UNITED WINEGROWERS for Sonoma County

Phone: (707) 433-7319 P.O. Box 382. Santa Rosa, CA 95402

September 24, 1996

First, we take note of the fact that the ocean discharge alternative was eliminated early on from this EIR. As stated in the Project Description in a discussion of Ocean Discharge: 001

> "This alternative was not carried forward because...this alternative does not achieve the purposes of maximizing reclamation and optimizing water conservation and therefore would not fulfill the purpose and need for the project." (Page 3-22)

Indeed, if it too were part of this EIR, imagine how long the DEIR would have been. Coming to grips with this one @ 7,000+ pages has in and of itself been a challenge.

Water (or more precisely, the lack of water) connects us all here on the North Coast whether we like it or not. The issue is not how many millions of acre-feet end up at Jenner on average each year. As this EIR and other water decisions go forward, other entities will be watching to gauge our actions concerning what happens to water diverted into winter storage and its use and reuse during the dry season.

After reviewing the DEIR's many volumes, some basic questions arise concerning capacity of the treatment plant at 21.3 mgd ADWF (Average Dry Weather Flow) and how that number was subsequently used to frame and conduct the environmental analysis. An analysis of the numbers suggest that a phased approach may be the preferrable alternative.

During the scoping process, UW requested a detailed flow chart be presented (as was done by CH2M Hill in an earlier round). The DEIR includes a series of summaries and technical reports none of which show actual changes month by month to storage, irrigation and discharge for the discharge alternatives for either the 70 water years of record 1923-92 or the 23 "dry" and "critical dry" years identified in the last EIR. 002

Reference is made to a complex computer model developed for both monthly and daily flows and the problems encountered in adapting the earlier model used by CH2M Hill. Yet, no numbers are provided in the DEIR for monthly changes in discharges; actual months when discharges occur; nor the amount of discharge into the Laguna that would approach and in some cases exceed certain water quality standards. For instance the chapter on Surface Water Quality finds a significant impact is caused by the 20% Laguna discharge exceeding loading limits established by the Regional Board for the Laguna. Yet, no quantification is provided showing the level or levels of discharge causing the impact. 003

Furthermore, it is not clear if this environmental analysis is intended to be the basis for requesting a change in the Basin Plan increasing allowable discharges from one to twenty percent under all flow conditions and for all dischargers or only as a basis for establishing a maximum discharge volume based upon the Subregional System's ADWF at buildout. 004

When evaluating other sources of wastewater, the DEIR reviews Windsor's planned expansion. However, it states those additional flows would exceed the Basin Plan's 1% limitation thus Windsor would need to find additional storage. And, because then they would not be over the 1% threshold, the DEIR concludes it is not necessary to include Windsor's future expansion in the tally of wastewater flows in the Russian River. 005

The Summary shows 4,640 MG as the amount of water that will be discharged to the Russian River under the two 20% alternatives and, in another technical report, the maximum river discharge is shown as 775 MG per month (25 MG per day). Were these 006

the maximum levels used to evaluate the various environmental impacts of the 20% river discharge alternative? Similarly, given the interplay between river flows, plant flows, irrigation and the storage curve, what factor or combination of factors could serve to reliably determine and monitor the 20% alternative in the future? 006 (cont.)

Not finding a month-to-month water balance in the EIR documentation, I have prepared two for your review based on numbers from technical reports completed by HBA showing "Average Monthly Plant Flows" and Russian River flows for the period of record 1923-92. 007

One is a monthly water balance for the full 70 year period. It adds the proposed 4,000 MG of new storage to the existing+interim storage capacity (1,450 MG), as reported by the City to the North Coast Regional Water Quality Control Board this year. In addition this water balance increases total summer irrigation 4 to 10% over HBA's figure of 7,535 MG (+4%=7,820 MG, +8%=8,150 MG and +10%=8,290 MG). The total amount of summer irrigation is allowed to vary by these three amounts based upon total storage in April/May of each year (with total storage on May 1st at or below 5,450 MG).

The other, a "1/2 Plan," relies on the same HBA numbers but phases treatment plant expansion midway between the current permit of 18.0 mgd and the proposed expansion to 21.3 mgd or 19.7 mgd. (This amount is 10% higher than the plant expansion of 19.44 mgd at buildout under Maximum Conservation or the 19.21 mgd developed by Parsons Engineering for General Plan Populations per a Memorandum dated April 15, 1995.) Each of HBA's "Actual Plant Flows" for the 840 months of record were reduced in this water balance by the difference of 21.3 minus 19.7 or 7.5%. River flows were converted from cfs to MG per month by multiplying cfs times 1.983 to get ac.ft./day and that times 0.3258 to get MGD times the number of days in the month. Though the "1/2 Plan" only covers 35 years (1923-1957), it does include 4 of the 5 "critical dry years" identified by the Sonoma County Water Agency when low river flows would trigger mandatory curtailments of water deliveries. Those years are 1924, 1933, 1934, 1935 and 1977 (Beach, 1996).

The "1/2 Plan" shows what may happen by phasing a project to include: a) half of the proposed new storage, b) half of the treatment plant expansion and c) half the amount of reclaimed water farmers applied during the 1994 irrigation season. It also imposed a further limits months when river discharge can take place to only January, February and March (not to exceed 775 MG/month) so this plan closes more than half the current October 1 to May 15 discharge window. This water balance shows an average annual river discharge of 856 MG compared to the EIR's 685 MG for the 10 low flow years or an earlier estimate by Dames and Moore (1988) for an average annual discharge @ 1% of 2,000 MG.

Will a phased approach be acceptable to the Regional Board? That of course is a decision to they will make at some future date. However, in the last round, the resolution by your Board and Council was for half of the initially proposed project. In that round the EIR had evaluated alternatives based on 15,000 acre feet of storage. Yet, the final resolution approved a reclamation project with 7,500 acre feet of storage.

Attached are HBA'a tables for the 840 months of record showing "Average Monthly Plant Flows for 21.0 mgd ADWF" and flows in the Russian River (expressed in cfs). Also included are various references showing storage, treatment and irrigation levels from different chapters in the DEIR. Before the October 7th deadline, I will be submitting additional comments on the Draft EIR along with a computer disk for the "Full" and "1/2 Plan" water balances to assist the responders in making their comments. 008

On behalf of the United Winegrowers board of directors, I am

Bob Anderson
Executive Director

2

	DEIR	"Full Plan"	"1/2 Plan"	
Plant Flows	mgd	mgd	mgd	
* ADWF	21.3	21	19.7	
* at Maximum Conservation	19.44			
* Buildout Year	2018			
* Buildout /current rate (12/9/95 workshop)	2020			
Plant Flows	mg	mg	mg	
* Ave Annual	8,220	8,223	7,600	
* Range	7,650-9207			
* 95th percentile	8823			
Irrigation	mg	mg	mg	
* 1994 volume	3775	3775	3775	
* Interim	620	620	620	
* New	3140	3425-3895	1505-1805	
	7535	7820-8290	5900-6200	
Acre Feet	23132	24-25500	18-19000	
Acreage at 24.2 "/yr	11500	11900-12600	9000-9500	
Additional Acres		400-1100		
Current Acreage	5300			
River Discharge				
* Allowable MGs/yr at 1%	685		804	(Jan-March)
* # months > 1%		0	10 in 420 (7 separate years)	
* Ave MGs/yr at 2%		0	280	
* Ave MGs /2% month		0	52	
* Ave MGs above 2%		0	0	

Prepared by Bob Anderson 9/24/96

3

Plant Flow Distribution by month:

	November	December	January	February	March	April
Actual 93-5	7.40%	8.97%	12.67%	9.47%	11.34%	8.09%
HBA	7.43%	8.96%	11.41%	9.98%	10.95%	8.88%
CH2MHill	7.43%	8.96%	11.41%	9.98%	10.95%	8.88%

	May	June	July	August	September	October
Actual 93-5	7.81%	6.93%	6.93%	6.77%	6.58%	7.02%
HBA	7.72%	7.15%	7.05%	6.67%	6.59%	7.[illegible]
CH2MHill	7.72%	7.15%	7.05%	6.67%	6.59%	

Actual Plant Flows

	November	December	January	February	March	April
1993	518	711	968	754	861	577
1994	547	657	635	695	620	566
1995	633	690	1305	724	1122	714
	1698	2058	2908	2173	2603	1857
	7.40%	8.97%	12.67%	9.47%	11.34%	8.09%

Difference: 1993-95 & HBA (MG)

	7	2	290	117	90	181

	May	June	July	August	September	October
1993	540	520	529	513	498	541
1994	568	522	524	522	510	541
1995	684	549	537	519	503	530
	1792	1591	1590	1554	1511	1612
	7.81%	6.93%	6.93%	6.77%	6.58%	7.02%

Difference between 1993-95 & HBA (MG)

	20	50	28	23	1	42

Prepared by Bob Anderson 9/2496

4

City of Santa Rosa
Laguna Wastewater Treatment Plant
SELF-MONITORING REPORT FOR 1993

Date	....Daily Flow.... Total mgd	MIN mgd	MAX mgd	Temp Cent I
(	31.24	25.7	38.7	
3	26.96	20.3	31.8	
R	22.79	16.2	26.1	
R	19.22	13.1	24.0	
Y	17.44	10.0	21.5	
N	17.34	11.3	23.0	
L	17.05	8.9	20.5	
G	16.54	9.4	20.3	
P	16.60	10.2	18.6	
T	17.46	11.6	19.8	
V	18.23	11.8	22.5	
C	21.18	12.7	25.8	
G	20.14	13.4	24.3	

City of Santa Rosa
Laguna Wastewater Treatment Plant
SELF-MONITORING REPORT FOR 1994

Date	....Daily Flow.... Total mgd	MIN mgd	MAX mgd	Ten Cen I
JAN	20.48	15.8	24.2	
FEB	24.81	16.8	30.9	
MAR	20.01	12.7	24.5	
APR	18.85	13.8	22.5	
MAY	18.31	9.8	23.5	
JUN	17.39	10.6	21.3	
JUL	16.91	11.2	21.7	
AUG	16.84	10.2	21.1	
SEP	17.01	9.9	22.1	
OCT	17.45	9.4	20.9	
NOV	21.10	12.0	27.4	
DEC	22.27	14.5	27.4	
AVG	19.25	12.2	23.9	

City of Santa Rosa
Laguna Wastewater Treatment Plant
SELF-MONITORING REPORT FOR 1995

Date	....Daily Flow.... Total mgd	MIN mgd	MAX mgd	T C
JAN	42.10	32.6	51.0	
FEB	25.86	17.6	31.6	
MAR	36.20	25.8	43.8	
APR	23.80	17.4	29.4	
MAY	22.08	14.0	27.5	
JUN	18.31	11.9	22.9	
JUL	17.33	10.4	21.6	
AUG	16.74	9.8	20.7	
SEP	16.77	8.7	20.8	
OCT	17.10	9.7	22.7	
NOV	17.27	12.1	22.8	
DEC	22.44	13.4	28.5	
AVG	23.02	15.2	28.6	

5

CITY OF SANTA ROSA

SUBREGIONAL WATER RECLAMATION SYSTEM

ANNUAL REPORT

1993

6

Table 2
Frequency Analysis

Annual Wastewater Flow from	to	Frequency	Cummulative Frequency	%
7650	7725	1	1	1.43%
7726	7800	3	4	5.71%
7801	7875	4	8	11.43%
7876	7950	7	15	21.43%
7951	8025	13	28	40.00%
8026	8100	8	36	51.43%
8101	8175	2	38	54.29%
8176	8250	4	42	60.00%
8251	8325	5	47	67.14%
8326	8400	2	49	70.00%
8401	8475	5	54	77.14%
8476	8550	2	56	80.00%
8551	8625	5	61	87.14%
8626	8700	2	63	90.00%
8701	8775	0	63	90.00%
8776	8850	0	63	90.00%
8851	8925	4	67	95.71%
8926	9000	1	68	97.14%
9001	9075	0	68	97.14%
9076	9207	2	70	100.00%

Table 3
Projected Flows

Month	Projected Flows (MG/Month) 90%	95%
Oct	622	636
Nov	641	656
Dec	773	791
Jan	984	1,007
Feb	861	881
Mar	945	966
Apr	766	783
May	666	681
Jun	617	631
Jul	608	622
Aug	575	588
Sep	568	581
Total	8,626	8,823

wwflo.xls

8/10/95 6:56 AM

7

Table R1-9
ESTIMATED MONTHLY RECLAIMED WATER FLOW DISTRIBUTION

Month	Percentage of Average Annual Flow by Volume
January	11.41
February	9.98
March	10.95
April	8.88
May	7.72
June	7.15
July	7.05
August	6.67
September	6.59
October	7.21
November	7.43
December	8.96
TOTAL	100.00

Plant flows

during the release season. During actual operations, the releases would be scheduled, depending on the flow of the Russian River. The differences between a uniform release assumption and scheduled releases do not significantly impact the water balance analysis.

Direct Discharge to Russian River

It is anticipated that under some conditions, direct discharge to the Russian River via the Laguna de Santa Rosa would be appropriate. These discharges would be within the limitations specified by the NPDES permit. The discharges would occur through the Delta Pond and Meadowlane Pond facilities.

For the purposes of this analysis, it was assumed that direct discharges would occur during wet-year conditions. The amount of reclaimed water released via direct discharge would be less than the historic average allowable discharges estimated for the Russian River (approximately 5,5[illegible] million gallons). In the water balance analysis, this discharge was scheduled to coincide with the estimated monthly variation in allowable discharge. Using the Sonoma County Water Agency's Russian River flow model (with Warm Springs Dam and anticipated 2010 water withdrawals factored into the model), Dames and Moore, in Technical Memorandum No. L2, estimated the average annual Russian River release in 2010 to be 2,002 million gallons at a 1 percent dilution rate.

IVAF Discharge

Table 3.4

Reclaimed Water Use Allocation for Alternative 2 - South County Reclamation

MILLION GALLONS PER YEAR - AVERAGE FLOW					
TOTAL WASTEWATER (MG/Yr)	CONSERVATION (MG/Yr)	REUSE (MG/Yr)	DISCHARGE (MG/Yr)	STORAGE MG	COMMENTS
		Existing Conditions			
7,300					Current Estimated Output
	(30)				City Retrofit Demonstration Program
		10			Wetlands - 10 acres Kelly
		10			Wetlands - 10 acres Laguna
		3,000			Agricultural Irrigation Normal - 4,500 acres
		10			Agricultural Irrigation Low - 200 acres in 1993
		210			Golf Course - 300 acres Oakmont
		210			Golf Course - 300 acres Mount Shadow
		10			Urban Irrigation - 20 acres
				1,200	Storage - 1993 storage capacity
		Interim Plan			
		80			Urban Irrigation - 280 acres Rohnert Park
		40			North Pipeline Extension - 150 acres
	(150)				Adopted Retrofit Program
		Future Plan			
2,750					Estimated Output - Buildout
	(1,400)				State Regulation
	(250)				Expanded Retrofit Program
		190			Urban Irrigation - 220 acres Fountain Grove
		190			Urban Irrigation - 350 acres Bennett Valley
		3,575			Agricultural Irrigation - South County
		-			Agricultural Irrigation - West County
		Optional			Optional Irrigation - Sebastopol[1]
		-	685		Geysers Recharge
				-	Russian River @ 1% of flows maximum
				4,000	Storage - South County Reservoirs
				-	Storage - West County Reservoirs
				Optional	Optional Aquifer Storage and Recovery (ASR)[2]
10,050	(1,830)	7,535	685	5,200	Total
	8,220	8,220			Grand Total

Table Notes: [1] Sebastopol irrigation is an optional component which would reuse 1,200 MG of treated wastewater per year; if selected, only 2,400 MG/yr of reuse would go to South County irrigation.

[2] Aquifer Storage and Recovery is an optional component which would provide 1,000 MG of additional storage.

Table 3.4

Reclaimed Water Use Allocation for Alternative 3 - West County Reclamation

MILLION GALLONS PER YEAR - AVERAGE FLOW					
TOTAL WASTEWATER (MG/Yr)	CONSERVATION (MG/Yr)	REUSE (MG/Yr)	DISCHARGE (MG/Yr)	STORAGE MG	COMMENTS
		Existing Conditions			
7,300					Current Estimated Output
	(30)				City Retrofit Demonstration Program
		10			Wetlands - 10 acres Kelly
		10			Wetlands - 10 acres Laguna
		3,000			Agricultural Irrigation Normal - 4,500 acres
		10			Agricultural Irrigation Low - 200 acres in 1993
		210			Golf Course - 300 acres Oakmont
		210			Golf Course - 300 acres Mount Shadow
		10			Urban Irrigation - 20 acres
				1,200	Storage - 1993 storage capacity
		Interim Plan			
		80			Urban Irrigation - 280 acres Rohnert Park
		40			North Pipeline Extension - 150 acres
	(150)				Adopted Retrofit Program
		Future Plan			
2,750					Estimated Output - Buildout
	(1,400)				State Regulation
	(250)				Expanded Retrofit Program
		190			Urban Irrigation - 220 acres Fountain Grove
		190			Urban Irrigation - 350 acres Bennett Valley
		-			Agricultural Irrigation - South County
		3,585			Agricultural Irrigation - West County
		Optional			Optional Irrigation - Sebastopol[1]
		-	675		Geysers Recharge
				-	Russian River @ 1% of flows maximum
				4,000	Storage - South County Reservoirs
				Optional	Storage - West County Reservoirs
					Optional Aquifer Storage and Recovery (ASR)[2]
10,050	(1,830)	7,545	675	5,200	Total
	8,220	8,220			Grand Total

Table Notes: [1] Sebastopol irrigation is an optional component which would reuse 1,200 MG of treated wastewater per year; if selected, only 2,400 MG/yr of reuse would go to West County irrigation.

[2] Aquifer Storage and Recovery is an optional component which would provide 1,000 MG of additional storage.

9

3. DESCRIPTION OF EXISTING SYSTEM AND ALTERNATIVES (PROJECT DESCRIPTION)

This chapter of the Santa Rosa Subregional Long-Term Wastewater Project EIR/EIS is organized in eight sections.

- **Section 3.1 Project Location** identifies the geographic location of the project area in relation to governmental jurisdictions and major man-made and natural features.
- **Section 3.2 Existing System With Interim Improvements** describes the existing Subregional Reclamation System, along with the interim improvements now underway, to provide a background for understanding the project alternatives.
- **Section 3.3 Development of Alternatives** describes the process by which the project alternatives were developed and evaluated, leading to the selection of the five project alternatives which are the subject of this EIR/EIS. This section also describes alternatives which were considered and not carried forward as one of the selected project alternatives, and the basis for that determination.
- **Section 3.4 Description of Alternatives** identifies the project components which comprise each of the five alternatives, and describes subalternatives which have been defined as the basis for evaluation in this EIR/EIS.
- **Section 3.5 Description of Project Components** describes the location and scope of individual project components, including reuse, discharge, and storage components, which are included in each of the project alternatives.
- **Section 3.6 Cumulative Projects** identifies other proposed projects whose impacts, taken together with those of the Subregional Wastewater Project, might compound or increase the environmental effects.
- **Section 3.7 Required Permits and Approvals** identifies permits and other governmental approvals which are necessary to implement the proposed project.
- **Section 3.8 Emergency Events** identifies potential events which may occur during unplanned and/or natural occurrences.

Table 3.4

Reclaimed Water Use Allocation for Alternative 1 - No Project / No Action

MILLION GALLONS PER YEAR - AVERAGE FLOW				STORAGE	
TOTAL WASTEWATER (MG/Yr)	CONSERVATION (MG/Yr)	REUSE (MG/Yr)	DISCHARGE (MG/Yr)	MG	COMMENTS
Existing Conditions					
7,300	(30)				Current Estimated Output
		10			City Retrofit Demonstration Program
		10			Wetlands - 10 acres Kelly
		3,000			Wetlands - 10 acres Laguna
		10			Agricultural Irrigation Normal - 4,500 acres
		210			Agricultural Irrigation Low - 200 acres in 1993
		210			Golf Course - 300 acres Oakmont
		10			Golf Course - 300 acres Mount Shadow
					Urban Irrigation - 20 acres
				1,200	Storage - 1993 storage capacity
Interim Plan					
	(150)	80			Urban Irrigation - 280 acres Rohnert Park
		40			North Pipeline Extension - 150 acres
					Adopted Retrofit Program
Future Plan					
	(620)				Estimated Output - Buildout
					State Regulation
					Expanded Retrofit Program
					Urban Irrigation - 220 acres Fountain Grove
					Urban Irrigation - 350 acres Bennett Valley
					Agricultural Irrigation - South County
					Agricultural Irrigation - West County
					Optional Irrigation - Sebastopol[1]
			(2,920)		Geysers Recharge
					Russian River @ 1% of flows maximum
					Storage - South County Reservoirs
					Storage - West County Reservoirs
					Optional Aquifer Storage and Recovery (ASR)
7,300	(800)	3,580	2,920	1,200	Total
	6,500	6,500			Grand Total

10

SANTA ROSA SUBREGIONAL WATER RECLAMATION SYSTEM
TECHNICAL MEMORANDUM

SUBJECT: Projected Subregional System Flows and Reclamation System Capacity Requirements

PREPARED BY: Carol Abramson
Dave Richardson

REVIEWED BY: Jane Rozga

DATE: August 10, 1993

PROJECT: SFO19445.RH

Summary

This technical memorandum presents an analysis of projected Subregional System flows and reclamation system capacity requirements. The following conclusions can be drawn:

- Under anticipated growth conditions, existing capacity at the Laguna plant would be sufficient to meet projected inflow through the year 2000 if a citywide retrofit program were implemented.
- Under anticipated growth conditions, the current storage capacity in the reclamation system would provide the capacity needed to meet projected system inflow through the year 2000.
- Under anticipated and worst case growth conditions, existing irrigation capacity, along with the capacity to be added through the 1994 irrigation projects, would meet capacity requirements through the year 2000 if a citywide retrofit program is implemented. If a citywide retrofit program is not implemented, additional irrigation projects (already identified) may be needed as early as 1996 to meet required capacity.

Anticipated growth conditions were based on documented trends over the past few years. Worst case conditions were also analyzed and under these conditions, existing treatment plant and irrigation capacity would be exceeded prior to the year 2000. However, a retrofit program and additional irrigation acreage would delay capacity exceedance.

current storage →

//

Figure 1 shows the current 18.0 mgd ADWF treatment plant capacity being exceeded by the year 1998 or 1997 for the Most Likely and Worst Case scenarios, respectively, without a citywide retrofit program. All three retrofit alternatives for the Most Likely Case scenario are shown on Figure 2 and all three for the Worst Case scenario are shown on Figure 3. For the two retrofit alternatives under the Most Likely Case scenario, the existing treatment plant capacity of 18.0 mgd ADWF would be sufficient through the year 2000.

Projected Storage and Irrigation Capacity

Storage Capacity

The total storage capacity of the reclamation system is currently 1,550 million gallons (mg). This includes the recent addition of 140 mg of effective storage at West College and Delta Ponds. The minimum storage capacity seen in the system is 100 mg because the pumping units from the various storage ponds can not remove all of the reclaimed water for distribution. Therefore, the current effective storage of the system is 1,450 mg.

Sufficient effective storage capacity is required so that the risk of discharge, in excess of 1 percent, does not increase over the 1985 baseline condition. In 1985, seventy seven days of storage capacity of the ADWF was required on October 1. For 77 days of 18.49 mgd ADWF (inflow projected in the year 2000 for the Most Likely Case scenario with no retrofit), 1,424 million gallons (mg) of effective storage capacity is required.

The existing effective storage capacity of 1,450 mg is adequate to provide storage for a ADWF of 18.83 mgd (storage volume/77 days). All the scenarios and retrofit alternatives in Table 3, except for the Worst Case scenario with no retrofit in the year 2000, have sufficient storage capacity.

Irrigation Capacity

Enough irrigation capacity is needed so that the reclaimed water stored during discharge season and all reclaimed water produced during non-discharge season can be irrigated. As with storage capacity, sufficient irrigation capacity is required to ensure that the risk of discharge, in excess of 1 percent, does not increase.

The total acreage available for reclaimed water irrigation is currently 5,239 acres. Using an average application rate of 23 inches per year, the current irrigation capacity is 3,270 mg. The current average application rate is 24 inches per year so current irrigation capacity is actually higher (around 3,400 mg). However, for

12

	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	August	Sept.		HBA
1923	578	593	716	911	797	875	709	617	571	563	533	526	7987	7988
1924	558	575	693	883	772	847	687	597	553	546	516	510	7737	7738
1925	596	614	741	943	825	905	734	638	591	583	551	545	8266	8265
1926	575	593	715	910	796	874	708	616	570	562	532	526	7977	7978
1927	616	635	766	976	853	936	759	660	611	603	570	563	8548	8550
1928	592	610	736	937	820	899	729	634	587	579	548	541	8212	8215
1929	563	581	700	892	780	856	694	603	559	551	521	515	7815	7815
1930	582	600	723	921	805	884	717	623	577	569	538	532	8071	8070
1931	560	577	696	886	775	850	689	599	555	547	518	512	7764	7765
1932	575	593	715	910	796	874	708	616	570	562	532	526	7977	7978
1933	568	585	705	898	786	862	699	608	563	555	525	519	7873	7873
1934	574	592	713	909	795	872	707	615	569	561	531	525	7963	7962
1935	590	608	733	933	816	896	726	631	585	577	546	539	8180	8179
1936	596	614	740	942	824	904	733	638	591	582	551	544	8259	8259
1937	580	598	721	918	803	881	715	621	575	567	537	530	8046	8047
1938	656	676	815	1038	908	998	808	702	650	641	607	600	9097	9097
1939	564	581	700	892	780	856	694	604	559	551	521	515	7817	7817
1940	620	639	771	982	859	942	764	654	615	607	574	567	8594	8606
1941	643	663	800	1018	891	977	792	689	638	629	595	588	8923	8923
1942	624	643	775	987	864	948	769	668	619	610	577	570	8654	8654
1943	594	612	738	940	822	902	731	636	589	581	549	543	8237	8236
1944	571	589	710	904	791	867	703	612	566	558	528	522	7921	7921
1945	581	598	722	919	804	882	715	622	576	568	537	531	8055	8054
1946	590	608	734	934	817	897	727	632	585	577	546	540	8187	8189
1947	573	590	712	906	793	870	705	613	568	560	530	523	7943	7942
1948	577	595	717	913	799	877	711	618	572	564	534	528	8005	8006
1949	580	597	720	917	802	880	714	621	575	567	536	530	8039	8041
1950	577	595	718	914	799	877	711	618	573	565	534	528	8009	8008
1951	604	623	751	956	837	918	744	647	599	591	559	552	8381	8382
1952	621	640	771	982	859	943	764	665	615	607	574	567	8608	8608
1953	609	628	757	964	843	925	750	652	604	596	564	557	8449	8451
1954	597	615	742	945	827	907	735	639	592	584	552	546	8281	8282
1955	571	589	710	904	791	868	704	612	567	559	528	522	7925	7923
1956	640	660	796	1013	886	972	788	685	635	626	592	585	8878	8879
1957	578	596	716	915	800	878	712	619	573	565	535	528	8015	8019
1958	644	663	800	1019	891	978	793	689	638	629	596	588	8928	8929
1959	578	596	716	915	800	878	712	619	573	565	535	528	8015	8016
1960	584	601	725	924	808	886	719	625	579	571	540	533	8095	8095
1961	583	601	725	923	808	886	719	625	579	571	540	533	8093	8092
1962	586	604	729	928	812	891	722	628	582	573	542	536	8133	8133
1963	605	624	752	958	838	919	745	648	600	592	560	553	8394	8392
1964	571	588	709	903	790	867	703	611	566	558	528	522	7916	7917
1965	617	635	766	976	853	936	759	660	611	603	570	564	8550	8552
1966	587	605	730	929	813	892	723	629	582	574	543	537	8144	8146
1967	609	628	757	964	844	926	751	653	604	596	564	557	8453	8453
1968	582	599	723	921	805	883	716	623	577	569	538	532	8068	8068
1969	623	642	774	986	862	946	767	667	618	609	576	569	8639	8640
1970	621	640	772	983	860	943	765	665	616	607	575	568	8615	8614
1971	599	617	744	947	828	909	737	641	594	585	554	547	8302	8302
1972	569	586	707	901	788	864	701	609	564	556	526	520	7891	7893
1973	607	625	754	960	840	921	747	650	602	593	561	554	8414	8414
1974	640	660	795	1013	886	972	788	685	635	626	592	585	8877	8877
1975	599	617	744	948	829	909	737	641	594	585	554	547	8304	8304
1976	559	576	695	884	774	849	688	598	554	546	517	511	7751	7751
1977	554	571	689	877	767	842	682	593	550	542	513	506	7686	7686
1978	616	635	766	975	853	936	759	660	611	602	570	563	8546	8546
1979	578	595	718	914	799	877	711	618	573	565	534	528	8010	8010
1980	607	625	754	960	840	921	747	650	602	593	561	554	8414	8414
1981	576	593	716	911	797	875	709	617	571	563	533	526	7987	7987
1982	641	661	797	1015	888	974	790	687	636	627	593	586	8895	8896
1983	664	684	825	1051	919	1008	818	711	658	649	614	607	9208	9207
1984	610	629	758	965	844	927	751	653	605	597	564	558	8461	8462
1985	576	594	716	912	798	876	710	617	572	564	533	527	7995	7996
1986	621	640	772	983	859	943	765	665	616	607	574	568	8613	8612
1987	570	587	708	902	789	866	702	610	565	557	527	521	7904	7906
1988	579	596	719	916	801	879	713	620	574	566	535	529	8027	8028
1989	574	591	713	908	794	871	707	614	569	561	531	524	7957	7958
1990	563	580	700	891	779	855	693	603	558	551	521	515	7809	7809
1991	569	586	707	900	787	863	700	609	564	556	526	520	7887	7886
1992	573	591	713	908	794	871	706	614	569	561	531	524	7955	7954
	41505	42770	51576	65682	57452	63036	51110	44431	41158	40582	38392	37935	575629	575665

Average monthly Plant Flows @ 21 mgd

13

water year	annual	October	November	December	January	February	March	April	May	June	July	August	September
1923	1167	323	652	2531	3003	1765	971	3314	752	249	151	145	145
1924	275	157	342	314	393	1460	206	77	109	72	58	54	51
1925	2319	162	922	1860	2985	11301	2062	4037	2955	1042	200	142	175
1926	1162	313	532	648	682	7021	1059	2519	534	198	153	140	143
1927	3165	157	2242	4457	4611	13675	4868	5485	1508	488	175	150	157
1928	1950	334	1434	1202	2732	4295	6879	4773	978	319	154	146	152
1929	564	139	547	1049	860	2000	718	629	350	165	107	102	98
1930	1446	97	94	4017	3228	3271	3365	1751	810	270	152	148	148
1931	374	141	177	178	1383	685	1139	207	140	125	109	105	99
1932	1125	98	129	4624	3485	2144	962	739	609	283	147	145	143
1933	797	138	176	357	1851	1384	2623	1314	979	303	155	144	144
1934	1057	140	320	3079	3098	3089	1446	679	240	168	147	142	137
1935	1798	144	929	489	6207	1473	5666	5041	1006	188	148	145	145
1936	2128	142	172	203	6862	12355	2051	2532	470	290	167	145	143
1937	1407	140	240	173	337	7156	4692	2547	907	253	155	143	144
1938	4997	141	3555	11266	3567	19912	14659	4368	1592	452	174	141	138
1939	553	193	472	966	1010	1477	1582	374	128	121	103	104	100
1940	3285	98	96	624	8929	14587	9377	4267	793	208	154	145	142
1941	4373	142	306	8760	12964	10819	8185	8574	1688	542	202	146	144
1942	3526	239	451	8459	8753	14269	2256	4988	1768	662	182	146	144
1943	1990	178	1022	2763	9883	3649	3421	1447	852	225	154	143	143
1944	935	141	200	275	948	3460	4338	712	662	155	126	102	98
1945	1415	244	1321	2367	1232	6705	2201	1599	651	222	147	148	147
1946	1794	173	1359	9955	4449	1972	1494	1203	326	161	152	145	140
1947	1004	139	910	1193	448	3400	3467	1581	248	231	146	144	143
1948	1321	318	375	310	2387	868	1878	6393	2273	590	174	141	142
1949	1338	169	394	850	996	3255	7352	1727	695	176	150	144	142
1950	1252	139	183	259	3103	5654	2243	2111	733	165	145	144	144
1951	2487	452	4275	7930	6679	5631	2558	810	888	173	147	148	147
1952	3268	142	1023	8232	11618	8409	5422	2426	1162	296	196	141	143
1953	2686	138	311	8203	15732	1601	3300	1205	956	342	152	145	140
1954	2151	149	1002	1064	7526	6327	4435	4133	575	170	152	145	140
1955	941	139	905	2793	2534	1031	825	1671	800	160	147	140	142
1956	4141	139	241	15787	15864	12701	2988	764	583	187	152	145	142
1957	1341	159	284	237	2013	5369	4335	1182	1704	347	147	146	166
1958	4430	1360	1228	3088	6112	22787	7824	9205	812	308	146	144	143
1959	1281	138	245	301	4637	7234	1239	573	191	153	144	139	138
1960	1552	139	186	204	1464	9118	5288	1149	453	190	151	144	142
1961	1528	140	371	3447	1508	6513	3916	1200	638	164	151	145	140
1962	1665	139	440	2064	1341	8944	5330	809	308	163	152	145	141
1963	2589	2261	553	3248	2238	8708	3101	8762	1488	276	148	144	142
1964	897	151	2514	936	4155	1173	697	364	188	155	148	143	139
1965	3001	136	1186	13827	12672	1974	926	4028	663	167	149	145	144
1966	1678	143	1562	2256	7163	4900	2189	999	314	164	147	148	147
1967	2749	140	2019	5269	9140	3658	4941	5639	1285	463	142	145	143
1968	1424	139	354	1422	4690	5992	2931	745	220	162	147	146	138
1969	3360	140	261	5741	14243	12829	4564	1398	525	179	147	145	143
1970	3209	187	212	5940	21207	6698	2763	665	260	157	145	139	139
1971	2162	140	1508	9489	6799	1095	4480	1380	454	164	147	144	143
1972	830	140	171	1619	1971	2390	1619	1163	283	162	148	145	145
1973	2587	144	1335	2939	10667	9089	4652	1297	327	161	147	146	145
1974	4105	213	7282	7338	11308	4131	11246	6438	685	189	147	141	142
1975	2258	139	230	735	1419	10197	10893	2109	745	190	148	142	143
1976	329	169	341	571	235	424	1006	644	129	120	104	99	99
1977	90	96	104	93	134	102	197	57	73	70	51	53	48
1978	3024	49	1214	3681	13385	8232	5791	2769	570	165	150	145	141
1979	1255	141	184	194	3192	6204	2972	938	634	164	147	146	145
1980	2589	360	1728	3545	9733	9261	4261	1215	376	159	149	144	142
1981	1136	140	173	1563	4264	2953	2876	850	232	155	149	143	139
1982	4267	331	5784	10384	6820	8650	4549	2315	1546	363	168	145	148
1983	5446	324	2591	9365	8581	13323	18866	7067	3787	882	255	147	161
1984	2712	300	7658	14184	2699	3387	2240	1164	311	165	149	144	141
1985	1174	158	4287	2325	802	2708	2009	977	225	162	150	145	144
1986	3344	189	426	1626	4122	23200	8697	954	271	162	149	[illegible]	185
1987	871	168	160	287	1168	3048	4177	640	210	168	145	[illegible]	[illegible]
1988	1252	148	251	4996	6856	1148	445	363	229	162	145	146	[illegible]
1989	1024	138	836	914	1146	498	6802	1124	222	154	151	140	166
1990	570	317	280	235	1925	1907	774	127	566	405	110	102	97
1991	769	222	290	152	122	280	6839	706	179	120	109	104	100
1992	1059	107	364	511	863	6316	2823	759	237	170	153	144	161
	137728	15603	75921	241963	351113	423241	279046	167771	51060	17311	10368	9827	9666
	1967.5	222.9	1084.6	3456.6	5015.9	6046.3	3986.4	2396.7	729.4	247.3	148.1	137.5	138.1

Prepared by Bob Anderson 9/24/96

15

Table 1
Average Monthly Plant Flows
Source: Water Balance Model

ADWF: 21.0

WATER YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Flow
1923	576	593	716	911	797	875	709	617	571	563	533	526	7,988
1924	558	575	693	883	772	847	687	597	553	546	516	510	7,738
1925	596	614	741	943	825	905	734	638	591	583	551	545	8,265
1926	575	593	715	910	796	874	708	616	570	562	532	526	7,978
1927	616	635	766	976	853	936	759	660	611	603	570	563	8,550
1928	592	610	736	937	820	899	729	634	587	579	548	541	8,215
1929	563	581	700	892	780	856	694	603	559	551	521	515	7,815
1930	582	600	723	921	805	884	717	623	577	569	538	532	8,070
1931	560	577	696	886	775	850	689	599	555	547	518	512	7,765
1932	575	593	715	910	796	874	708	616	570	562	532	526	7,978
1933	568	585	705	898	786	862	699	608	563	555	525	519	7,873
1934	574	592	713	909	795	872	707	615	569	561	531	525	7,962
1935	590	608	733	933	816	896	726	631	585	577	546	539	8,179
1936	596	614	740	942	824	904	733	638	591	582	551	544	8,259
1937	580	598	721	918	803	881	715	621	575	567	537	530	8,047
1938	656	676	815	1,038	908	996	808	702	650	641	607	600	9,097
1939	564	581	700	892	780	856	694	604	559	551	521	515	7,817
1940	620	639	771	982	859	942	764	664	615	607	574	567	8,606
1941	643	663	800	1,018	891	977	792	689	638	629	595	588	8,923
1942	624	643	775	987	864	948	769	668	619	610	577	570	8,654
1943	594	612	738	940	822	902	731	636	589	581	549	543	8,236
1944	571	589	710	904	791	867	703	612	566	558	528	522	7,921
1945	581	598	722	919	804	882	715	622	576	568	537	531	8,054
1946	590	608	734	934	817	897	727	632	585	577	546	540	8,189
1947	573	590	712	906	793	870	705	613	568	560	530	523	7,942
1948	577	595	717	913	799	877	711	618	572	564	534	528	8,006
1949	580	597	720	917	802	880	714	621	575	567	536	530	8,041
1950	577	595	718	914	799	877	711	618	573	565	534	528	8,008
1951	604	623	751	956	837	918	744	647	599	591	559	552	8,382
1952	621	640	771	982	859	943	764	665	615	607	574	567	8,608
1953	609	628	757	964	843	925	750	652	604	596	564	557	8,451
1954	597	615	742	945	827	907	735	639	592	584	552	546	8,282
1955	571	589	710	904	791	868	704	612	567	559	528	522	7,923
1956	640	660	796	1,013	886	972	788	685	635	626	592	585	8,879
1957	578	596	718	915	800	878	712	619	573	565	535	528	8,019

16

Table 1
Average Monthly Plant Flows
Source: Water Balance Model

ADWF: 21.0

WATER YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Flow
1958	644	663	800	1,019	891	978	793	689	638	629	596	588	8,929
1959	578	596	718	915	800	878	712	619	573	565	535	528	8,016
1960	584	601	725	924	808	886	719	625	579	571	540	533	8,095
1961	583	601	725	923	808	886	719	625	579	571	540	533	8,092
1962	586	604	729	928	812	891	722	628	582	573	542	536	8,133
1963	605	624	752	958	838	919	745	648	600	592	560	553	8,392
1964	571	588	709	903	790	867	703	611	566	558	528	522	7,917
1965	617	635	766	976	853	936	759	660	611	603	570	564	8,552
1966	587	605	730	929	813	892	723	629	582	574	543	537	8,146
1967	609	628	757	964	844	926	751	653	604	596	564	557	8,453
1968	582	599	723	921	805	883	716	623	577	569	538	532	8,068
1969	623	642	774	986	862	946	767	667	618	609	576	569	8,640
1970	621	640	772	983	860	943	765	665	616	607	575	568	8,614
1971	599	617	744	947	828	909	737	641	594	585	554	547	8,302
1972	569	586	707	901	788	864	701	609	564	556	526	520	7,893
1973	607	625	754	960	840	921	747	650	602	593	561	554	8,414
1974	640	660	795	1,013	886	972	788	685	635	626	592	585	8,877
1975	599	617	744	948	829	909	737	641	594	585	554	547	8,304
1976	559	576	695	884	774	849	688	598	554	546	517	511	7,751
1977	554	571	689	877	767	842	682	593	550	542	513	506	7,686
1978	616	635	766	975	853	936	759	660	611	602	570	563	8,546
1979	578	595	718	914	799	877	711	618	573	565	534	528	8,010
1980	607	625	754	960	840	921	747	650	602	593	561	554	8,414
1981	576	593	716	911	797	875	709	617	571	563	533	526	7,987
1982	641	661	797	1,015	888	974	790	687	636	627	593	586	8,896
1983	664	684	825	1,051	919	1,008	818	711	658	649	614	607	9,207
1984	610	629	758	965	844	927	751	653	605	597	564	558	8,462
1985	576	594	716	912	798	876	710	617	572	564	533	527	7,996
1986	621	640	772	983	859	943	765	665	616	607	574	568	8,612
1987	570	587	708	902	789	866	702	610	565	557	527	521	7,906
1988	579	596	719	916	801	879	713	620	574	[illegible]	535	529	8,028
1989	574	591	713	908	794	871	707	614	569	561	531	524	7,958
1990	563	580	700	891	779	855	693	603	558	551	521	515	7,809
1991	569	586	707	900	787	863	700	609	564	556	526	520	7,886
1992	573	591	713	908	794	871	706	614	569	561	531	524	7,954

TABLE 1b

MEAN ANNUAL AND MONTHLY FLOWS OF RUSSIAN RIVER AT GUERNEVILLE
FOR SCENARIO 2, YEAR 2010 DIVERSIONS CONDITIONS (ALL FLOWS CFS)

Water Year	Annual	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1923	1,167	323	652	2531	3003	1765	971	3314	752	249	151	145	135
1924	275	157	342	314	393	1460	206	77	109	72	58	54	51
1925	2,319	162	922	1860	2965	11301	2062	4037	2955	1042	200	142	175
1926	1,162	313	532	648	682	7021	1059	2519	534	198	153	140	143
1927	3,165	157	2242	4457	4611	13675	4868	5485	1508	488	175	150	157
1928	1,950	334	1434	1202	2732	4295	6879	4773	978	319	154	146	152
1929	564	139	547	1049	660	2000	718	629	350	165	107	102	98
1930	1,446	97	94	4017	3228	3271	3365	1751	810	270	152	148	148
1931	374	141	177	178	1383	685	1139	207	140	125	109	105	99
1932	1,125	98	126	4624	3485	2144	962	739	609	283	147	145	143
1933	797	138	176	357	1851	1384	2623	1314	979	303	155	144	144
1934	1,057	140	320	3079	3098	3089	1446	679	240	168	147	142	137
1935	1,798	144	929	489	6207	1473	5666	5041	1996	188	148	145	145
1936	2,128	142	172	203	6862	12355	2051	2532	470	290	167	145	143
1937	1,407	140	240	173	337	7156	4692	2547	907	253	155	143	144
1938	4,997	141	3555	11266	3567	19912	14659	4368	1592	452	174	141	138
1939	553	193	472	966	1010	1477	1582	374	128	121	103	104	100
1940	3,285	98	96	624	8929	14587	9377	4267	793	208	154	145	142
1941	4,373	142	306	8760	12964	10819	8185	8574	1688	542	202	146	144
1942	3,528	239	451	8459	8753	14269	2256	4988	1768	662	182	146	144
1943	1,990	178	1022	2763	9803	3649	3421	1447	852	225	154	143	143
1944	935	141	200	275	948	3460	4338	712	662	155	126	102	98
1945	1,415	244	1321	2367	1232	6705	2201	1599	651	222	147	148	147
1946	1,794	173	1359	9955	4449	1972	1494	1203	326	161	152	145	140
1947	1,004	139	910	1193	448	3400	3467	1581	248	231	146	144	143
1948	1,321	318	375	310	2387	868	1878	6393	2273	590	174	141	142
1949	1,338	169	394	850	996	3255	7352	1727	695	176	150	144	142
1950	1,252	139	183	259	3103	5654	2243	2111	733	165	145	144	144
1951	2,487	452	4275	7830	6679	5631	2558	810	868	173	147	148	147
1952	3,268	142	1023	6232	11618	8409	5422	2426	1162	296	196	141	143
1953	2,686	138	311	6203	15732	1601	3300	1205	956	342	152	145	140
1954	2,151	149	1002	1064	7526	6327	4435	4133	575	170	152	145	140
1955	941	139	905	2793	2534	1031	825	1671	800	160	147	140	142
1956	4,141	139	241	15787	15864	12701	2988	764	503	187	152	145	142
1957	1,341	159	284	237	2013	5369	4335	1182	1704	347	147	146	166

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TABLE 1b (continued)

MEAN ANNUAL AND MONTHLY FLOWS OF RUSSIAN RIVER AT GUERNEVILLE
FOR SCENARIO 2, YEAR 2010 DIVERSIONS CONDITIONS (ALL FLOWS CFS)

Water Year	Annual	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1958	4,430	1360	1228	3088	6112	22787	7824	9205	812	308	146	144	145
1959	1,261	138	245	301	4637	7234	1239	573	191	153	144	139	138
1960	1,552	139	186	204	1464	9118	5288	1149	453	190	151	144	142
1961	1,528	140	371	3447	1508	6513	3916	1200	638	164	151	145	140
1962	1,665	139	440	2064	1341	8944	5330	809	308	163	152	145	141
1963	2,589	2261	553	3248	2238	8708	3101	8762	1488	276	148	144	142
1964	897	151	2514	936	4155	1173	697	364	188	155	148	143	139
1965	3,001	136	1186	13827	12672	1974	926	4028	663	167	149	145	144
1966	1,678	143	1562	2256	7163	4900	2189	999	314	164	147	148	147
1967	2,749	140	2019	5269	9140	3658	4941	5639	1285	463	142	145	143
1968	1,424	139	354	1422	4690	5992	2931	745	220	162	147	146	138
1969	3,360	140	261	5741	14243	12829	4564	1398	525	179	147	145	143
1970	3,209	187	212	5940	21207	6698	2763	665	260	157	145	139	139
1971	2,162	140	1508	9489	6799	1095	4480	1380	454	164	147	144	143
1972	830	140	171	1619	1971	2390	1619	1163	283	162	148	145	145
1973	2,587	144	1335	2939	10667	9089	4652	1297	327	161	147	146	145
1974	4,105	213	7282	7338	11308	4131	11246	6438	685	189	147	141	142
1975	2,258	139	230	735	1419	10197	10893	2109	745	190	148	142	143
1976	329	169	341	571	235	424	1006	644	129	120	104	99	99
1977	90	96	104	93	134	102	197	57	73	70	51	53	48
1978	3,024	49	1214	3681	13385	8232	5791	2769	570	165	150	145	141
1979	1,255	141	184	194	3192	6204	2972	938	634	164	147	146	145
1980	2,589	360	1728	3545	9733	9261	4261	1215	376	159	149	144	142
1981	1,136	140	173	1563	4264	2953	2876	850	232	155	149	143	139
1982	4,267	331	5784	10384	6820	8650	4549	12315	1546	363	168	145	148
1983	5,446	324	2591	9365	8581	13323	18866	7067	3797	882	255	147	161
1984	2,712	300	7658	14184	2699	3387	2240	1164	311	165	149	144	141
1985	1,174	158	4287	2325	802	2708	2009	977	225	162	150	145	144
1986	3,344	189	426	1626	4122	23200	8697	954	271	162	149	146	185
1987	871	168	160	287	1168	3048	4177	640	210	168	145	145	141
1988	1,252	148	251	4996	6856	1148	445	363	229	162	145	146	140
1989	1,024	138	836	914	1146	498	6802	1124	222	154	151	140	166
1990	570	317	280	235	1925	1907	774	127	566	405	110	102	97
1991	769	222	290	152	122	280	6839	706	179	120	109	104	100
1992	1,059	107	364	511	863	6316	2923	759	237	170	153	144	161
Mean =	1,967.5	222.9	1,084.5	3,456.6	5,015.9	6,046.3	3,986.3	2,396.8	729.4	247.3	148.1	137.5	138.1

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Volume/Time (Flow)

To convert	Multiply by
Acre-feet per day to cubic feet per second	0.5043
to cubic meters per second	0.0143
to gallons per minute	226.24
to million gallons per day	0.3258
Cubic feet/second to acre-feet/day	1.983
to acre-inch per hour	0.992
to cubic feet per day	86,400.00
to cubic meters per second	0.028317
to gallons per day	646,272.00
to gallons per minute	448.80
to gallons per second	7.48
to liters per second	28.317
Cubic meters/second to acre-feet/day	70.0456
to cubic feet per second	35.314
to gallons per minute	15,850.37
to liters per second	1,000.00
to million gallons per day	22.824
Gallons per minute to acre-feet per day	0.00442
to cubic feet per second	0.00223
to cubic meters per second	0.00006309
to gallons per day	1,440.00
to liters per second	0.06309
Liters/second to cubic feet/second	0.035314
to cubic meters per second	0.001
to gallons per minute	15.85
Million gallons/day to acre-feet/day	3.0689
to cubic feet per second	1.547
to cubic meters per second	0.043813
to gallons per minute	695.00

Yield

To convert	Multiply by
Kilograms per hectare to pounds per acre	0.8916
Pounds per acre to kilograms per hectare	1.122

CALIFORNIA SALMONID STREAM HABITAT RESTORATION MANUAL

SECOND EDITION

Prepared by:

GARY FLOSI and FORREST L. REYNOLDS

Principal Contributors:
Members of the Anadromous Fisheries Habitat Restoration Program

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Inland Fisheries Division
California Department of Fish and Game
The Resources Agency

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20

Draft

MEMORANDUM

TM-DD-1

TO: Anders Hauge (HBA)
Robin Cort (Parsons ES)
Pat Collins (HBA)

FROM: Jessamy Zagel Trisler (Parsons ES)

DATE: 8 August 1995

RE: Santa Rosa Subregional Long-Term Wastewater Project, Direct Discharge Water Balance

GENERAL

One of the alternatives being examined for disposal of reclaimed water is an expansion of the current discharge program to include direct discharge to the Russian River upstream of the SCWA water supply intake wells. Currently, direct discharge is permitted to the Laguna de Santa Rosa through outfalls from the existing system. Discharges of 1 percent of Russian River flow are allowed from October 1 through May 15 after flow in the Russian River has reached 1,000 cfs. Discharges of up to 5 percent are allowed with special permission from the Regional Water Quality Control Board. Under the Direct Discharge Alternative (Alternative 5), the maximum permitted discharge rate would be 20 percent of Russian River flow. The reclaimed water to be discharged would first flow to Delta pond. From Delta pond a pump station would pump the water through a pipeline to the outfall at the River. The purpose of this memorandum is to:

- present the components of the direct discharge (alternative 5) water balance system,
- determine pipeline and pump station sizing,
- develop present worth costs for the different alternatives,
- recommend an appropriate pipeline and pump station selection, and
- present the capacity of the existing system to handle the flows indicated in the Monthly Water Balance Model.

Another aspect of the Direct Discharge Alternative is the outlet structure to the Russian River. Appendix A presents a discussion and conceptual design of this structure.

TABLE 1

CITY OF SANTA ROSA

Irrigation Demands[1]

Month	1994 Reclamation Annual Report Flows (MG/Month)	HBA June 16, 1994 Interim Irr. Demands (MG/Month)	Total Irrigation Demands (MG/Month)
O	334	55	389
N	25	4	29
D	0	0	0
J	0	0	0
F	0	0	0
M	56	9	65
A	221	36	257
M	404	66	470
J	621	102	723
J	931	153	1084
A	747	123	870
S	433	71	504
Totals	3772	620	4392

[1] Data obtained from City of Santa Rosa 1994 Annual Reclamation System Report.

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22

TABLE 2

CITY OF SANTA ROSA

RUSSIAN RIVER STAGE-FLOW INFORMATION

10-Year Low Flows

Month	Guerneville Gage Flow (cfs)	Direct Discharge Outfall Flow (cfs)	Direct Discharge Outfall Flow (MGD)
O	154	143	92
N	348	279	180
D	593	454	293
J	798	654	422
F	1,254	959	620
M	1,225	929	600
A	536	445	288
M	314	265	171
J	160	145	94
J	108	109	71
A	103	108	70
S	108	109	71

Notes:

1. The Direct Discharge outlet is 9.1miles upstream of the Guerville gage.

2. From analysis by Dames and Moore, Technical Memorandum No. T-2 dated December 30, 1988.

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23

TABLE 3A

CITY OF SANTA ROSA

MONTHLY WATER BALANCE

10-Year Low Flows - Discharge Option A

Month	(1) Total Reclaimed Water (MG/Mo)	(2) Direct Discharge to Russian River (MG/Mo)	(3) Reclaimed Water to Irrigation (MG/Mo)	(4) Reclaimed Water to Storage (MG/Mo)	(5) Net Storage (MG)	(6) DD as % of Russian River Flow (MG/Mo)
O	636	0	389	247	347	0.0
N	656	540	29	87	434	10.0
D	791	800	0	-9	425	8.8
J	1,007	800	0	207	632	6.1
F	881	691	0	190	822	4.0
M	966	800	65	101	923	4.3
A	783	800	257	-274	648	9.3
M	681	0	470	211	859	0.0
J	631	0	723	-92	767	0.0
J	622	0	1,084	-462	305	0.0
A	588	0	870	-282	23	0.0
S	581	0	504	77	100	0.0
Totals	8,823	4,431	4,392			

Maximum Additional Storage Needed (MG) 0

(1) Projected monthly reclaimed water flows based on the Water Balance Model with ADWF of 21 mgd. See TM-WBM-8.

(2) Direct Discharge to the Russian River based on a Maximum of 20% of Russian River flows to be discharged from October 1 through May 15.

(3) Assumes irrigation flow of 100% of 1994 existing flow from the Subregional Reclamation Storage Table in the Reclamation System 1994 Annual Report plus the proposed interim plan irrigation.

(4) Flow into storage during the winter months is necessary to provide adequate volumes to meet dry season irrigation requirements. Obtain a minimum 100 MG.

(5) Net Storage presents the storage volume available during that month.

(6) From Table 2.

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24

TABLE 3B

CITY OF SANTA ROSA

MONTHLY WATER BALANCE

10-Year Low Flows - Discharge Option B

Month	(1) Total Reclaimed Water (MG/Mo)	(2) Direct Discharge to Russian River (MG/Mo)	(3) Reclaimed Water to Irrigation (MG/Mo)	(4) Reclaimed Water to Storage (MG/Mo)	(5) Net Storage (MG)	(6) DD as % of Russian River Flow (MG/Mo)
O	636	0	389	247	347	0.0
N	656	0	29	627	974	0.0
D	791	0	0	791	1,765	0.0
J	1,007	0	0	1,007	2,772	0.0
F	881	0	0	881	3,653	0.0
M	966	0	65	901	4,554	0.0
A	783	0	257	526	5,079	0.0
M	681	0	470	211	5,290	0.0
J	631	0	723	-92	5,198	0.0
J	622	0	1,084	-462	4,736	0.0
A	588	0	870	-282	4,454	0.0
S	581	0	504	77	4,531	0.0
Totals	8,823	0	4,392			

Maximum Additional Storage Needed (MG) 3,790

(1) Projected monthly reclaimed water flows based on the Water Balance Model with ADWF of 21 mgd. See TM-W8M-8.

(2) Direct Discharge to the Russian River based on a Maximum of 20% of Russian River flows to be discharged from Oct. 1 through May 15 after daily flow exceeds 1,000 cfs.

(3) Assumes irrigation flow of 100% of 1994 existing flow from the Subregional Reclamation Storage Table in the Reclamation System 1994 Annual Report plus the proposed interim plan irrigation.

(4) Flow into storage during the winter months is necessary to provide adequate volumes to meet dry season irrigation requirements. Obtain a minimum 100 MG.

(5) Net Storage presents the storage volume available during that month.

(6) From Table 2.

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25

From the monthly water balance, Option A, the following are the maximum discharge flows and possible discharges from the existing outfalls at Meadowlane and Delta Ponds.

Month	Maximum Required Discharge Flow (MGD)	Discharge Required from Each Pond (MGD)			Maximum Equivalent Velocity (fps)
		Total	24-inch	36-inch	
Nov	25.0	12.50	3.85	8.65	1.89
Dec	25.8	12.90	3.97	8.93	1.95
Jan	25.8	12.90	3.97	8.93	1.95
Feb	24.7	12.35	3.80	8.55	1.87
Mar	25.8	12.90	3.97	8.93	1.95
Apr	26.7	13.35	4.11	9.24	2.02

Clearly these discharge velocities are available. Therefore, the existing system is capable of discharging the projected flows. At lower flows (less than the 95 percentile used in the Water Balance), discharge can still be divided between the two ponds and between the two outlets from each pond. Another option is to discharge from a single pond and a single outlet at that pond for lower flows. Flow capacity for the 36-inch at 5 fps is 22.8 MGD. Flows up to 22.8 MGD could be discharged through a single 36-inch outlet at either Delta or Meadowlane Pond. Flow capacity for the 24-inch outlet at 5 fps is 10.15 MGD. Flows up to 10.15 MGD could be discharged at a single 24-inch outlet at either pond.

outlet

Santa Rosa Subregional Long-Term Wastewater Project

INTRODUCTION AND SUMMARY TO THE DRAFT ENVIRONMENTAL IMPACT REPORT/ ENVIRONMENTAL IMPACT STATEMENT

City of Santa Rosa
and
U.S. Army Corps of Engineers

Cooperating Agencies:

Bureau of Land Management
National Oceanic Atmospheric Administration

July 1996

27

Volume of Reclaimed Water Discharge

Design Discharge Rate (as a Proportion of Russian River Flow)	Average Volume of Reclaimed Water Discharged to Laguna (October 1–May 14)
1 Percent	685 million gallons
5 Percent	1,825 million gallons
10 Percent	2,740 million gallons
15 Percent	3,490 million gallons
No Project	3,245 million gallons
Existing Conditions	3,735 million gallons
20 Percent	4,640 million gallons
The average volume of the Russian River from October 1 to May 14	341,000 million gallons

Table 1-15.

for a reservoir, which is the primary determinant for impacts, would not change substantially under any of the discharge options. Similarly, the reduction in size of pipelines or size of pumps in pump stations would not result in a smaller construction zone or level of construction activity. There would be some reduction in the operational noise level at pump stations, but not to a level less than significant.

The decrease in agricultural irrigation would result in decreased length of pipeline and number of pump stations. It is likely environmental impacts would also be reduced. However, because the actual properties to be irrigated are not known at this time for any of the discharge options, it is not possible fully to determine the degree of reduced impacts. Thus, even though the reduction in irrigated acreage for Alternative 2, South County, would be approximately 30 percent under a 5% option and nearly 60 percent under a 10% option, the reductions in some impacts would not necessarily be reduced proportionately, and depending on the actual location and characteristics of the properties to be irrigated, could be substantially more or less than the reduction in the total irrigation acreage. The significant impact of agricultural irrigation with regard to the numerical standard for dissolved copper for Alternative 3 (West County) would be avoided by the 5%, 10%, and 15% options. However, significant impacts on the esteros would not be avoided by any of the reduced irrigation options.

The elimination of a second reservoir for Alternatives 2B and 2D would eliminate impacts associated with that site including pipelines leading to the site as well as the pump station at the dam. Impacts for alternatives 2B and 2D, with only one reservoir each, would be reduced but not eliminated.

The increased river discharge (relative to a one percent design discharge) would not require a change in the size or location of the outfall structure in the Laguna. The increased discharge would increase impacts on the Laguna and Russian River related to streambank erosion, flooding, and water quality. However, the increases would not be sufficient to change the level of impacts from less than significant to significant for any of the Surface Water Hydrology criteria. Mitigation of the 5%, 10%, and 15% discharge options would not avoid significant adverse water quality impacts, but the cumulative projects scenario (nitrogen load reduction) combined with mitigation would avoid significant impacts. Study and control of aluminum in Santa Rosa reclaimed water would mitigate the only significant adverse cumulative impact.

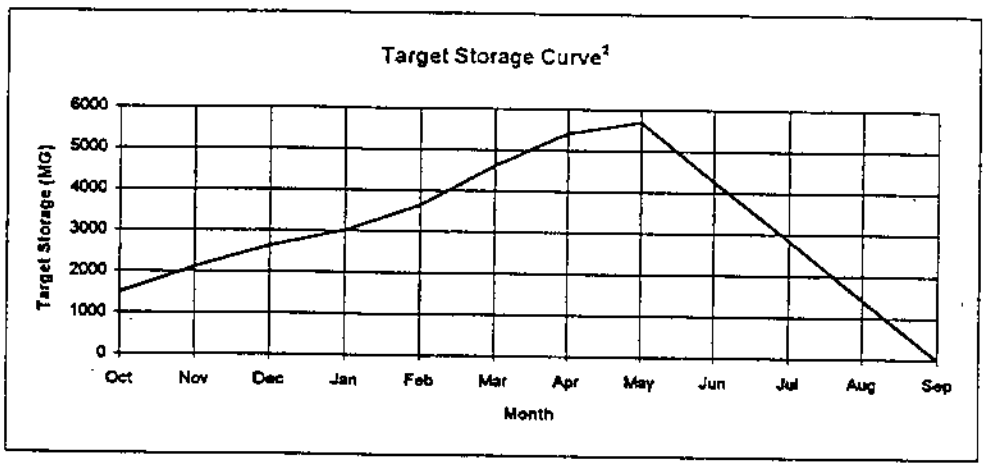
28

MODEL RUN SUMMARY #2

Alternative 2 - South County Reclamation
2/22/95 16:06
Remarks: New storage taken from original HBA Screening Report.
Irrigation acreage adjusted to achieve reliability target.

Primary Parameters

Russian River Discharge Rate (percent)	1
Average Dry Weather Flow (MGD)[1]	26.85
Existing Storage (MG)	1200
New Storage (MG)	4500
Total Maximum Available Storage (MG)	5700



Irrigation Areas and Hydraulic Loading Rates:

Type	Area (acres)[3]	Rate (inches annually)[4]
Existing Irrigation	5300	24
Laguna Wetlands	400	60
Ag. Irrig. (Normal)	8000	30
Ag. Irrig.-Vineyards (Low)	2000	12
Ag. Irrig.-Sebastopol (High)	0	36
Urban Irrigation	0	30

Discharge Summary

Average Monthly Excess Release (MG)[5]	115
Maximum Monthly Excess Release (MG)	270
Months of Exceedance[6]	28
Reliability (# in 20)[7]	1.00

29

TECHNICAL MEMORANDUM TM-R-2

13 March 1995
723129.31005

To: City of Santa Rosa, Ed Brauner
Dan Carlson
Marie Meredith

From: Anders Hauge, Robin Cort, Rich Maurer

Subject: Santa Rosa Subregional Long-term Wastewater Project
Two Rock Reservoir

Some confusion has arisen regarding which configuration of the Two Rock reservoir is being carried forward to design.

Three Two Rock reservoir configurations were originally identified: T5, T6, and T6A, in the order of moving further up the canyon and reduction in size of the watershed captured by the reservoir, reduction in the water surface area, and reduction in the impacted wetlands area.

The maximum storage capacity for the Two Rock site was originally estimated as 6,567 MG (19,700 AF) for the T-6 dam location, with 4,453 MG (13,360 AF) capacity identified for the T-6A dam location, and somewhat less capacity for the T-5 dam location.

Subsequently, we and RUST agreed that the T-6A dam location could be developed to store up to 4,500 MG, the capacity required for the 1% Russian River discharge alternative. >4500

The jurisdictional wetlands which would be impacted by construction of a Two Rock reservoir has been determined by Parsons ES as affecting 43 acres for the T-6 site and 32 acres for the T-6A site.

In light of the fact that the T-6A reservoir configuration would meet the maximum storage requirement of 4,500 MG and would flood less wetland acreage and less overall site acreage than the other Two Rock configurations, we recommend that the T-6A dam site be selected for the Two Rock reservoir configuration.

This recommendation is subject to receipt and evaluation of the geotechnical report for the Two Rock dam sites, and decision by the City/BPU that the maximum capacity reservoir possible on this site; i.e., T-6, is not to be developed.

83-67.R1

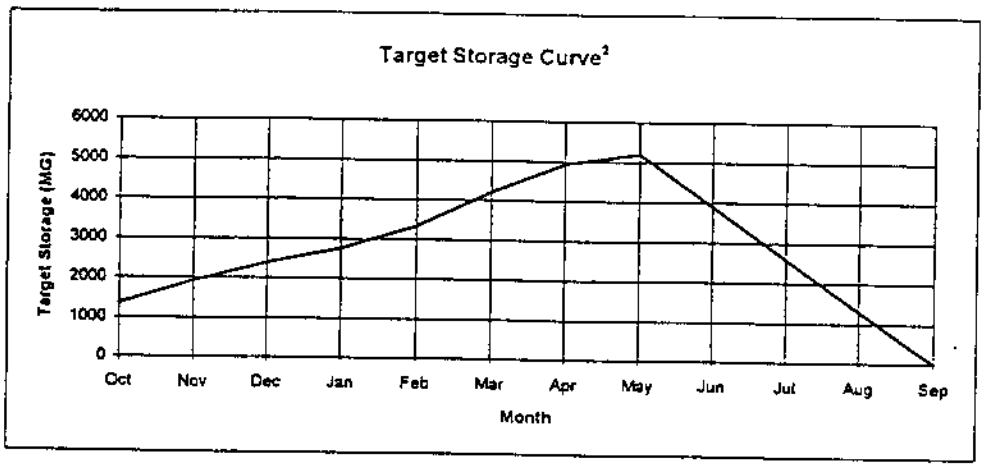
30

MODEL RUN SUMMARY

Alternative 2 - South County Reclamation
4/19/95 16:21
Remarks: System requirements based on new WYA ADWF estimate.

Primary Parameters

Russian River Discharge Rate (percent)	1
Average Dry Weather Flow (MGD)[1]	20.5
Existing Storage (MG)	1200
New Storage (MG)	4000
Total Maximum Available Storage (MG)	5200



Irrigation Areas and Hydraulic Loading Rates:

Type	Area (acres)[3]	Rate (inches annually)[4]
Existing Irrigation	5300	24
Laguna Wetlands	400	60
Ag. Irrig. (Normal)	3985	30
Ag. Irrig.-Vineyards (Low)	0	12
Ag. Irrig.-Sebastopol (High)	0	36
Urban Irrigation	0	30

Discharge Summary

Average Monthly Excess Release (MG)[5]	96
Maximum Monthly Excess Release (MG)	263
Months of Exceedance[6]	28
Reliability (# in 20)[7]	1.00

3/

FOOTNOTES
Model Run Summary

[1] Average Dry Weather Flow is based on 9,800 MG annual wastewater volume (includes conservation) from the 1993 HBA Screening Report.

[2] Target storage curve taken from original CH2M Hill water balance model.

[3] Existing irrigation area from 1994 Reclamation Annual Report. Wetland area per conversation with Dave Smith.

[4] Existing irrigation rate from 1994 Reclamation Annual Report. Wetland irrigation rate per Dave Smith. Agricultural irrigation rates per Jeff Peters. Urban irrigation rate assumed to be same as moderate agricultural.

[5] Excess release defined as actual Russian River discharge in excess of allowable.

[6] Months of exceedance: Number of months over the period of record (70 years) in which the actual Russian River release exceeded allowable.

[7] Reliability (# in 20): The number of months in twenty in which actual Russian River discharge exceeded allowable discharge. The target reliability number is one.

32

SONOMA COUNTY WATER AGENCY

WATER AND WASTEWATER EFFICIENCY/ AVOIDED COST STUDY

SEPTEMBER 1995

MONTGOMERY WATSON
William O. Maddaus
Jack Weber
Dan Bishop
Wendy Gleason

MONTGOMERY WATSON

in association with

PACIFIC TECHNOLOGY ASSOCIATES
Ned Orrett

City of Santa Rosa: [(29 mg * $773/mg) + (2,980 mg * $390/mg)] / 3,009 mg = $394/mg

The assumption is made that the Subregional System is currently discharging the maximum volume of dry weather flow-derived wastewater possible, under the terms of its current NPDES permit, to the Russian River. This is the least costly discharge option available. Consequently, storage is provided for additional wastewater so it may be irrigated on pastures during the summer. The avoided costs above reflect the concept that the economic benefit of conservation today, in terms of avoided wastewater operations, is properly valued at the cost of irrigation.

Future Situation

Wastewater Treatment

A project is under development to increase the dry weather flow capacity of the Laguna Subregional Wastewater Treatment Plant from 18 to approximately 22.5 mgd. A subsequent project that will further expand capacity to 25 mgd may be necessary within the time horizon of this study (1995 to 2015). The timing for this project, however, depends on the effectiveness of water conservation. To the extent water conservation proposed herein will avoid or delay this increment of expansion of the Laguna WWTP, there is the potential for significant cost savings.

The 1990 EIR/S noted at the top of page 4-9: "The Laguna WWTP would be expanded to treat an average daily dry weather flow of 25 million gallons per day (mgd)." Figures 4-1 and 4-2, appearing on pages 4-2 and 4-3, respectively, indicate all disposal projects considered by the EIR/S were sized to accommodate 10,700 mg/yr of treated wastewater. Allowing for a 16% contribution by infiltration and inflow (typical for this system), this reflects a dry weather flow of approximately 9,000 mg/yr, or 24.6 mgd. This is consistent with the 25 mgd treatment capacity. These flow projections assume that state regulations regarding water-saving devices will be followed for all new construction (1990 EIR/S, p. 3-7).

HBA's March 1994 Screening Report reviewed thirty-two wastewater disposal alternatives. Assuming normal precipitation, nine of these are sized to accommodate 10,879 mg/yr (12,300 mg/yr at buildout in 2010 less 1,430 mg/yr of conservation due to state regulations); twenty are sized for 9,800 mg/yr (12,300 mg/yr at buildout less 1,430 mg/yr for state regulations and 1,070 mg/yr for retrofit programs), and three are sized for 8,000 mg/yr (maximum conservation of 4,300 mg/yr). Nine of these alternatives are therefore sized approximately the same as those in the 1990 EIR/S (therefore requiring 25 mgd treatment capacity in 2010), and twenty three have reduced flowrates.

Given the current growth trends in the Santa Rosa area, and improved efficiency of indoor water use due only to new plumbing codes, Mr. Dan Carlson, Capital Projects Manager for the City of Santa Rosa Utilities Department estimated in June, 1995, that the 2.5 mgd incremental expansion at the Laguna WWTP will be required between 2010 and 2015. The estimated cost for this project is $15 to $20 million.

This study, conducted independently from work sponsored by the City of Santa Rosa, supports Mr. Carlson's projection. Total baseline indoor water usage (no conservation beyond plumbing code) for the Cities of Santa Rosa (including South Park Sanitation District), Rohnert Park, and Cotati is estimated to total 20.87 mgd (23,380 AF/Y taking into account net values) in 2015 (see Tables 3-26, 3-27, and 3-28 in the body of this report). By adding 0.73 mgd to this to account for dry weather flow from the City of Sebastopol (Projected Flow at Buildout of the General Plan (2010), found in Table 1 of *Water Conservation Technical Memorandum No. WYA-1*, by Jim Yost and Doug Moore dated May 31, 1995), baseline influent ADWF for the Laguna WWTP is estimated at 21.6 mgd in 2015. Given that construction was underway on the City of Santa Rosa's current plant expansion when at 93% of capacity (16.8 mgd/18 mgd), the next phase may be expected to be underway when ADWF reaches 21 mgd (0.93 * 22.5 mgd). Under these conditions, this will occur between 2010 and 2015.

SANTA ROSA SUBREGIONAL SYSTEM
Avoided Cost Analysis: Wastewater

Present Situation

The City of Santa Rosa operates a "Subregional System" that provides wastewater treatment and treated effluent reuse/discharge services for the majority of the urbanized area of the Santa Rosa Plain. This is a centralized system that includes a wastewater treatment plant located on Llano Road, 1,540 million gallons (mg) of storage capacity for treated effluent, irrigation projects sufficient to reuse approximately 3,500 mg/yr (20 mg wetlands, 3,010 mg agricultural irrigation, 460 mg golf course irrigation, and 15 mg urban irrigation), and capability for discharging the balance of treated effluent to the Russian River via the Laguna de Santa Rosa (during October 1 to May 14, normally at a rate less than 1% of the Russian River flow; but in emergencies, up to 5%).

The current average dry weather flow (ADWF) for wastewater reaching the Laguna Subregional Plant is 16.8 mgd. Much of this influent derives from water supplied by the Sonoma County Water Agency. The cities of Santa Rosa, Rohnert Park, and Cotati, all of which purchase water from the Water Agency, discharge their wastewater to the Laguna Subregional Plant.

Table D-1 summarizes operating costs incurred by the City of Santa Rosa's Subregional System that vary with flow rate. These include flow-related pumping at the treatment plant (costs related to treating the organic load are excluded), disinfection, pumping downstream of the treatment plant, and other flow-related irrigation costs. The total annual volume of water that moves through each process is indicated, and from that an average unit variable cost for each process is calculated. The volume of dry weather flow that contributes to each process is also identified. This is important because dry weather flow, unlike the wet weather increment, passes through indoor plumbing "upstream" of the sewer system, and may be affected by conservation measures. Table D-1 also indicates other variable operating costs that apply to the City of Santa Rosa alone: sewer lift pumps in its collection system and the Oakmont treatment plant.

For the year 1993/94, the Subregional System processed 6,889 mg of wastewater. This included 6,132 mg from dry weather flow, and approximately 757 mg of additional flow received during the wet season (this increment is attributed to infiltration and inflow). Most of the wet weather increment (approximately 80%) was discharged directly to the Laguna. For the dry weather flow, however, approximately 39% was discharged to the Laguna, and the remainder was directed, usually via storage, to various sites for reuse. Reuse, because of the extra pumping and irrigation management costs, incurs higher variable costs than does discharge to the Laguna. Table D-2 organizes the unit costs by discharge option.

The relationship between flow and average unit variable costs gives a rough guide to potential avoided costs on the wastewater side. These are conservatively low because these are average, not marginal costs. For example, the Subregional System pays a premium for irrigating private land in instances where it compensates landowners for use of their own irrigation systems, and an even higher premium during the infrequent occasions when winter irrigation is required. These higher price signals are subsumed by this average cost analysis. Additionally, this analysis does not consider costs associated with environmental externalities.

The conservation programs proposed herein are likely to slow the rate at which dry weather flow increases during the next few years, not decrease it altogether. Consequently, until the Subregional System is expanded, the costs avoided by conservation-induced flow reduction are likely to reflect the areas where less wastewater will be applied than would otherwise be the case. For Subregional System users, this will be irrigation of private land. For the City of Santa Rosa, the avoided cost will also include savings on collection system pumping and savings at the Oakmont treatment plant. The respective weighted average unit avoided costs are:

Subregional System: $385/mg (local influent wastewater pumping not included)

The effect of water conservation due to the two Programs outlined in this study, however, removes the need for this 2.5 mgd increment of treatment capacity through the study period. The total combined reduction of indoor water usage for the Cities of Santa Rosa (including South Park Sanitation District), Rohnert Park, and Cotati projected by this study is estimated at 2.44 mgd and 2.84 mgd for Programs One and Two, respectively. This provides a total ADWF in 2015 of 19.8 and 19.4 mgd, respectively. With ADWF less than the construction threshold of 21 mgd, the unit capacity cost of the 2.5 mgd WWTP upgrade may be counted as a benefit for these conservation programs.

The avoided unit capital cost of new wastewater treatment capacity for the Subregional System is estimated as follows:

Avoided Unit Capital Cost =[($15,000,000 + $20,000,000)/2] / (2.5 mg/d * 365 d/yr)
– $19,000/mg/yr

While permanent water conservation will reduce the volume of wastewater the City of Santa Rosa's treatment plant must otherwise accommodate, the organic load will continue to rise at historic rate in proportion to population. The assumption is made above that treatment of this incremental load will be provided by the portion of operating expenses not counted as a benefit for conservation (only the expenses for pumping and disinfecting water are counted as benefits). In the event, however, that certain processes must be expanded to enhance organic load removal, the capital cost for those improvements should be deducted from the $19,000/mg/yr avoided cost noted above. The analysis required to determine whether provision should be made for such an investment, and if so, how much it should be, is beyond the scope of this study.

Wastewater Disposal

The City of Santa Rosa is engaged in a comprehensive wastewater management program that will provide weather independent compliance with its NPDES discharge permit. Three major strategies are being developed: (1) urban water conservation, to reduce the volume of water that ultimately requires management; (2) near-term reuse projects (agricultural, urban, and golf course irrigation projects consuming 620 mg/yr); and (3) a long-term disposal/reuse project. These strategies will augment the disposal/reuse projects currently in use.

Indoor water conservation measures that permanently reduce water use will allow a smaller, and less costly, disposal project than would otherwise be the case. The capital and O&M costs of the portion of the disposal project avoided by water conservation, although not directly available, are estimated below.

The City of Santa Rosa is currently preparing an EIR/S for the Subregional System's Long-Term Disposal Project. Although the projects under consideration all assume a substantial volume of water will be saved through conservation (similar in volume to the estimates in this study), the cost of these projects, when divided by the volume of treated effluent they accommodate, gives an average unit cost of disposal. This may be used as a proxy for the avoided unit cost by making the assumption that the average unit cost for disposal is the same for both the range of wastewater volume disposed by these projects, and for the additional increment avoided by conservation.

Santa Rosa Board of Public Utilities (BPU) selected five projects (along with the "No Project" alternative) in March of 1994 to study in depth in its forthcoming EIR/S. These are outlined as Alternatives #1 - #6 on Table D-3. By comparing each alternative against the current situation ("1993/94 Baseline"), the critical element for each project can be seen. For Alternatives #2, #3, and #4 it is an irrigation system; for Alternative #5, a discharge system to the Geysers; and for Alternative #6, relatively expensive storage related to a river discharge system.

At the time of completing this study (July, 1995), specific cost estimates are not available for the projects selected by the BPU. Accordingly, Mr. Dan Carlson, Capital Projects Manager for the City of Santa Rosa Utilities Department, recommended that the economic benefits of water conservation should be based upon

MEMORANDUM

19 April 1995

To: Robin Cort, Parsons ES
Andy Hauge, HBA

From: Rich Maurer, Parsons ES
John Hake, Parsons ES

Project: Santa Rosa Long Term Wastewater Project

Re: Preliminary ADWF Estimates by West Yost Associates (WYA), TM-WBM-6

cc: Dave Smith, Merritt Smith

Recently Parsons ES received preliminary Average Dry Weather Flow (ADWF) estimates from WYA. These estimates, if verified and adopted, will have a substantial impact on the previously identified storage requirements and irrigation area requirements. These estimates are shown below:

ADWF Estimates in MGD

	General Plan Projection	ABAG Projection
Land Use Based Flow	20.19	20.49
Population Based Flow	19.21	20.41

Land use based flows are estimated using the projected number of single family and multi-family dwelling units and commercial, industrial, and institutional facilities. Population based flows are used as a check of the land use based numbers and are based on projected population.

Based on the information provided in the above table, the most conservative ADWF (approximately 20.50 MGD) has been selected by Parsons ES for model reruns to gauge the effect upon system requirements (storage volume and irrigation area). The most recent ADWF assumed by ES for modeling purposes was 26.85 MGD. The model was run for Alternative 2, South County Reclamation, for both the 1 and 5 percent river discharges. Using the model, the minimum system requirements were determined using the new ADWF estimate, to meet the reliability requirement of one month in twenty of excess river discharge. Model run summary sheets for the revised model runs are attached. The results are provided below for comparison:

ADWF (MGD)	Discharge Rate	New Irrigation Required (acres)	New Storage Required (MG)
26.85	1%	8,025	5,000
20.50	1%	3,985	4,000
26.85	5%	5,100	2,900
20.50	5%	2,350	2,000

35

The new ADWF estimate significantly reduces system requirements, as expected. Because reductions in storage volume have less of a marginal impact on cost than do reductions in irrigation area, reductions in irrigation area were given priority over reductions in storage. Reductions of up to 54 percent of the irrigation area were achieved. For the 1 and 5 percent discharge options, 20 and 31percent reductions in storage volume were achieved, respectively.

Recommendations

It is recommended that the revised estimate of the ADWF receive special attention for the following reasons:

- The revised estimate is significantly lower than the previous estimate used by ES (as well as the previous estimate of 22.5 MGD estimated by CH2M Hill in the January 1993 Screenings Report).
- The ADWF has a significant effect upon the reclamation system requirements and costs and the scope of the project studies.

Parsons ES engineering staff requests immediate attention to this matter by project management so that the ADWF (which directly impacts system requirements) can be fixed to allow us to refocus engineering studies and design efforts.

Table 1-I-7

OCCURRENCE OF MANDATORY 30 PERCENT DIVERSION CURTAILMENTS WITH A 15 PERCENT DEFICIENCY DURING DRY MONTHS

Santa Rosa Subunit Russian River Urban Demand (acre-feet)	Months of 30% Curtailment 1922-1992				
	1977	1924	1933	1934	1935
60,000 (1)	0	0	0	0	0
70,000	0	0	0	0	0
80,000	0	0	0	0	0
90,000	6	0	0	0	0
100,000	8	1	0	0	0
105,000	9	1	0	0	0
110,000	10	1	3	2	0
112,000 (2)	10	1	4	3	1

(1) Approximate 1995 Santa Rosa subunit River urban use.
(2) Maximum Santa Rosa subunit urban water supply available.

The model study results demonstrate that the Russian River water supply is adequate to satisfy all identified water demands in Sonoma, Mendocino and Marin County which are likely to be placed on the main stem in the foreseeable future. The total identified Santa Rosa subunit 2015 urban demand, which includes all Agency diversions from the Russian River, is approximately 94,000 acre-feet per year. After satisfying all other identified water demands on the Russian River, this demand can be satisfied with an expectation of rarely (one or two years out of 70) having the mandatory 30 percent curtailment triggered. Under the 30 percent curtailment criteria, which is mandated by the Agency's water rights permit terms under certain reservoir conditions, and a voluntary 15 percent curtailment beginning in the second dry month, the maximum annual Santa Rosa subunit urban demand which can be satisfied without Lake Sonoma dropping below the minimum pool is approximately 112,000 acre-feet per year. Thus, 18,000 acre-feet per year of water supply is available from the Russian River to satisfy currently unidentified future needs in Sonoma and Marin Counties. The use of this remaining supply, however, would result in the mandatory curtailment criteria being triggered more frequently. If this supply were used, the construction of additional emergency off-stream water production facilities to reduce the impact on water consumers of the 30 percent curtailment in Russian River diversions might be necessary.[34]

[34]Ibid., IV-22.

The Russian River

An Assessment of Its Condition and Governmental Oversight

Sonoma County Water Agency

By
Robert F. Beach

Santa Rosa, California
August 1996

38

"FULL PLAN" for 1923-1992 Water Years

1923						288 carryover
593	716	911	797	875	709	4601 Plant Flows
November	December	January	February	March	April	(4889) Storage
May	June	July	August	September	October	
617	571	563	533	526	558	3368 Plant Flows
Summer Irrigation						MG ac ft
980	2120	2275	1470	650	325	7820 24007
0	0	0	0	0	0	
4526	2977	1265	328	(204)	437	
1924						437 carryover
575	693	883	772	847	687	4457 Plant Flows
November	December	January	February	March	April	(4894) Storage
May	June	July	August	September	October	
597	553	546	516	510	596	3318 Plant Flows
Summer Irrigation						MG ac ft
980	2120	2275	1470	650	325	7820 24007
0	0	0	0	0	0	
4511	2944	1215	261	(121)	392	
1925						392 carryover
614	741	943	825	905	734	4762 Plant Flows
November	December	January	February	March	April	(5154) Storage
May	June	July	August	September	October	
638	591	583	551	545	575	3483 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4772	3153	1361	387	(252)	487	
1926						487 carryover
593	715	910	796	874	708	4596 Plant Flows
November	December	January	February	March	April	(5083) Storage
May	June	July	August	September	October	
616	570	562	532	526	616	3422 Plant Flows
Summer Irrigation						MG ac ft
980	2120	2275	1470	650	325	7820 24007
0	0	0	0	0	0	
4719	3169	1456	518	(394)	685	
1927						685 carryover
635	766	976	853	936	599	4765 Plant Flows
November	December	January	February	March	April	(5450) Storage
					K 160	
May	June	July	August	September	October	
660	611	603	570	563	592	3599 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5050	3361	1504	474	(337)	759	

Prepared by Bob Anderson 9/24/96

1928						759 carryover
610	736	937	820	899	689	4691 Plant Flows
November	December	January	February	March	April	5450 Storage
					~ 40	
May	June	July	August	September	October	
634	587	579	548	541	563	3452 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5024	3311	1430	378	219	612	
1929						612 carryover
581	700	892	780	856	694	4503 Plant Flows
November	December	January	February	March	April	5115 Storage
May	June	July	August	September	October	
603	559	551	521	515	582	3331 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4698	3047	1223	219	54	296	
1930						296 carryover
600	723	921	805	884	717	4650 Plant Flows
November	December	January	February	March	April	4946 Storage
May	June	July	August	September	October	
623	577	569	538	532	560	3399 Plant Flows
Summer Irrigation						MG ac ft
980	2120	2275	1470	650	325	7820 24007
0	0	0	0	0	0	
4589	3046	1340	408	290	525	
1931						525 carryover
577	696	886	775	850	689	4473 Plant Flows
November	December	January	February	March	April	4998 Storage
May	June	July	August	September	October	
599	555	547	518	512	575	3306 Plant Flows
Summer Irrigation						MG ac ft
980	2120	2275	1470	650	325	7820 24007
0	0	0	0	0	0	
4617	3052	1324	372	234	484	
1932						484 carryover
593	715	910	796	874	708	4596 Plant Flows
November	December	January	February	March	April	5080 Storage
May	June	July	August	September	October	
616	570	562	532	526	568	3374 Plant Flows
Summer Irrigation						MG ac ft
980	2120	2275	1470	650	325	7820 24007
0	0	0	0	0	0	
4716	3166	1453	515	391	634	

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1933

						634 carryover
585	705	898	786	862	699	4535 Plant Flows
November	December	January	February	March	April	5169 Storage
May	June	July	August	September	October	
608	563	555	525	519	574	3344 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4757	3110	1290	290	129	363	

1934

						363 carryover
592	713	909	795	872	707	4588 Plant Flows
November	December	January	February	March	April	4951 Storage
May	June	July	August	September	October	
615	569	561	531	525	590	3391 Plant Flows
Summer Irrigation						MG ac ft
980	2120	2275	1470	650	325	7820 24007
0	0	0	0	0	0	
4586	3035	1321	382	257	522	

1935

						522 carryover
608	733	933	816	896	726	4712 Plant Flows
November	December	January	February	March	April	5234 Storage
May	June	July	August	September	October	
631	585	577	546	539	596	3474 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4845	3220	1422	443	302	558	

1936

						558 carryover
614	740	942	824	904	733	4757 Plant Flows
November	December	January	February	March	April	5315 Storage
May	June	July	August	September	October	
638	591	582	551	544	580	3486 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
4893	3184	1306	257	101	511	

1937

						511 carryover
598	721	918	803	881	715	4636 Plant Flows
November	December	January	February	March	April	5147 Storage
May	June	July	August	September	October	
621	575	567	537	530	656	3486 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4748	3113	1305	317	167	483	

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1938						483 carryover
676	815	1038	908	996	534	4967 Plant Flows
November	December	January	February	March	April	5450 Storage
					374	
May	June	July	August	September	October	
702	650	641	607	600	564	3764 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5092	3442	1623	630	530	924	
1939						924 carryover
581	700	892	780	856	694	4503 Plant Flows
November	December	January	February	March	April	5427 Storage
May	June	July	August	September	October	
604	559	551	521	515	620	3370 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
4971	3230	1321	242	57	507	
1940						507 carryover
639	771	982	859	942	750	4943 Plant Flows
November	December	January	February	March	April	5450 Storage
					14	
May	June	July	August	September	October	
654	615	607	574	567	643	3660 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5044	3359	1506	480	347	820	
1941						820 carryover
663	800	1018	891	977	281	4630 Plant Flows
November	December	January	February	March	April	5450 Storage
					511	
May	June	July	August	September	October	
689	638	629	595	588	624	3763 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5079	3417	1586	581	469	923	
1942						923 carryover
643	775	987	864	948	310	4527 Plant Flows
November	December	January	February	March	April	5450 Storage
					459	
May	June	July	August	September	October	
668	619	610	577	570	594	3638 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5058	3377	1527	504	374	798	

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1943

						798 carryover
612	738	940	822	902	638	4652 Plant Flows
November	December	January	February	March	April	5450 Storage
					93	
May	June	July	August	September	October	
636	589	581	549	543	571	3469 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5026	3315	1436	385	228	629	

1944

						629 carryover
589	710	904	791	867	703	4564 Plant Flows
November	December	January	February	March	April	5193 Storage
May	June	July	August	September	October	
612	566	558	528	522	581	3367 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4785	3141	1324	327	169	410	

1945

						410 carryover
598	722	919	804	882	715	4640 Plant Flows
November	December	January	February	March	April	5050 Storage
May	June	July	August	September	October	
622	576	568	537	531	590	3424 Plant Flows
Summer Irrigation						MG ac ft
980	2120	2275	1470	650	325	7820 24007
0	0	0	0	0	0	
4692	3148	1441	508	389	654	

1946

						654 carryover
608	734	934	817	897	727	4717 Plant Flows
November	December	January	February	March	April	5371 Storage
May	June	July	August	September	October	
632	585	577	546	540	573	3453 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
4943	3228	1345	291	131	534	

1947

						534 carryover
590	712	906	793	870	705	4576 Plant Flows
November	December	January	February	March	April	5110 Storage
May	June	July	August	September	October	
613	568	560	530	523	577	3371 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4703	3061	1246	251	94	331	

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1948						331 carryover
595	717	913	799	877	711	4612 Plant Flows
November	December	January	February	March	April	4943 Storage
May	June	July	August	September	October	
618	572	564	534	528	580	3396 Plant Flows
Summer Irrigation						MG ac ft
980	2120	2275	1470	650	325	7820 24007
0	0	0	0	0	0	
4581	3033	1322	386	264	519	
1949						519 carryover
597	720	917	802	880	714	4630 Plant Flows
November	December	January	February	March	April	5149 Storage
May	June	July	August	September	October	
621	575	567	536	530	577	3406 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4750	3115	1307	318	168	405	
1950						405 carryover
595	718	914	799	877	711	4614 Plant Flows
November	December	January	February	March	April	5019 Storage
May	June	July	August	September	October	
618	573	565	534	528	604	3422 Plant Flows
Summer Irrigation						MG ac ft
980	2120	2275	1470	650	325	7820 24007
0	0	0	0	0	0	
4657	3110	1400	464	342	621	
1951						621 carryover
623	751	956	837	918	744	4829 Plant Flows
November	December	January	February	March	April	5450 Storage
					0	
May	June	July	August	September	October	
647	599	591	559	552	621	3569 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5037	3336	1467	426	278	729	
1952						729 carryover
640	771	982	859	943	526	4721 Plant Flows
November	December	January	February	March	April	5450 Storage
					× 238	
May	June	July	August	September	October	
665	615	607	574	567	609	3637 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5055	3370	1517	491	358	797	

Prepared by Bob Anderson 9/24/96

1953						797 carryover
628	757	964	843	925	536	4653 Plant Flows
November	December	January	February	March	April	5450 Storage
					214	
May	June	July	August	September	October	
652	604	596	564	557	597	3570 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5042	3346	1482	446	303	730	
1954						730 carryover
615	742	945	827	907	684	4720 Plant Flows
November	December	January	February	March	April	5450 Storage
					51	
May	June	July	August	September	October	
639	592	584	552	546	571	3484 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5029	3321	1445	397	243	644	
1955						644 carryover
589	710	904	791	868	704	4566 Plant Flows
November	December	January	February	March	April	5210 Storage
May	June	July	August	September	October	
612	567	559	528	522	640	3428 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4802	3159	1343	346	188	488	
1956						488 carryover
660	796	1013	886	972	635	4962 Plant Flows
November	December	January	February	March	April	5450 Storage
					153	
May	June	July	August	September	October	
685	635	626	592	585	578	3701 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5075	3410	1576	568	453	861	
1957						861 carryover
596	716	915	800	878	684	4589 Plant Flows
November	December	January	February	March	April	5450 Storage
					28	
May	June	July	August	September	October	
619	573	565	535	528	644	3464 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5009	3282	1387	322	150	624	

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1958 — 624 carryover

663	800	1019	891	978	475	4826 Plant Flows
November	December	January	February	March	April	5450 Storage
					318	
May	June	July	August	September	October	
689	638	629	596	588	578	3718 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5079	3417	1586	582	470	878	

1959 — 878 carryover

596	716	915	800	878	667	4572 Plant Flows
November	December	January	February	March	April	5450 Storage
					45	
May	June	July	August	September	October	
619	573	565	535	528	584	3404 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5009	3282	1387	322	150	564	

1960 — 564 carryover

601	725	924	808	886	719	4663 Plant Flows
November	December	January	February	March	April	5227 Storage
May	June	July	August	September	October	
625	579	571	540	533	583	3431 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4832	3201	1397	412	265	508	

1961 — 508 carryover

601	725	923	808	886	719	4662 Plant Flows
November	December	January	February	March	April	5170 Storage
May	June	July	August	September	October	
625	579	571	540	533	586	3434 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4775	3144	1340	355	208	454	

1962 — 454 carryover

604	729	928	812	891	722	4686 Plant Flows
November	December	January	February	March	April	5140 Storage
May	June	July	August	September	October	
628	582	573	542	536	605	3466 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4748	3120	1318	335	191	456	

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1963

						456 carryover
624	752	958	838	919	745	4836 Plant Flows
November	December	January	February	March	April	5292 Storage
May	June	July	August	September	October	
648	600	592	560	553	571	3524 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4920	3310	1527	562	435	666	

1964

						666 carryover
588	709	903	790	867	703	4560 Plant Flows
November	December	January	February	March	April	5226 Storage
May	June	July	August	September	October	
611	566	558	528	522	617	3402 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4817	3173	1356	359	201	478	

1965

						478 carryover
635	766	976	853	936	759	4925 Plant Flows
November	December	January	February	March	April	5403 Storage
May	June	July	August	September	October	
660	611	603	570	564	587	3595 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5003	3314	1457	427	291	708	

1966

						708 carryover
605	730	929	813	892	723	4692 Plant Flows
November	December	January	February	March	April	5400 Storage
May	June	July	August	September	October	
629	582	574	543	537	609	3474 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
4969	3251	1365	308	145	584	

1967

						584 carryover
628	757	964	844	926	747	4866 Plant Flows
November	December	January	February	March	April 4	5450 Storage
May	June	July	August	September	October	
653	604	596	564	557	582	3556 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5043	3347	1483	447	304	716	

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1968

						716 carryover
599	723	921	805	883	716	4647 Plant Flows
November	December	January	February	March	April	5363 Storage
May	June	July	August	September	October	
623	577	569	538	532	623	3462 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
4926	3203	1312	250	82	535	

1969

						535 carryover
642	774	986	862	946	705	4915 Plant Flows
November	December	January	February	March	April	5450 Storage
					62	
May	June	July	August	September	October	
667	618	609	576	569	621	3660 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5057	3375	1524	500	369	820	

1970

						820 carryover
640	772	983	860	943	432	4630 Plant Flows
November	December	January	February	March	April	5450 Storage
					333	
May	June	July	August	September	October	
665	616	607	575	568	599	3630 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5055	3371	1518	493	361	790	

1971

						790 carryover
617	744	947	828	909	615	4660 Plant Flows
November	December	January	February	March	April	5450 Storage
					122	
May	June	July	August	September	October	
641	594	585	554	547	569	3490 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5031	3325	1450	404	251	650	

1972

						650 carryover
586	707	901	788	864	701	4547 Plant Flows
November	December	January	February	March	April	5197 Storage
May	June	July	August	September	October	
609	564	556	526	520	607	3382 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4786	3140	1321	322	162	429	

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1973						429 carryover
625	754	960	840	921	747	4847 Plant Flows
November	December	January	February	March	April	5276 Storage
May	June	July	August	September	October	
650	602	593	561	554	640	3600 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4906	3298	1516	552	426	726	
1974						726 carryover
660	795	1013	886	972	398	4724 Plant Flows
November	December	January	February	March	April	5450 Storage
					390	
May	June	July	August	September	October	
685	635	626	592	585	599	3722 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5075	3410	1576	568	453	882	
1975						882 carryover
617	744	948	829	909	521	4568 Plant Flows
November	December	January	February	March	April	5450 Storage
					216	
May	June	July	August	September	October	
641	594	585	554	547	559	3480 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5031	3325	1450	404	251	640	
1976						640 carryover
576	695	884	774	849	688	4466 Plant Flows
November	December	January	February	March	April	5106 Storage
May	June	July	August	September	October	
598	554	546	517	511	554	3280 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4684	3028	1199	191	22	236	
1977						236 carryover
571	689	877	767	842	682	4428 Plant Flows
November	December	January	February	March	April	4664 Storage
May	June	July	August	September	October	
593	550	542	513	506	616	3320 Plant Flows
Summer Irrigation						MG ac ft
980	2120	2275	1470	650	325	7820 24007
0	0	0	0	0	0	
4277	2707	974	17	-127	164	

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1978						164 carryover
635	766	975	853	936	759	4924 Plant Flows
November	December	January	February	March	April	5088 Storage
May	June	July	August	September	October	
660	611	602	570	563	578	3584 Plant Flows
Summer Irrigation						MG ac ft
980	2120	2275	1470	650	325	7820 24007
0	0	0	0	0	0	
4768	3259	1586	686	599	852	
1979						852 carryover
595	718	914	799	877	695	4598 Plant Flows
November	December	January	February	March	April	5450 Storage
					× 16	
May	June	July	August	September	October	
618	573	565	534	528	607	3425 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5008	3281	1386	320	148	585	
1980						585 carryover
625	754	960	840	921	747	4847 Plant Flows
November	December	January	February	March	April	5432 Storage
May	June	July	August	September	October	
650	602	593	561	554	576	3536 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5022	3324	1457	418	272	678	
1981						678 carryover
593	716	911	797	875	709	4601 Plant Flows
November	December	January	February	March	April	5279 Storage
May	June	July	August	September	October	
617	571	563	533	526	641	3451 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4876	3237	1425	433	279	580	
1982						580 carryover
661	797	1015	888	974	535	4870 Plant Flows
November	December	January	February	March	April	5450 Storage
					255	
May	June	July	August	September	October	
687	636	627	593	586	664	3793 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5077	3413	1580	573	459	953	

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1983						953 carryover
684	825	1051	919	1008	10	4497 Plant Flows
November	December	January	February	March	April	5450 Storage
					808	
May	June	July	August	September	October	
711	658	649	614	607	610	3849 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5101	3459	1648	662	569	1009	
1984						1009 carryover
629	758	965	844	927	318	4441 Plant Flows
November	December	January	February	March	April	5450 Storage
					433	
May	June	July	August	September	October	
653	605	597	564	558	576	3553 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5043	3348	1485	449	307	713	
1985						713 carryover
594	716	912	798	876	710	4606 Plant Flows
November	December	January	February	March	April	5319 Storage
May	June	July	August	September	October	
617	572	564	533	527	621	3434 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
4876	3148	1252	185	12	463	
1986						463 carryover
640	772	983	859	943	765	4962 Plant Flows
November	December	January	February	March	April	5425 Storage
May	June	July	August	September	October	
665	616	607	574	568	570	3600 Plant Flows
Summer Irrigation						MG ac ft
1060	2300	2460	1600	700	170	8290 25450
0	0	0	0	0	0	
5030	3346	1493	467	335	735	
1987						735 carryover
587	708	902	789	866	702	4554 Plant Flows
November	December	January	February	March	April	5289 Storage
May	June	July	August	September	October	
610	565	557	527	521	579	3359 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4879	3234	1416	418	259	498	

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1988						498 carryover
596	719	916	801	879	713	4624 Plant Flows
November	December	January	February	March	April	5122 Storage
May	June	July	August	September	October	
620	574	566	535	529	574	3398 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4722	3086	1277	287	136	370	
1989						370 carryover
591	713	908	794	871	707	4584 Plant Flows
November	December	January	February	March	April	4954 Storage
May	June	July	August	September	October	
614	569	561	531	524	563	3362 Plant Flows
Summer Irrigation						MG ac ft
980	2120	2275	1470	650	325	7820 24007
0	0	0	0	0	0	
4588	3037	1323	384	258	496	
1990						496 carryover
580	700	891	779	855	693	4498 Plant Flows
November	December	January	February	March	April	4994 Storage
May	June	July	August	September	October	
603	558	551	521	515	569	3317 Plant Flows
Summer Irrigation						MG ac ft
980	2120	2275	1470	650	325	7820 24007
0	0	0	0	0	0	
4617	3055	1331	382	247	491	
1991						491 carryover
586	707	900	787	863	700	4543 Plant Flows
November	December	January	February	March	April	5034 Storage
May	June	July	August	September	October	
609	564	556	526	520	573	3348 Plant Flows
Summer Irrigation						MG ac ft
980	2120	2275	1470	650	325	7820 24007
0	0	0	0	0	0	
4663	3107	1388	444	314	562	
1992						562 carryover
591	713	908	794	871	706	4583 Plant Flows
November	December	January	February	March	April	5145 Storage
May	June	July	August	September	October	
614	569	561	531	524	576	3375 Plant Flows
Summer Irrigation						MG ac ft
1020	2210	2375	1525	680	340	8150 25021
0	0	0	0	0	0	
4739	3098	1284	290	134	370	

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"1/2 Plan" for 1923 - 1957

1923						266	carryover	
549	662	843	737	809	656	4256	Plant Flows	
November	December	January	February	March	April	4522	Storage	
126	507	601	319	194	642	3407	Storage/1%	Discharge
May	June	July	August	September	October		J F M	849
571	528	521	493	487	516	3115	Plant Flows	
Summer Irrigation						MG	ac ft	
775	1680	1804	1166	515	260	6200	19034	
3202	2050	767	94	66	322			
1924						322	carryover	
532	641	817	714	783	635	4123	Plant Flows	
November	December	January	February	March	April	4445	Storage	2% JAN Feb Mar
66	63	79	264	41	15	3677	Storage/1%	
May	June	July	August	September	October		2J 2F 2M	446
562	521	513	486	480	531	3093	Plant Flows	
Summer Irrigation						MG	ac ft	
788	1707	1833	1184	523	265	6300	19341	
3452	2265	945	246	204	470			
1925						470	carryover	JAN @ 1% River
568	685	872	763	837	679	4405	Plant Flows	Feb @ Plant Flo
November	December	January	February	March	April	4875	Storage	Mar @ 1/2% Riv
179	373	594	2044	413	782	3311	Storage/1%	
May	June	July	August	September	October		J F/A .5M	1094
590	547	539	510	504	532	3222	Plant Flows	
Summer Irrigation						MG	ac ft	
763	1653	1775	1147	506	256	6100	18727	
3139	2033	797	160	157	433			
1926						433	carryover	
549	661	842	736	808	655	4251	Plant Flows	
November	December	January	February	March	April	4684	Storage	
103	130	137	1270	212	488	3599	Storage/1%	
May	June	July	August	September	October		J F/A M	652
570	527	520	492	487	570	3165	Plant Flows	
Summer Irrigation						MG	ac ft	
788	1707	1833	1184	523	265	6300	19341	
3382	2202	888	196	160	465			
1927						465	carryover	
587	709	903	789	866	702	4556	Plant Flows	
November	December	January	February	March	April	5020	Storage	
435	893	923	2474	975	1063	3282	Storage/1%	
May	June	July	August	September	October		.5J F/A .5M	1273
611	565	558	527	521	548	3329	Plant Flows	
Summer Irrigation						MG	ac ft	
738	1599	1717	1109	490	248	5900	18113	
3155	2121	962	380	411	711			

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1928						711 carryover	
564	681	867	759	832	674	4376 Plant Flows	
November	December	January	February	March	April	5087 Storage	
278	241	547	777	1378	925	3563 Storage/1%	
May	June	July	August	September	October	J F M(200)	813
586	543	536	507	500	521	3193 Plant Flows	
Summer Irrigation						MG ac ft	
788	1707	1833	1184	523	265	6300 19341	
3362	2198	900	223	200	456		
1929						456 carryover	
537	648	825	722	792	642	4165 Plant Flows	
November	December	January	February	March	April	4622 Storage	
106	210	172	362	144	122	3582 Storage/1%	
May	June	July	August	September	October	J 2F M	583
558	517	510	482	476	538	3081 Plant Flows	
Summer Irrigation						MG ac ft	
788	1707	1833	1184	523	265	6300 19341	
3352	2162	838	136	89	363		
1930						363 carryover	
555	669	852	745	818	663	4301 Plant Flows	
November	December	January	February	March	April	4664 Storage	
18	805	647	592	674	339	3426 Storage/1%	
May	June	July	August	September	October	J F	875
576	534	526	498	492	518	3144 Plant Flows	
Summer Irrigation						MG ac ft	
775	1680	1804	1166	515	260	6200 19034	
3227	2081	804	135	112	370		
1931						370 carryover	
534	644	820	717	786	637	4138 Plant Flows	
November	December	January	February	March	April	4508 Storage	
34	36	277	124	228	40	3478 Storage/1%	
May	June	July	August	September	October	2J 2F M	660
554	513	506	479	474	532	3058 Plant Flows	
Summer Irrigation						MG ac ft	
775	1680	1804	1166	515	260	6200 19034	
3257	2090	792	105	64	336		
1932						336 carryover	
549	661	842	736	808	655	4251 Plant Flows	
November	December	January	February	March	April	4587 Storage	
25	926	698	388	193	143	3501 Storage/1%	
May	June	July	August	September	October	J F	750
570	527	520	492	487	525	3121 Plant Flows	
Summer Irrigation						MG ac ft	
775	1680	1804	1166	515	260	6200 19034	
3296	2143	859	185	157	422		

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1933						422 carryover	
541	652	831	727	797	647	4195 Plant Flows	
November	December	January	February	March	April	4617 Storage	
34	71	371	250	525	255	3471 Storage/1%	
May	June	July	August	September	October	J F M	724
562	521	513	486	480	531	3093 Plant Flows	
Summer Irrigation						MG ac ft	
775	1680	1804	1166	515	260	6200 19034	
3258	2099	808	128	94	364		
1934						364 carryover	
548	660	841	735	807	654	4244 Plant Flows	
November	December	January	February	March	April	4608 Storage	
62	617	620	559	290	132	3429 Storage/1%	
May	June	July	August	September	October	J F	815
569	526	519	491	486	546	3137 Plant Flows	
Summer Irrigation						MG ac ft	
775	1680	1804	1166	515	260	6200 19034	
3223	2069	783	109	80	365		
1935						365 carryover	
562	678	863	755	829	672	4359 Plant Flows	
November	December	January	February	March	April	4724 Storage	
180	98	1243	266	1135	977	3328 Storage/1%	
May	June	July	August	September	October	J(863) 2F	1031
584	541	534	505	499	551	3213 Plant Flows	
Summer Irrigation						MG ac ft	
763	1653	1775	1147	506	256	6100 18727	
3149	2037	796	154	146	441		
1936						441 carryover	
568	685	871	762	836	678	4400 Plant Flows	
November	December	January	February	March	April	4842 Storage	
33	41	1374	2235	411	491	3208 Storage/1%	
May	June	July	August	September	October	J(871) F/A	1192
590	547	538	510	503	537	3225 Plant Flows	
Summer Irrigation						MG ac ft	
738	1599	1717	1109	490	248	5900 18113	
3061	2009	830	230	244	533		
1937						533 carryover	
553	667	849	743	815	661	4288 Plant Flows	
November	December	January	February	March	April	4821 Storage	
47	35	67	1295	940	494	3639 Storage/1%	
May	June	July	August	September	October	J F/A .5M	649
574	532	524	497	490	607	3225 Plant Flows	
Summer Irrigation						MG ac ft	
788	1707	1833	1184	523	265	6300 19341	
3426	2251	942	254	222	564		

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1938						564	carryover	
625	754	960	840	921	747	4848	Plant Flows	
November	December	January	February	March	April	5412	Storage	
689	2256	714	3602	2936	847	3397	Storage/1%	
May	June	July	August	September	October	J F/A .5M		1451
649	601	593	561	555	522	3482	Plant Flows	
Summer Irrigation						MG	ac ft	
788	1707	1833	1184	523	265	6300	19341	
3259	2153	912	289	321	579			
1939						579	carryover	
537	648	825	722	792	642	4165	Plant Flows	
November	December	January	February	March	April	4744	Storage	
91	193	202	267	317	72	3459	Storage/1%	
May	June	July	August	September	October	J F/A .5M		706
559	517	510	482	476	574	3117	Plant Flows	
Summer Irrigation						MG	ac ft	
775	1680	1804	1166	515	260	6200	19034	
3243	2080	785	102	63	377			
1940						377	carryover	
591	713	908	795	871	707	4585	Plant Flows	
November	December	January	February	March	April	4962	Storage	
19	125	1788	2639	1878	827	3392	Storage/1%	
May	June	July	August	September	October	J(775) F/A		1193
605	569	561	531	524	595	3386	Plant Flows	
Summer Irrigation						MG	ac ft	
775	1680	1804	1166	515	260	6200	19034	
3222	2111	868	233	243	578			
1941						578	carryover	
613	740	942	824	904	733	4755	Plant Flows	
November	December	January	February	March	April	5333	Storage	
59	1754	2596	1957	1639	1662	3371	Storage/1%	
May	June	July	August	September	October	J775 F775 .		1384
637	590	582	550	544	577	3481	Plant Flows	
Summer Irrigation						MG	ac ft	
775	1680	1804	1166	515	260	6200	19034	
3233	2143	921	306	335	652			
1942						652	carryover	
595	717	913	799	877	711	4612	Plant Flows	
November	December	January	February	March	April	5264	Storage	
87	1694	1753	2581	452	967	3488	Storage/1%	
May	June	July	August	September	October	J775 F775 .		1124
618	573	564	534	527	549	3365	Plant Flows	
Summer Irrigation						MG	ac ft	
775	1680	1804	1166	515	260	6200	19034	
3331	2223	983	351	364	653			

Prepared by Bob Anderson 9/24/96

1943						653	carryover	
566	683	870	760	834	676	4389	Plant Flows	
November	December	January	February	March	April	5042	Storage	
198	553	1979	660	685	280	3607	Storage/1%	
May	June	July	August	September	October	J(775) F		782
588	545	537	508	502	528	3209	Plant Flows	
Summer Irrigation						MG	ac ft	
788	1707	1833	1184	523	265	6300	19341	
3408	2245	950	273	252	516			
1944						516	carryover	
545	657	836	732	802	650	4222	Plant Flows	
November	December	January	February	March	April	4738	Storage	
39	55	190	626	869	138	3487	Storage/1%	
May	June	July	August	September	October	J F/A .5M		734
566	524	516	488	483	537	3114	Plant Flows	
Summer Irrigation						MG	ac ft	
775	1680	1804	1166	515	260	6200	19034	
3279	2122	834	157	125	402			
1945						402	carryover	
553	668	850	744	816	661	4292	Plant Flows	
November	December	January	February	March	April	4694	Storage	
256	474	247	1213	441	310	3483	Storage/1%	
May	June	July	August	September	October	J F/A .5M		809
575	533	525	497	491	546	3167	Plant Flows	
Summer Irrigation						MG	ac ft	
775	1680	1804	1166	515	260	6200	19034	
3283	2136	857	188	165	450			
1946						450	carryover	
562	679	864	756	830	672	4363	Plant Flows	
November	December	January	February	March	April	4814	Storage	
263	1994	891	357	299	233	3532	Storage/1%	
May	June	July	August	September	October	J775 F/a .5		831
585	541	534	505	500	530	3194	Plant Flows	
Summer Irrigation						MG	ac ft	
788	1707	1833	1184	523	265	6300	19341	
3329	2163	864	184	161	426			
1947						426	carryover	
590	712	906	793	870	705	4576	Plant Flows	
November	December	January	February	March	April	5002	Storage	
176	239	90	615	694	306	3603	Storage/1%	
May	June	July	August	September	October	J F M		973
567	525	518	490	484	534	3118	Plant Flows	
Summer Irrigation						MG	ac ft	
788	1707	1833	1184	523	265	6300	19341	
3383	2201	885	191	152	421			

Prepared by Bob Anderson 9/24/96

1948						421	carryover	
550	663	845	739	811	658	4266	Plant Flows	
November	December	January	February	May	April	4687	Storage	
73	62	478	157	376	1239	3519	Storage/1%	
May	June	July	August	September	October	J 2F M		747
572	529	522	494	488	537	3141	Plant Flows	
Summer Irrigation						MG	ac ft	
788	1707	1833	1184	523	265	6300	19341	
3303	2125	813	123	89	360			
1949						360	carryover	
552	666	848	742	814	660	4283	Plant Flows	
November	December	January	February	May	April	4643	Storage	
76	170	199	589	1472	335	3655	Storage/1%	
May	June	July	August	September	October	2J F		627
574	532	524	496	490	534	3151	Plant Flows	
Summer Irrigation						MG	ac ft	
788	1707	1833	1184	523	265	6300	19341	
3442	2267	958	269	237	506			
1950						506	carryover	
550	664	845	739	811	658	4268	Plant Flows	
November	December	January	February	May	April	4774	Storage	
35	52	621	1023	449	409	3413	Storage/1%	
May	June	July	August	September	October	J F/A		855
572	530	523	494	488	559	3165	Plant Flows	
Summer Irrigation						MG	ac ft	
763	1653	1775	1147	506	256	6100	18727	
3223	2099	847	194	176	479			
1951						479	carryover	
576	695	884	774	849	688	4467	Plant Flows	
November	December	January	February	May	April	4946	Storage	
829	1588	1338	1019	512	157	3396	Storage/1%	
May	June	July	August	September	October	J(775) F/a		1071
598	554	547	517	511	574	3301	Plant Flows	
Summer Irrigation						MG	ac ft	
763	1653	1775	1147	506	256	6100	18727	
3232	2133	905	275	279	598			
1952						598	carryover	
592	713	908	795	872	707	4587	Plant Flows	
November	December	January	February	March	April	5185	Storage	
198	1649	2327	1521	1086	470	3635	Storage/1%	
May	June	July	August	September	October	J(775) F(77		952
615	569	561	531	524	563	3364	Plant Flows	
Summer Irrigation						MG	ac ft	
788	1707	1833	1184	523	265	6300	19341	
3462	2324	1052	399	400	699			

Prepared by Bob Anderson 9/24/96

1953						699 carryover	
581	700	892	780	856	694	4502 Plant Flows	
January	December	January	February	March	April	5201 Storage	
60	1643	3151	290	661	234	3651 Storage/1%	
May	June	July	August	September	October	J(775) F(77	851
603	559	551	522	515	552	3302 Plant Flows	
Summer Irrigation						MG ac ft	
788	1707	1833	1184	523	265	6300 19341	
3467	2318	1036	373	366	653		
1954						653 carryover	
569	686	874	765	839	680	4413 Plant Flows	
November	December	January	February	March	April	5066 Storage	
194	213	1507	1145	888	801	3526 Storage/1%	
May	June	July	August	September	October	J(775 F/a	887
591	548	540	511	505	528	3223 Plant Flows	
Summer Irrigation						MG ac ft	
788	1707	1833	1184	523	265	6300 19341	
3330	2170	877	203	185	449		
1955						449 carryover	
545	657	836	732	803	651	4224 Plant Flows	
November	December	January	February	March	April	4673 Storage	
175	559	508	187	165	324	3627 Storage/1%	
May	June	July	August	September	October	J 2F M	597
566	524	517	488	483	592	3171 Plant Flows	
Summer Irrigation						MG ac ft	
788	1707	1833	1184	523	265	6300 19341	
3405	2223	906	210	170	498		
1956						498 carryover	
611	736	937	820	899	729	4731 Plant Flows	
November	December	January	February	March	April	5229 Storage	
47	3162	3177	2298	598	148	3679 Storage/1%	
May	June	July	August	September	October	J(7750 F(77	1052
634	587	579	548	541	535	3423 Plant Flows	
Summer Irrigation						MG ac ft	
788	1707	1833	1184	523	265	6300 19341	
3525	2405	1151	514	533	803		
1957						803 carryover	
551	662	846	740	812	659	4271 Plant Flows	
November	December	January	February	March	April	5073 Storage	
55	47	403	971	868	229	3496 Storage/1%	
May	June	July	August	September	October	J F(775) .5	775
573	530	523	495	488	596	3204 Plant Flows	
Summer Irrigation						MG ac ft	
775	1680	1804	1166	515	260	6200 19034	29957
3294	2143	862	191	165	500		856

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