Time Value of Water

American River Example

The attached tables present an example output for the time value of water for the American River below Nimbus Dam.

Matrix A: The first matrix presents the basic value of water for the fall chinook salmon resource. For this example we used AFRP recommended flows to prescribe the value of specific flows. The prescribed flows for wet years were considered for this example as providing 100 percent of the salmon's needs. In the case of October, that level is provided by a flow of 2,500 cfs. Flows for normal, dry, and critical years were used to define the 75%, 50% and 25% level of benefit. (These levels are shown in bold font in the table.) Flow benefits for intermediate flows were simply extrapolated. For flows higher than the 100% level, an additional 1 percent was added arbitrarily for each 250 cfs increment. The value of each increment of water is the increment of value: for example, the value of the 250 cfs increment of flow from 250 to 500 cfs in October is 10 salmon units, as compared to 5 salmon units for the increment from 1000 to 1250 cfs. Above each of the monthly columns is an example weight for each month in terms of value of the month to the salmon resource.

Matrix B: The second matrix on page 2 depicts the weighted benefits of flow, as derived by multiplying the values in Matrix A by the weighting factors at the top of each of the monthly columns in Matrix A. For example, in Matrix A the value for October of 2500 cfs was 100 units. In Matrix B, the value was reduced to 80 units by the weighting factor of 0.8 at the top of the October column. Thus, in the example, 2500 cfs provides 80 units of chinook salmon value in October, and 100 units of value in November. At the bottom of Matrix B are further examples of how weighting factors could be determined. Each monthly weight could be determined from the normalized sum of the value for each of six life stages. These examples for fall chinook and steelhead were taken from weighting factors presented in the preliminary draft CVPIA PEIS.

Matrix C: The third matrix depicts how the value matrix could be used to allocated environmental storage water. In this example, the highlighted area depicts the blocks of water that would be released to maximize benefits for chinook salmon if you had 750 TAF of storage available for environmental release from Folsom Reservoir in a critical year. In this hypothetical case, minimum AFRP flows would be automatically maintained. The additional 750 TAF of water would be released where it would provide the greatest benefit. In the example, none of the available water was allocated to June or July because there is minimal benefit. If we had to divert an additional 15 TAF of water during a critical year and short AFRP flows, we would cut the May requirement from 1500 to 1250 cfs because that 15 TAF (250 cfs) increment has the lowest value (2 units).

Chinook Salmon and Steelhead Benefits of American River Flow

Basis: American River AFRP Flow Recommendations

A. Estimated benefit of flow in each month without weighting between months

Weights	0.8	1.0	0.8	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.2	0.6
Flow (cfs)	October	November	December	January	February	March	April	May	June	July	August	September
5000	110	110	110	110	110	102	102	102	102	110	110	110
4750	109	109	109	109	109	101	101	101	101	109	109	109
4500	108	108	108	108	108	**100**	**100**	**100**	**100**	108	108	108
4250	107	107	107	107	107	98	98	98	98	107	107	107
4000	106	106	106	106	106	95	95	95	95	106	106	106
3750	105	105	105	105	105	90	90	90	90	105	105	105
3500	104	104	104	104	104	85	85	85	85	104	104	104
3250	103	103	103	103	103	80	80	80	80	103	103	103
3000	102	102	102	102	102	**75**	**75**	**75**	**75**	102	102	102
2750	101	101	101	101	101	65	65	65	65	101	101	101
2500	**100**	**100**	**100**	**100**	**100**	60	60	60	60	**100**	**100**	**100**
2250	90	90	90	90	90	55	55	55	55	90	90	95
2000	***75***	***75***	***75***	***75***	***75***	**50**	**50**	**50**	**50**	***75***	***75***	90
1750	**50**	**50**	**50**	**50**	**50**	35	35	35	45	60	70	85
1500	40	40	40	40	40	**25**	**25**	**25**	40	**50**	65	***75***
1250	35	***25***	***25***	***25***	***25***	20	20	20	35	45	60	60
1000	30	20	20	20	20	15	15	15	30	40	**50**	**50**
750	**25**	15	15	15	15	10	10	10	27	35	40	40
500	15	10	10	10	10	5	5	5	***25***	***25***	***25***	***25***
250	5	5	5	5	5	0	0	0	10	10	10	10

100 AFRP Flow Recommendations for Wet years
75 AFRP Flow Recommendations for Normal years
50 AFRP Flow Recommendations for Dry years
25 AFRP Flow Recommendations for Critical years

Each monthly block of flow requires a volume of 15 TAF (250 cfs * 30 days * 2 AF/dsf). Given an allocation of available water at the beginning of a month, allocate the water to maximize the fishery benefit for the remainder of the months

B. Weighted benefit of flow in each month

Weights	0.8	1.0	0.8	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.2	0.6
Flow (cfs)	October	November	December	January	February	March	April	May	June	July	August	September
5000	88	110	88	88	77	61.2	51	40.8	30.6	22	22	66
4750	87.2	109	87.2	87.2	76.3	60.6	50.5	40.4	30.3	21.8	21.8	65.4
4500	86.4	108	86.4	86.4	75.6	60	50	40	30	21.6	21.6	64.8
4250	85.6	107	85.6	85.6	74.9	58.8	49	39.2	29.4	21.4	21.4	64.2
4000	84.8	106	84.8	84.8	74.2	57	47.5	38	28.5	21.2	21.2	63.6
3750	84	105	84	84	73.5	54	45	36	27	21	21	63
3500	83.2	104	83.2	83.2	72.8	51	42.5	34	25.5	20.8	20.8	62.4
3250	82.4	103	82.4	82.4	72.1	48	40	32	24	20.6	20.6	61.8
3000	81.6	102	81.6	81.6	71.4	45	37.5	30	22.5	20.4	20.4	61.2
2750	80.8	101	80.8	80.8	70.7	39	32.5	26	19.5	20.2	20.2	60.6
2500	80	100	80	80	70	36	30	24	18	20	20	60
2250	72	90	72	72	63	33	27.5	22	16.5	18	18	57
2000	60	75	60	60	52.5	30	25	20	15	15	15	54
1750	40	50	40	40	35	21	17.5	14	13.5	12	14	51
1500	32	40	32	32	28	15	12.5	10	12	10	13	45
1250	28	25	20	20	17.5	12	10	8	10.5	9	12	36
1000	24	20	16	16	14	9	7.5	6	9	8	10	30
750	20	15	12	12	10.5	6	5	4	8.1	7	8	24
500	12	10	8	8	7	3	2.5	2	7.5	5	5	15
250	4	5	4	4	3.5	0	0	0	3	2	2	6
Fall Run Chinook	0.76	1.204	0.549	0.334	0.5	0.459	0.659	0.783	0.653	0	0	0.106
Adult Migration	0.5	0.3	0.1									0.1
Spawning	0.2	0.65	0.15									
Incubation	0.06	0.254	0.299	0.239	0.119	0.03						0.006
. ry Rearing				0.095	0.381	0.429	0.095					
Juvenile Rearing							0.364	0.333	0.303			
Juvenile Migration							0.2	0.45	0.35			
Steelhead	0.203	0.203	0.391	0.828	1.026	1.01	0.899	0.622	0.443	0.106	0.133	0.133
Adult Migration	0.12	0.12	0.12	0.34	0.15	0.05					0.05	0.05
Spawning			0.1	0.23	0.34	0.23	0.1					
Incubation			0.038	0.125	0.253	0.302	0.189	0.075	0.019			
Fry Rearing						0.045	0.227	0.364	0.341	0.023		
Juvenile Rearing	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Juvenile Migration			0.05	0.05	0.2	0.3	0.3	0.1				

C. Weighted incremental benefit of adding 250 cfs in a month

Weights	0.8	1.0	0.8	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.2	0.6
Flow (cfs)	October	November	December	January	February	March	April	May	June	July	August	September
5000	0.8	1.0	0.8	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.2	0.6
4750	0.8	1.0	0.8	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.2	0.6
4500	0.8	1.0	0.8	0.8	0.7	1.2	1.0	0.8	0.6	0.2	0.2	0.6
4250	0.8	1.0	0.8	0.8	0.7	1.8	1.5	1.2	0.9	0.2	0.2	0.6
4000	0.8	1.0	0.8	0.8	0.7	3	2.5	2.0	1.5	0.2	0.2	0.6
3750	0.8	1.0	0.8	0.8	0.7	3	2.5	2.0	1.5	0.2	0.2	0.6
3500	0.8	1.0	0.8	0.8	0.7	3	2.5	2.0	1.5	0.2	0.2	0.6
3250	0.8	1.0	0.8	0.8	0.7	3	2.5	2.0	1.5	0.2	0.2	0.6
3000	0.8	1.0	0.8	0.8	0.7	6	5.0	4.0	3.0	0.2	0.2	0.6
2750	0.8	1.0	0.8	0.8	0.7	3	2.5	2.0	1.5	0.2	0.2	0.6
2500	8	10	8	8	7	3	2.5	2	1.5	2.0	2.0	3
2250	12	15	12	12	10.5	3	2.5	2	1.5	3.0	3.0	3
2000	20	25	20	20	17.5	9	7.5	6	1.5	3.0	1.0	3
1750	8	10	8	8	7	6	5	4	1.5	2.0	1.0	6
1500	4	15	12	12	10.5	3.0	2.5	2.0	1.5	1.0	1.0	9
1250	4	5.0	4.0	4.0	3.5	3.0	2.5	2.0	1.5	1.0	2.0	6
1000	4	5.0	4.0	4.0	3.5	3.0	2.5	2.0	0.9	1.0	2.0	6
750	8.0	5.0	4.0	4.0	3.5	3.0	2.5	2.0	0.6	2.0	3	9
500	8.0	5.0	4.0	4.0	3.5	3.0	2.5	2.0	4.5	3.0	3.0	9.0
250	4.0	5.0	4.0	4.0	3.3	-0.3	-0.3	-0.1	3.0	2.0	2.0	6.0
Blocks Added 50	7	5	5	5	5	10	2	2	0	0	1	8

Added Flow

Minimum Flow

1 Assume that the minimum instream flow allocation corresponds to the Critical year AFRP flows.
This corresponds to the 25% benefit flow in each month of Table A. This requires about 50 monthly blocks of water (750 TAF).

2 Now suppose that an additional 750 TAF (50 monthly blocks) was allocated for instream flows.
The allocation procedure would add blocks of water with the highest incremental benefits, as shown in Table C.
All blocks with a value of greater than 3 units are added in each month.

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