-4550
below Wenatchee Lake

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean Discharge	570	854	802	592	544	603	1570	3487	3627	2060	691	378
One in Three Year Discharge (Q_3)	620	908	879	644	582	651	1718	3808	3989	2266	753	411
One in Two Year Discharge (Q_2)	474	644	672	507	453	539	1425	3344	3440	1774	610	360
One in Ten Year Discharge (Q_{10})	213	232	302	249	215	307	815	2271	2212	855	325	243
$Q_2 - Q_{10}$	261	413	370	258	238	232	610	1074	1228	919	284	117
Water Use (Depletions)												

Period of Record: 1933-58. Remarks: Measured data

Table 15

FREQUENCY AND WATER USE DATA

FOR CHIWANA RIVER . U.S.G.S. GAGE 12-4565
Near Plain

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean Discharge	179	199	178	142	111	158	572	1575	1580	754	248	146
One in Three Year Discharge (Q_3)	198	216	195	156	121	173	634	1734	1747	835	274	159
One in Two Year Discharge (Q_2)	161	171	167	131	106	145	511	1476	1463	673	228	141
One in Ten Year Discharge (Q_{10})	88	85	104	79	72	86	269	914	862	354	132	100
$Q_2 - Q_{10}$	73	86	63	52	34	59	242	562	601	319	96	41
Water Use (Depletions)												

Period of Record: 1914, 1937-49, 1955-57 Remarks: Measured data

Table 16

FREQUENCY AND WATER USE DATA

FOR WENATCHEE RIVER, U.S.G.S. GAGE 12-4570
at Plain (near Leavenworth)

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean Discharge	953	1309	1332	1087	1016	1132	2662	5859	6460	3349	1151	677
One in Three Year Discharge (Q_3)	1035	1417	1443	1180	1096	1231	2929	6370	7142	3695	1261	737
One in Two Year Discharge (Q_2)	814	1080	1117	938	864	1016	2453	5637	6077	2968	1054	638
One in Ten Year Discharge (Q_{10})	397	481	521	472	426	574	1445	3916	3753	1544	617	415
$Q_2 - Q_{10}$	417	599	596	466	438	942	1008	1721	2323	1424	437	223
Water Use (Depletions)												

Period of Record: 1911-70 . Remarks: Measured data

Table 17

FREQUENCY AND WATER USE DATA

FOR ICICLE CREEK, U.S.G.S. GAGE 12-4580
above Snow Cr., near Leavenworth

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean Discharge	248	343	348	269	263	262	661	1737	1993	900	264	164
One in Three Year Discharge (Q_3)	271	367	380	295	282	287	732	1891	2191	990	289	178
One in Two Year Discharge (Q_2)	211	273	294	236	218	244	608	1664	1881	787	240	155
One in Ten Year Discharge (Q_{10})	100	112	138	123	101	150	349	1136	1194	398	139	102
$Q_2 - Q_{10}$	111	160	157	114	117	94	259	528	687	389	102	53
Water Use * (Depletions)	3	0	0	0	0	0	20	50	80	90	80	50

Period of Record: 1937-70. Remarks: Measured data

* water use downstream of gage

Table 18

FREQUENCY AND WATER USE DATA

FOR WENATCHEE RIVER. U.S.G.S. GAGE 12-4590
at Reshasfin

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean Discharge	1244	1820	1777	1448	1454	1645	3786	8242	9075	4435	1395	817
One in Three Year Discharge (Q ₃)	1350	1947	1925	1582	1572	1785	4152	8953	9980	4878	1526	888
One in Two Year Discharge (Q ₂)	1050	1426	1461	1252	1236	1491	3491	7922	8582	3887	1254	771
One in Ten Year Discharge (Q ₁₀)	497	564	643	623	602	872	2081	5501	5473	1976	697	505
Q ₂ - Q ₁₀	554	862	818	628	633	619	1410	2421	3109	1911	556	265
Water Use (Depletions)												

Period of Record: 1931-70. Remarks: Measured data

Table 19

FREQUENCY AND WATER USE DATA

FOR WENATCHEE RIVER
AT PESMASTIN

U.S.G.S. GAGE

12-4590

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean Discharge	1231	1807	1767	1439	1446	1640	3802	8293	9149	4522	1462	857
One in Three Year Discharge (Q_3)	1335	1931	1913	1571	1563	1780	4169	9006	10056	4974	1599	930
One in Two Year Discharge (Q_2)	1035	1409	1449	1241	1226	1486	3508	7975	8661	3987	1327	812
One in Ten Year Discharge (Q_{10})	485	551	633	615	595	867	2096	5551	5548	2061	761	543
$Q_2 - Q_{10}$	550	858	816	627	631	619	1412	2424	3113	1926	566	269
Water Use (Depletions)	-13	-13	-10	-9	-8	-5	16	51	74	87	67	40

Period of Record: 1930-1970 . Remarks: CORRECTED FOR DEPLETIONS(- indicates months where
Return Flows exceed depletions)

Table 20

FREQUENCY AND WATER USE DATA

FOR WENATCHEE RIVER
AT PESMASTIN, U.S.G.S. GAGE 12-4590

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean Discharge	1136	1498	1481	1673	1826	1974	3009	7971	10710	5510	1979	991
One in Three Year Discharge (Q_3)	1246	1642	1635	1843	2008	2122	3310	8637	11803	6093	2173	1081
One in Two Year Discharge (Q_2)	1066	1366	1366	1512	1548	1678	2842	7706	10162	4887	1742	949
One in Ten Year Discharge (Q_{10})	668	791	800	838	712	833	1803	5484	6503	2532	901	643
$Q_2 - Q_{10}$	397	576	566	674	836	845	1038	2221	3659	2355	841	305
Water Use (Depletions)	-13	-13	-10	-9	-8	-5	16	51	74	87	67	40

Period of Record: 1963-1974. Remarks: Corrected for depletions

(- indicates months where return flows exceed depletions)

Table 21

FREQUENCY AND WATER USE DATA

FOR Wenatchee River
at Monitor

U.S.G.S. GAGE

12-4625

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean Discharge	1182	1636	1621	1808	2068	2276	3314	8386	11041	5389	1832	898
One in Three Year Discharge (Q ₃)	1296	1791	1787	1988	2280	2441	3655	9107	12207	5948	2000	986
One in Two Year Discharge (Q ₂)	1112	1492	1501	1620	1756	1932	3105	8077	10395	4713	1555	847
One in Ten Year Discharge (Q ₁₀)	703	865	891	880	806	962	1908	5648	6439	2354	734	539
Q ₂ - Q ₁₀	408	627	610	740	950	970	1196	2429	3956	2359	821	308
Water Use (Depletions)												

Period of Record: 1963 - 74 Remarks: measured data

Table 22

FREQUENCY AND WATER USE DATA

WENATCHEE RIVER
AT MONITOR

FOR

U.S.G.S. GAGE

12-4625

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean Discharge	1163	1519	1522	1723	1991	2229	3412	8708	11524	5957	2267	1122
One in Three Year Discharge (Q_3)	1276	1662	1681	1893	2190	2385	3759	9441	12710	6583	2494	1220
One in Two Year Discharge (Q_2)	1092	1366	1394	1526	1665	1879	3209	8410	10909	5349	2042	1081
One in Ten Year Discharge (Q_{10})	685	760	798	802	735	922	2003	5957	6919	2880	1125	754
$Q_2 - Q_{10}$	406	606	596	724	930	956	1206	2453	3991	2469	917	328
Water Use (Depletions)	-19	-117	-99	-85	-77	-47	98	322	483	568	435	224

Period of Record: 1963 - 1974 . Remarks: *Corrected for depletions*

(- indicates months where return flow exceeds depletions)

FREQUENCY AND WATER USE DATA

FOR WENATCHEE RIVER
AT MONITOR U.S.G.S. GAGE 12-4625

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean Discharge	1259	1832	1814	1481	1576	1851	4308	9055	9844	4888	1673	970
One in Three Year Discharge (Q ₃)	1367	1954	1966	1613	1703	1998	4731	9843	10820	5371	1834	1049
One in Two Year Discharge (Q ₂)	1060	1409	1478	1252	1318	1663	3960	8700	9293	4361	1555	924
One in Ten Year Discharge (Q ₁₀)	497	528	631	588	614	958	2326	6028	5898	2343	949	636
Q ₂ - Q ₁₀	563	881	847	664	704	705	1634	2672	3395	2018	606	288
Water Use (Depletions)	-19	-117	-99	-85	-77	-47	98	322	483	568	435	224

Period of Record: 1930-1970 Remarks: The period of record has been extended back to 1930 by correlation with 12-4590 (Table 19)

FREQUENCY AND WATER USE DATA

FOR MISSION CREEK, U.S.G.S. GAGE 12-4614
above Sand Creek, near Cashmere

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean Discharge	3	6	7	8	17	18	27	33	18	6	3	2
One in Three Year Discharge (Q_3)	4	6	7	9	19	20	30	37	19	7	3	2
One in Two Year Discharge (Q_2)	3	5	6	7	14	16	25	30	17	6	3	2
One in Ten Year Discharge (Q_{10})	2	3	3	3	7	8	15	16	11	5	2	1
$Q_2 - Q_{10}$	1	2	3	4	7	8	10	14	6	1	1	1
Water Use (Depletions)												

Period of Record: 1961-70. Remarks: measured data

Table 25

FREQUENCY AND WATER USE DATA

MISSION CREEK

FOR *AT CASHMERE*, U.S.G.S. GAGE _____.

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean Discharge	6	12	16	12	22	39	101	83	29	9	5	5
One in Three Year Discharge (Q_3)												
One in Two Year Discharge (Q_2)												
One in Ten Year Discharge (Q_{10})												
$Q_2 - Q_{10}$												
Water Use (Depletions)												

Period of Record: _____

Remarks: _____

Monthly flows have been estimated by correlation with 12-4615 and 12-4620. See table 28

FREQUENCY AND WATER USE DATA

FOR PESHASTIN CREEK
AT MOUTH

U.S.G.S. GAGE

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean Discharge	12	40	54	50	78	73	344	901	414	148	74	44
One in Three Year Discharge (Q_3)												
One in Two Year Discharge (Q_2)												
One in Ten Year Discharge (Q_{10})												
$Q_2 - Q_{10}$												
Water Use (Depletions)												

Period of Record: _____ Remarks: *Monthly flows have been estimated by correlation with 12-4600 and 12-4570. See table 27*

TABLE 27. ESTIMATE OF AVERAGE MONTHLY FLOW IN PESHASTIN CREEK
(in cfs)

Month	1911			Average	
	Peshastin Creek Below Ingalls Creek	Wenatchee River at Plain	Wenatchee River at Plain	Below Ingalls Creek	Near Mouth
	Peshastin Creek*				
OCT	24	2,000	953	10	12
NOV	65	3,000	1,309	30	40
DEC	40	1,240	1,332	40	54
JAN	35	876	1,087	40	50
FEB	35	591	1,016	60	78
MAR	35	950	1,132	40	73
APR	248	2,540	2,662	260	344
MAY	596	4,210	5,859	830	901
JUN	378	6,220	6,460	390	414
JUL	111	2,720	3,349	140	148
AUG	60	951	1,151	70	74
SEP	40	756	677	40	44
Annual Runoff					
Acre-ft	101,000	1,570,000	1,591,000	118,000	135,000
Inches	19	50	50	22	19
Area			521	101	133
USGS Gage No.			12-4545	12-4600	-

*Calculated

TABLE 28. AVERAGE MONTHLY FLOWS IN THE
MISSION CREEK BASIN
(cubic feet per second)

Month	Mission Above Sand Creek	Sand Creek	Incremental Area*	Mission at Cashmere
OCT	3	1	2	6
NOV	6	1	5	12
DEC	7	3	6	16
JAN	8	5	0	12
FEB	17	3	2	22
MAR	18	13	8	39
APR	27	54	20	101
MAY	33	32	18	83
JUN	18	6	5	29
JUL	6	2	1	9
AUG	3	2	0	5
SEP	2	1	2	5
Annual Runoff				
Acre-ft	8,725	7,295	4,425	20,445
Inches	4	7	4	5
Area (mi ²)	39.8	18.6	22.8	81.2

*The estimate of flows from the incremental area includes the associated errors. The range is +100 to -50 percent or +2 cfs in the case of zero flows.

TABLE 29. MONTHLY DISCHARGE FOR THE WENATCHEE BASIN

Stream or Station (See map for area location)	Drainage Area (sq mi)	Average Monthly Flow (in cfs)											
		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Chiwawa River (4565)	172	179	199	178	142	111	158	572	1575	1580	754	248	146
White River (4540)	150	408	484	424	330	317	313	732	1891	2556	1493	527	300
Little Wenatchee (4550)	123	162	370	378	262	227	290	838	1596	1071	567	164	78
Nason Creek Area (4570)	146	204	256	352	353	361	371	520	797	1253	535	212	153
Middle Wenatchee (4590)	216	30	155	87	83	167	246	479	697	696	273	47	16
Icicle Creek (4580)	193	248	343	348	269	263	262	661	1737	1993	900	264	164
Peshastin Creek (Mouth)	133	12	40	54	50	78	73	344	901	414	148	74	44
Mission Creek (Mouth)	83	6	12	16	12	22	39	101	83	29	9	5	5
Lower Wenatchee (4625)*	111	36	44	37	17	60	118	19	-345	97	35	17	2
TOTAL	1327												

*The figures for this area are too low, but it cannot be corrected accurately. This is caused by the "accumulation of error" of adding and subtracting the flows at various stations, and by using the estimates from Peshastin and Mission creeks.

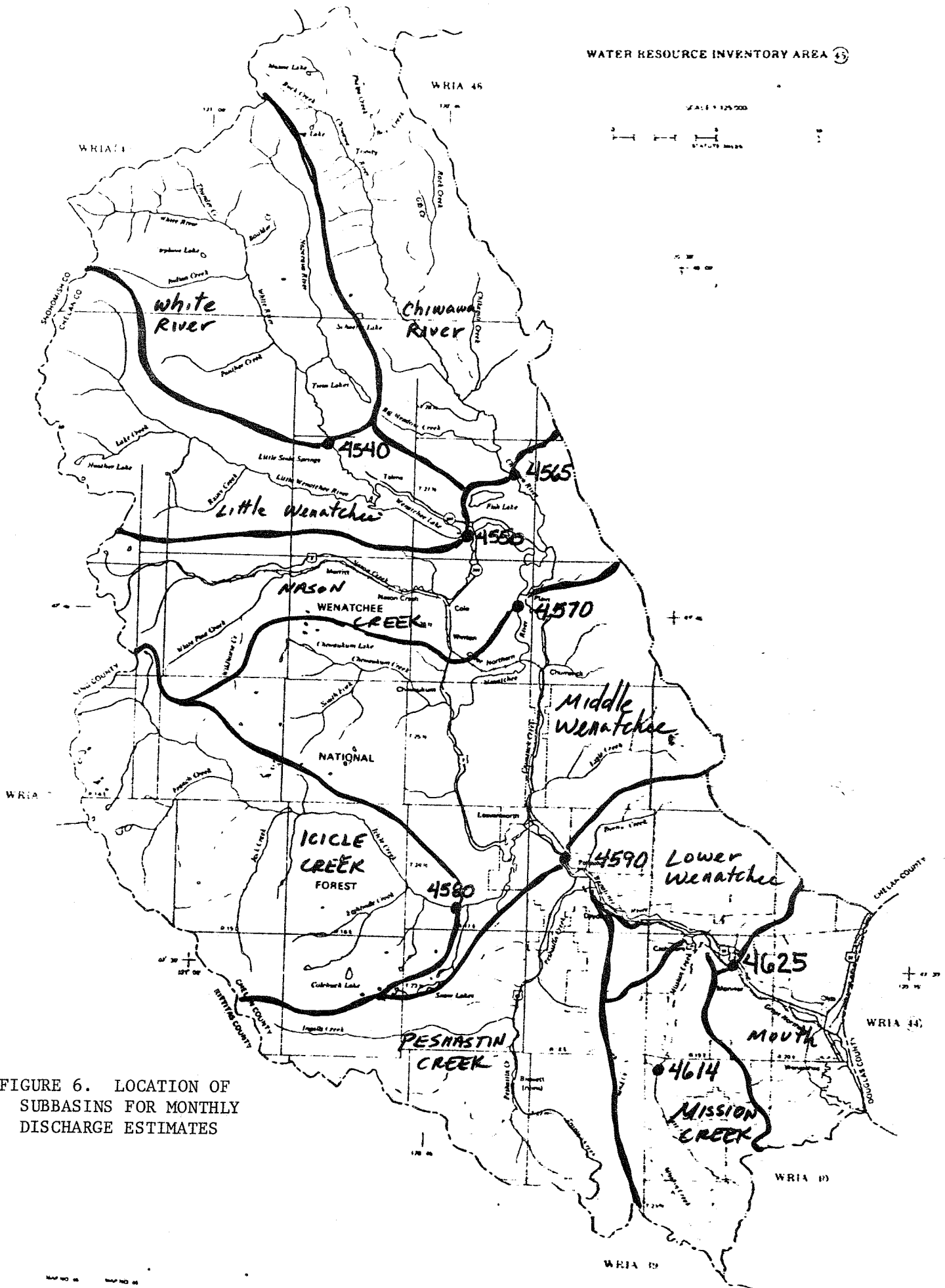


FIGURE 6. LOCATION OF SUBBASINS FOR MONTHLY DISCHARGE ESTIMATES

TABLE 30. IRRIGATION DEPLETIONS - WENATCHEE RIVER
 AT MONITOR (12-4625)
 (in cfs)

Month	Depletions above Station (14,300 acres)	Depletions below Station (2,700 acres)	Total Depletions
OCT	- 9	13	4
NOV	-58	0	-58
DEC	-50	0	-50
JAN	-42	0	-42
FEB	-39	0	-39
MAR	-24	0	-24
APR	48	15	63
MAY	158	42	200
JUN	238	64	302
JUL	279	76	355
AUG	214	64	278
SEP	111	42	153

Ground Water

Ground water in the Basin is restricted to the larger river valleys where there are sizable deposits of alluvial material. The only place where ground water occurs in large quantities is at the confluence of the Wenatchee River with the Columbia River, and is used extensively for water supply. Figure 7 shows the general availability of ground water in the Basin.

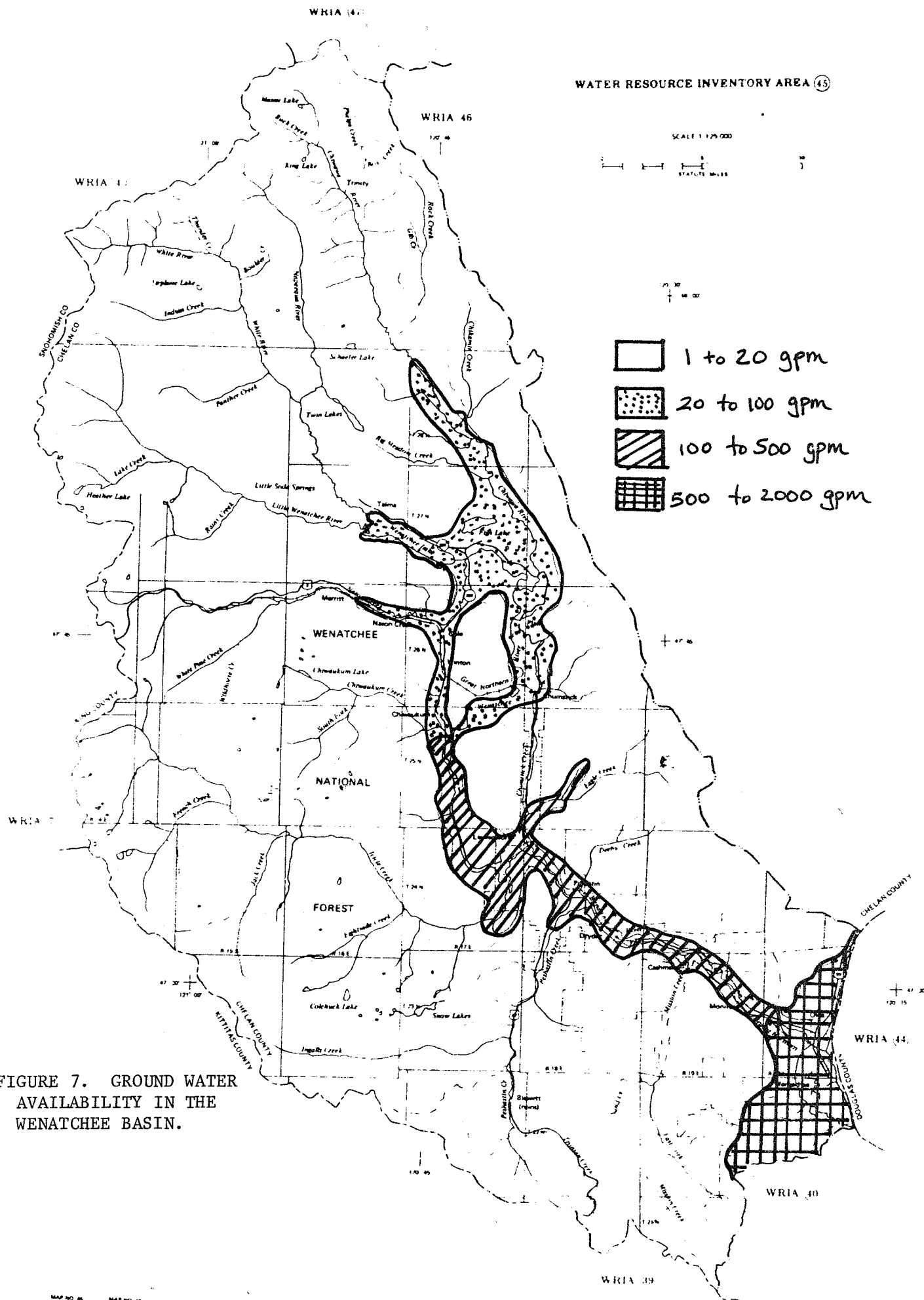


FIGURE 7. GROUND WATER AVAILABILITY IN THE WENATCHEE BASIN.

MAP NO 45
MAP NO 46
MAP NO 47
MAP NO 48

