CHAPTER III

Development of Alternative Plans

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
MID-PACIFIC REGION

CHAPTER III

DEVELOPMENT OF ALTERNATIVE PLANS

A. PLAN FORMULATION

Each refuge has its own unique set of problems and needs. Some of the refuges need additional water during the fall and winter. Other refuges need better quality water than is currently provided. Most of the refuges currently rely upon intermittent water supplies, agricultural return flows, or runoff available only during wet weather periods.

To develop alternatives for dependable water supplies, the study team members met with wildlife managers and representatives of local water and irrigation districts. Based on these discussions and field visits, potential alternatives were developed for each refuge for different water supply levels. As discussed in Chapter II, Water Supply Level 1 is the existing firm water supply that is provided through surface water rights or long-term water contracts. Water Supply Level 2 represents the current average annual water delivery. Water Supply Level 3 represents the amount of water needed for full use of the existing developed lands on the refuge. Water Supply Level 4 represents the amount of water that wetland managers estimate to be necessary for optimum management of all lands within the existing refuge boundary.

Level 1 is considered to be the No Action Alternative and does not require any additional facilities or water supplies. Generally, new or enhanced facilities are not required to meet Level 2. However, Level 2 alternatives were developed for several of the refuges because some of the existing water supplies may not be available during certain portions of the year. For example, several refuges in the Sacramento Valley cannot receive water during the winter with existing facilities.

Following the identification of water supply levels and facility alternatives, the study team members met with the refuge wildlife managers and representatives of the water and irrigation districts to determine 1) the available capacity of the existing conveyance facilities, 2) the potential for extending the time period in which districts would convey water to accommodate fall and winter deliveries to the refuges; 3) the acceptability of the proposed improvements to the water and irrigation districts, 4) the feasibility of developing conveyance agreements, and 5) the local costs for similar types of construction. Through this process, alternatives were developed and modified for each refuge. The alternatives for each refuge are described in Chapter IV and summarized in Table III-1.

TABLE III-1

SUMMARY OF DELIVERY ALTERNATIVES

Refuge	Level 1	Level 2	Level 3	Level 4
Modoc NWR	None	2A. Rehabilitate Well	3A. Rehabilitate Well	4A. Construct Wells, Rehabilitate Dam on Pit River.
				4B. Construct Wells in the Godfrey Tract.
Sacramento NWR	None	2A. Construct Pipeline from Tehama-Colusa Canal.	3A. Construct Pipeline from Tehama-Colusa Canal.	4A. Construct Pipeline from Tehama-Colusa Canal.
		2B. Deliver CVP Water through Kanawha WD.	3B. Deliver CVP Water through Kanawha WD.	4B. Deliver CVP Water through Kanawha WD.
		2C. Construct Pipeline to Transport CVP Water from Tehama-Colusa Canal.	3C. Construct Pipeline to Transport CVP Water from Tehama-Colusa Canal.	4C. Construct Pipeline to Transport CVP Water from Tehama-Colusa Canal.
		2D. Delivery CVP Water from Tehama-Colusa Canal to GCID Lateral 35-C.	3D. Deliver CVP Water from Tehama-Colusa Canal to GCID Lateral 35-C.	4D. Deliver CVP Water from Tehama-Colusa Canal to GCID Lateral 35-C.
		2E. Implement a Conjunctive Use Plan.	3E. Implement a Conjunctive Use Plan.	4E. Implement a Conjunctive Use Plan.
Delevan NWR[a]	None	2A. Convey Water from Sacramento NWR.	3A. Convey Water from Sacramento NWR	4A. Construct Pump Station on 2047 Drain
		2B. Construct Crossover on GCID Lateral 41-1.	3B. Construct Crossover on GCID Lateral 41-1.	4B. Construct Siphons Under the MID Canal
		2C. Improve Hunter's Creek No. 2 Diversion Weir.	3C. Improve Hunter's Creek No. 2 Diversion Weir.	4C. Implement a Conjunctive Use Plan.
		2D. Implement a Conjunctive Use Plan.	3D. Implement a Conjunctive Use Plan.	
Colusa NWR[a]	None	2A. Construct Weir on 2047 Drain and replace Davis Weir.	3A. Construct Weir on 2047 Drain and replace Davis Weir.	4A. Construct Facilities to Serve Tracts 4, 7, 9, and 11.
		2B. Convey CVP Water through Zumwalt Farms and Glenn-Colusa ID.	3B. Convey CVP Water through Zumwalt Farms and Glenn-Colusa ID.	4B. Implement a Conjunctive Use Plan.
		2C. Implement a Conjunctive Use Plan.	3C. Implement a Conjunctive Use Plan.	

TABLE III-1

SUMMARY OF DELIVERY ALTERNATIVES
(Continued)

Refuge	Level 1	Level 2	Level 3	Level 4
Sutter NWR	None	2A. Deliver Water from Thermalito Afterbay through Butte Creek.	3A. Deliver Water from Thermalito Afterbay through Butte Creek.	4A. Deliver Water from Thermalito Afterbay through Butte Creek.
		2B. Delivery Water from Thermalito Afterbay through Wadsworth Canal.	3B. Delivery Water from Thermalito Afterbay through Wadsworth Canal.	4B. Delivery Water from Thermalito Afterbay through Wadsworth Canal.
		2C. Obtain Water from Sutter Extension Water District.	3C. Obtain Water from Sutter Extension Water District.	4C. Obtain Water from Sutter Extension Water District.
		2D. Implement a Conjunctive Use Plan.	3D. Implement a Conjunctive Use Plan.	4D. Implement a Conjunctive Use Plan.
Gray Lodge WMA	None	2A. Construct Ditch from Cherokee Canal.	3A. Construct Ditch from Cherokee Canal.	4A. Construct Ditch from Cherokee Canal.
		2B. Construct Canal from Thermalito Afterbay.	3B. Construct Canal from Thermalito Afterbay.	4B. Construct Canal from Thermalito Afterbay.
		2C. Improve BWGID System.	3C. Improve BWGID System.	4C. Improve BWGID System.
		2D. Implement a Conjunctive Use Plan.	3D. Implement a Conjunctive Use Plan.	4D. Implement a Conjunctive Use Plan.
Grassland Resource Conservation District	None	2A. Convey Water Under the Zahm-Sansoni-Nelson Plan.	3A. Construct Turnouts on Delta-Mendota Canal at Almond Drive and Russell Avenue.	4A. Construct Turnouts on Delta-Mendota Canal at Almond Drive and Russell Avenue.
		2B. Utilize the Wolfson Bypass.		
		2C. Implement a Conjunctive Use Plan.	3B. Implement a Conjunctive Use Plan.	4B. Implement a Conjunctive Use Plan.
Volta WMA	None	None	3A. Construct Turnouts at Main Canal and Upgrade Outtakes.	4A. Construct Turnouts at Main Canal and Upgrade Outtakes.
			3B. Implement a Conjunctive Use Plan.	4B. Implement a Conjunctive Use Plan.

TABLE III-1

SUMMARY OF DELIVERY ALTERNATIVES
(Continued)

Refuge	Level 1	Level 2	Level 3	Level 4
Los Banos WMA[b]	None	2A. Reconstruct SLCC Facilities.	3A. Reconstruct SLCC Facilities.	4A. Reconstruct SLCC Facilities.
		2B. Implement a Conjunctive Use Plan.	3B. Implement a Conjunctive Use Plan.	4B. Implement a Conjunctive Use Plan.
Kesterson NWR[b]	None	2A. Rehabilitate Santa Fe Canal.	3A. Extend Eagle Ditch into Refuge.	4A. Extend Eagle Ditch into Refuge.
			3B. Extend West Side Ditch to Eagle Ditch.	4B. Extend West Side Ditch to Eagle Ditch.
			3C. Convey Water from Garzas Creek to Los Banos Creek.	4C. Convey Water from Garzas Creek to Los Banos Creek.
			3D. Utilize Mud Slough.	4D. Utilize Mud Slough.
			3E. Extend Santa Fe Canal.	4E. Extend Santa Fe Canal.
			3F. Implement a Conjunctive Use Plan.	4F. Implement a Conjunctive Use Plan.
San Luis NWR[b]	None	2A. Enlarge and Line SLCC Facilities.	3A. Enlarge and Line SLCC Facilities.	4A. Enlarge and Line SLCC Facilities.
		2B. Construct Lift Pumps to Utilize San Joaquin River Water.	3B. Construct Lift Pumps to Utilize San Joaquin River Water.	4B. Construct Lift Pumps to Utilize San Joaquin River Water.
		2C. Implement a Conjunctive Use Plan.	3C. Implement a Conjunctive Use Plan.	4C. Implement a Conjunctive Use Plan.
Merced NWR	None	2A. Utilize the East Side Bypass	3A. Extend Casebeer Lateral to Refuge Boundary.	4A. Extend Casebeer Lateral to Refuge Boundary.
		2B. Implement a Conjunctive Use Plan	3B. Extend Casebeer Lateral to Deadman Creek.	4B. Extend Casebeer Lateral to Deadman Creek.
			3C. Implement a Conjunctive Use Plan.	4C. Implement a Conjunctive Use Plan.
			3D. Utilize Treated Wastewater from the Merced Treatment Plant.	

TABLE III-1

SUMMARY OF DELIVERY ALTERNATIVES
(Continued)

Refuge	Level 1	Level 2	Level 3	Level 4
Mendota WMA	None	None	3A. Change Operation of Mendota Pool	4A. Change Operation of Mendota Pool
			3B. Extend WWD Laterals 4 and 6 to Refuge	4B. Extend WWD Laterals 4 and 6 to Refuge
			3C. Implement a Conjunctive Use Plan.	4C. Implement a Conjunctive Use Plan.
Pixley NWR	None	None	3A. Obtain Friant-Kern Canal Water via Deer Creek.	4A. Obtain Friant-Kern Canal Water via Deer Creek.
			3B. Utilize Mid-Valley Canal Water via Deer Creek.	4B. Utilize Mid-Valley Canal Water via Deer Creek.
			3C. Obtain CVP Water via the California Aqueduct.	4C. Obtain CVP Water via the California Aqueduct.
			3D. Implement a Conjunctive Use Plan.	4D. Implement a Conjunctive Use Plan.
Kern NWR	None	2A. Transport CVP Water through the BVWSD Facilities.	3A. Transport CVP Water through the BVWSD Facilities.	4A. Transport CVP Water through the BVWSD Facilities.
		2B. Transport State Water Project Water through the LHWSD Facilities.	3B. Transport State Water Project Water through the LHWSD Facilities.	4B. Transport State Water Project Water through the LHWSD Facilities.
		2C. Transport CVP Water through the Friant-Kern Canal and Poso Creek.	3C. Transport CVP Water through the Friant-Kern Canal and Poso Creek.	4C. Transport CVP Water through the Friant-Kern Canal and Poso Creek.
		2D. Implement a Conjunctive Use Plan.	3D. Implement a Conjunctive Use Plan.	4D. Implement a Conjunctive Use Plan.

(a) All of the alternatives for these refuges require implementation of Alternatives 2A, 2B, 2C, 2D, or 2E for Sacramento NWR.

(b) All of the alternatives for these refuges require implementation of Alternatives 2A or 2B for Grassland Resource Conservation District.

With Level 1, the No Action Alternative, only 7 of the 15 refuges have existing dependable water rights or long-term water contracts, and only Modoc National Wildlife Refuge has dependable water rights for more than 50 percent of the Level 4 water supply. Therefore, under the No Action Alternative, eight refuges would not receive firm water and six refuges would not receive adequate supplies of dependable water.

Currently, many of the refuges receive surplus water through temporary agreements or from agricultural return flows. Following the completion of the Water Contracting EISs, the surplus water may be delivered elsewhere under long-term agreements. In addition, water conservation methods may be implemented in the future which will reduce the amount of agricultural return flows available to the refuges.

B. PLAN EVALUATION AND SELECTION CRITERIA

As part of this report, alternatives were developed for each water supply level. The alternatives were evaluated with respect to many factors, including:

- Availability of Water Supply
- Ability to Convey Water
- Need for New Conveyance Agreements
- Type of Water Supply (Fresh Water, Groundwater, or Agricultural Return Flows)
- Operational Flexibility
- Wildlife Habitat
- Public Use
- Total Annual Costs
- Impacts to Fish and Wildlife Resources
- Ease of Implementation

The alternative plans also will be evaluated as part of the Water Contracting EISs. The evaluation will include regional analyses. The results of the evaluation will be used to determine the actual water supply level that will be available to each refuge.

Reclamation requested from the Service and DFG a prioritized list of refuges within the Sacramento Valley and the San Joaquin Valley to receive water. Both agencies indicated that their priorities for water supply were Water Supply Level 4 through Water Supply Level 1, with Water Supply Level 4 being the highest priority. The replies did not include priorities for specific refuges.

1. Cost Estimates

Appraisal level cost estimates were developed using cost curves, simple sketches, and general design criteria. Unit costs were developed in coordination with Reclamation and the Service and included in Appendix F. The cost estimates presented in this report

are to be used only as an aid in comparing the alternatives, and are not to be considered to be representative of more detailed material quantity and unit price cost estimates. The cost estimates represent average costs for project facilities that may be designed and have construction managed by a private engineering consultant, and are not intended to be used in lieu of detailed quantity and unit price estimates.

2. Economic Analyses

The benefits derived from recreation opportunities were based upon consumptive and non-consumptive uses created as a result of providing the wildlife refuges various water supplies. Public-use days were estimated by refuge managers. Wildlife refuges are unique areas that are intensively managed as waterfowl feeding and resting sites. Portions of the wildlife refuges are also specifically set aside for hunting and are managed particularly for that purpose. Hunting is allowed only on designated days, with a regulated number of hunters. As a result of this type of management and a lack of available land with public hunting access, these public shooting areas are highly valued and heavily used. In addition to consumptive recreation activities, non-consumptive recreation activities such as bird watching may be expected to occur at the wildlife refuges. Consequently, a high quality, specialized type of recreation experience can be obtained at these refuge areas.

The recreation benefits were calculated using values developed by Reclamation, and summarized in Tables III-2 and III-3. As part of the preparation of the Water Contracting EISs, more detailed economic evaluations will be conducted.

Because the values developed in the Water Contracting EISs may be significantly different than the economic values presented in Tables III-2 and III-3, the economic analyses was not completed for each of the alternatives. Instead, the change in bird use days and public use days per additional acre-foot of water was used to compare alternatives. The incremental costs per 1000 bird use days were determined for each refuge by dividing the increase in total annual costs, as compared to the No Action Alternative, by the increase in bird use days, as compared to the No Action Alternative. The incremental costs per public use days were determined for each refuge by dividing the increase in total annual costs, as compared to the No Action Alternative, by the increase in public use days, as compared to the No Action Alternative.

3. Environmental Analyses

The alternatives considered in this study primarily involve construction of weirs, turnouts, pumps, connecting canals, and wells. Most of these facilities would be constructed in or near existing canals and ditches which are periodically cleaned by the local irrigation districts. The connecting canals would mostly be constructed across currently tilled areas. Therefore, the

TABLE III-2
COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
MODOC NWR			
Water Needs (ac-ft)	18,550	18,550	--
Public Use Days			
Consumptive	6,430	6,430	--
Non-Consumptive	7,870	7,870	--
Total	14,300	14,300	--
Benefit Value (c)			
Consumptive	$ 41,800	$ 41,800	$ --
Non-Consumptive	43,300	43,300	--
Total	$ 85,100	$ 85,100	$ --
Public Use Days/Acre-Foot			
Consumptive	0.35	0.35	--
Non-Consumptive	0.42	0.42	--
Total	0.77	0.77	--
Benefit Value/Acre-Foot			
Consumptive	$ 2.25	$ 2.25	--
Non-Consumptive	2.33	2.33	--
Total	$ 4.58	$ 4.58	--
SACRAMENTO NWR			
Water Needs (ac-ft)	0	50,000	50,000
Public Use Days			
Consumptive	--	6,300	6,300
Non-Consumptive	--	32,900	32,900
Total	--	39,200	39,200
Benefit Value (c)			
Consumptive	$ --	$ 40,950	$ 40,950
Non-Consumptive	--	180,950	180,950
Total	$ --	$221,900	$221,900
Public Use Days/Acre-Foot			
Consumptive	--	0.13	0.13
Non-Consumptive	--	0.66	0.66
Total	--	0.79	0.79

TABLE III-2

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 0.82	$ 0.82
Non-Consumptive	--	3.62	3.62
Total	$ --	$ 4.44	$ 4.44
DELEVAN NWR			
Water Needs (ac-ft)	0	20,950	20,950
Public Use Days			
Consumptive	--	5,600	5,600
Non-Consumptive	--	2,200	2,200
Total	--	7,800	7,800
Benefit Value (c)			
Consumptive	$ --	$ 36,400	$ 36,400
Non-Consumptive	--	12,100	12,100
Total	$ --	$ 48,500	$ 48,500
Public Use Days/Acre-Foot			
Consumptive	--	0.27	0.27
Non-Consumptive	--	0.11	0.11
Total	--	0.38	0.38
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 1.74	$ 1.74
Non-Consumptive	--	0.58	0.58
Total	$ --	$ 2.32	$ 2.32
COLUSA NWR			
Water Needs (ac-ft)	0	25,000	25,000
Public Use Days			
Consumptive	--	4,100	4,100
Non-Consumptive	--	3,100	3,100
Total	--	7,200	7,200
Benefit Value (c)			
Consumptive	$ --	$ 26,650	$ 26,650
Non-Consumptive	--	17,050	17,050
Total	$ --	$ 43,700	$ 43,700

TABLE III-2

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
Public Use Days/Acre-Foot			
Consumptive	--	0.16	0.16
Non-Consumptive	--	0.12	0.12
Total	--	0.28	0.28
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 1.07	$ 1.07
Non-Consumptive	--	0.68	0.68
Total	$ --	$ 1.75	$ 1.75
SUTTER NWR			
Water Needs (ac-ft)	0	23,500	23,500
Public Use Days			
Consumptive	--	3,100	3,100
Non-Consumptive	--	--	--
Total	--	3,100	3,100
Benefit Value (c)			
Consumptive	$ --	$ 20,150	$ 20,150
Non-Consumptive	--	--	--
Total	$ --	$ 20,150	$ 20,150
Public Use Days/Acre-Foot			
Consumptive	--	0.10	0.10
Non-Consumptive	--	--	--
Total	--	0.10	0.10
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 0.67	$ 0.67
Non-Consumptive	--	--	--
Total	$ --	$ 0.67	$ 0.67
GRAY LODGE WMA			
Water Needs (ac-ft)	8,000	35,400	27,400
Public Use Days			
Consumptive	20,800	29,800	9,000
Non-Consumptive	83,300	135,400	52,100
Total	104,100	165,200	61,100

TABLE III-2

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
Benefit Value (c)			
Consumptive	$135,200	$ 193,700	$ 58,500
Non-Consumptive	458,150	744,700	286,550
Total	$593,350	$ 938,400	$345,050
Public Use Days/Acre-Foot			
Consumptive	2.6	0.84	-1.76
Non-Consumptive	10.41	3.82	-6.59
Total	13.01	4.66	-8.35
Benefit Value/Acre-Foot			
Consumptive	$ 16.9	$ 5.47	$ -11.43
Non-Consumptive	57.27	21.04	-36.23
Total	$ 74.17	$ 26.51	$ -47.66
GRASSLAND RCD			
Water Needs (ac-ft)	50,000	125,000	75,000
Public Use Days			
Consumptive	60,000	70,000	10,000
Non-Consumptive	31,000	39,000	8,000
Total	91,000	109,000	18,000
Benefit Value (c)			
Consumptive	$390,000	$455,000	$ 65,000
Non-Consumptive	170,500	214,500	44,000
Total	$560,500	$669,500	$109,000
Public Use Days/Acre-Foot			
Consumptive	1.2	0.56	-0.64
Non-Consumptive	0.62	0.31	-0.31
Total	1.82	0.87	-0.95
Benefit Value/Acre-Foot			
Consumptive	$ 7.80	$ 3.64	$ -4.16
Non-Consumptive	3.41	1.72	-1.69
Total	$ 11.21	$ 5.36	$ -5.85

TABLE III-2

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
VOLTA WMA			
Water Needs (ac-ft)	10,000	16,000	6,000
Public Use Days			
Consumptive	3,900	3,900	--
Non-Consumptive	3,100	3,100	--
Total	7,000	7,000	--
Benefit Value (c)			
Consumptive	$ 25,350	$ 25,300	$ --
Non-Consumptive	17,050	17,050	--
Total	$ 42,400	42,400	--
Public Use Days/Acre-Foot			
Consumptive	0.39	0.24	-0.15
Non-Consumptive	0.31	0.19	-0.12
Total	0.70	0.43	-0.27
Benefit Value/Acre-Foot			
Consumptive	$ 2.25	$ 1.58	$ -0.67
Non-Consumptive	1.71	1.07	-0.64
Total	$ 3.96	$ 2.65	$ -1.31
LOS BANOS WMA			
Water Needs (ac-ft)	6,200	16,670	10,470
Public Use Days			
Consumptive	2,200	3,400	1,200
Non-Consumptive	11,600	31,000	19,400
Total	13,800	34,400	20,600
Benefit Value (c)			
Consumptive	$ 14,300	$ 22,100	$ 7,800
Non-Consumptive	63,800	170,500	106,700
Total	$ 78,100	$192,600	$114,500
Public Use Days/Acre-Foot			
Consumptive	0.35	0.20	-0.15
Non-Consumptive	1.87	1.86	-0.01
Total	2.22	2.06	-0.16

TABLE III-2

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
Benefit Value/Acre-Foot			
Consumptive	$ 2.31	$ 1.33	$ -0.98
Non-Consumptive	10.29	10.23	-0.06
Total	$ 12.6	$ 11.56	$ -1.04
KESTERSON NWR			
Water Needs (ac-ft)	3,500	3,500	--
Public Use Days			
Consumptive	1,800	1,800	--
Non-Consumptive	300	300	--
Total	2,100	2,100	--
Benefit Value (c)			
Consumptive	$ 11,700	$ 11,700	$ --
Non-Consumptive	1,650	1,650	--
Total	$ 13,350	$ 13,350	---
Public Use Days/Acre-Foot			
Consumptive	0.51	0.51	--
Non-Consumptive	0.09	0.09	--
Total	0.60	0.60	--
Benefit Value/Acre-Foot			
Consumptive	$ 3.34	$ 3.34	$ --
Non-Consumptive	0.09	0.09	--
Total	$ 3.43	$ 3.43	$ --
SAN LUIS NWR			
Water Needs (ac-ft)	0	13,350	13,350
Public Use Days			
Consumptive	--	3,800	3,800
Non-Consumptive	--	18,600	18,600
Total	--	22,400	22,400
Benefit Value (c)			
Consumptive	$ --	$ 24,700	$ 24,700
Non-Consumptive	--	102,300	102,300
Total	$ --	$127,000	$127,000

TABLE III-2

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
Public Use Days/Acre-Foot			
Consumptive	--	0.28	0.28
Non-Consumptive	--	1.39	1.39
Total	--	1.67	1.67
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 1.85	$ 1.85
Non-Consumptive	--	7.67	7.67
Total	$ --	$ 9.52	$ 9.52
MERCED NWR			
Water Needs (ac-ft)	0	13,500	16,000
Public Use Days			
Consumptive	--	900	900
Non-Consumptive	--	1,900	1,900
Total	--	2,800	2,800
Benefit Value (c)			
Consumptive	$ --	$ 5,850	$ 5,850
Non-Consumptive	--	10,450	10,450
Total	$ --	$ 16,300	$ 16,300
Public Use Days/Acre-Foot			
Consumptive	--	0.07	0.07
Non-Consumptive	--	0.14	0.14
Total	--	0.21	0.21
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 0.43	$ 0.43
Non-Consumptive	--	0.77	0.77
Total	$ --	$ 1.20	$ 1.20
MENDOTA WMA			
Water Needs (ac-ft)	18,500	18,500	--
Public Use Days			
Consumptive	12,200	12,200	--
Non-Consumptive	2,600	2,600	--
Total	14,800	14,800	--

TABLE III-2

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
Benefit Value (c)			
Consumptive	$ 79,300	$ 79,300	$ --
Non-Consumptive	14,300	14,300	--
Total	$ 93,600	$ 93,600	$ --
Public Use Days/Acre-Foot			
Consumptive	0.66	0.66	---
Non-Consumptive	0.14	0.14	--
Total	0.70	0.70	--
Benefit Value/Acre-Foot			
Consumptive	$ 4.29	$ 4.29	$ --
Non-Consumptive	0.77	0.77	--
Total	$ 5.06	$ 5.06	$ --
PIXLEY NWR			
Water Needs (ac-ft)	0	1,280	1,280
Public Use Days			
Consumptive	--	3,300	3,300
Non-Consumptive	300	2,000	1,700
Total	300	5,300	1,600
Benefit Value (c)			
Consumptive	$ --	$ 21,450	$ 21,450
Non-Consumptive	1,650	11,000	9,350
Total	$ 1,650	$ 32,450	$ 30,800
Public Use Days/Acre-Foot			
Consumptive	--	2.58	2.58
Non-Consumptive	--	1.56	1.56
Total	--	4.14	4.14
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 16.76	$ 16.76
Non-Consumptive	--	8.60	8.60
Total	$ --	$ 25.36	$ 25.36

TABLE III-2

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
KERN NWR			
Water Needs (ac-ft)	0	9,950	9,950
Public Use Days			
Consumptive	--	1,900	1,900
Non-Consumptive	300	4,800	4,500
Total	300	6,700	6,400
Benefit Value (c)			
Consumptive	$ --	$ 12,350	$ 12,350
Non-Consumptive	1,650	26,400	24,750
Total	$ 1,650	$ 38,750	$ 37,100
Public Use Days/Acre-Foot			
Consumptive	--	0.19	0.19
Non-Consumptive	--	0.48	0.48
Total	--	0.67	0.67
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 1.24	$ 1.24
Non-Consumptive	--	2.65	2.65
Total	$ --	$ 3.89	$ 3.89

(a) Supply Level 1: Existing firm water supply
(b) Supply Level 2: Current average annual water deliveries
(c) Values from U.S. Forest Service Publication, RPA Update, 1985, adjusted for 1987 costs

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 4

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
MODOC NWR			
Water Needs (ac-ft)	18,550	20,550	2,000
Public Use Days			
Consumptive	6,430	6,430	--
Non-Consumptive	7,870	7,870	--
Total	14,300	14,300	--
Benefit Value (c)			
Consumptive	$ 41,800	$ 41,800	$ --
Non-Consumptive	43,300	43,300	--
Total	$ 85,100	$ 85,100	$ --
Public Use Days/Acre-Foot			
Consumptive	0.35	0.35	--
Non-Consumptive	0.42	0.42	--
Total	0.77	0.77	--
Benefit Value/Acre-Foot			
Consumptive	$ 2.25	$ 2.25	$ --
Non-Consumptive	2.33	2.33	--
Total	$ 4.58	$ 4.58	$ --
SACRAMENTO NWR			
Water Needs (ac-ft)	0	50,000	50,000
Public Use Days			
Consumptive	--	6,500	6,500
Non-Consumptive	--	33,000	33,000
Total	--	39,500	39,500
Benefit Value (c)			
Consumptive	$ --	$ 42,250	$ 42,250
Non-Consumptive	--	181,500	181,500
Total	$ --	$223,750	$223,750
Public Use Days/Acre-Foot			
Consumptive	--	0.13	0.13
Non-Consumptive	--	0.66	0.66
Total	--	0.79	0.79

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 4
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 0.85	$ 0.85
Non-Consumptive	--	3.63	3.63
Total	$ --	$ 4.48	$ 4.48
DELEVAN NWR			
Water Needs (ac-ft)	0	30,000	30,000
Public Use Days			
Consumptive	--	6,200	6,200
Non-Consumptive	--	2,200	2,200
Total	--	8,400	8,400
Benefit Value (c)			
Consumptive	$ --	$ 40,300	$ 40,300
Non-Consumptive	--	12,100	12,100
Total	$ --	$ 52,400	$ 52,400
Public Use Days/Acre-Foot			
Consumptive	--	0.21	0.21
Non-Consumptive	--	0.07	0.07
Total	--	0.28	0.28
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 1.34	$ 1.34
Non-Consumptive	--	0.40	0.40
Total	$ --	$ 1.74	$ 1.74
COLUSA NWR			
Water Needs (ac-ft)	0	25,000	25,000
Public Use Days			
Consumptive	--	4,100	4,100
Non-Consumptive	--	3,100	3,100
Total	--	7,200	7,200
Benefit Value (c)			
Consumptive	$ --	$ 26,650	$ 26,650
Non-Consumptive	--	17,050	17,050
Total	$ --	$ 43,700	$ 43,700

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 4
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
Public Use Days/Acre-Foot			
Consumptive	--	0.16	0.16
Non-Consumptive	--	0.12	0.12
Total	--	0.28	0.28
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 1.07	$ 1.07
Non-Consumptive	--	0.68	0.68
Total	$ --	$ 1.75	$ 1.75
SUTTER NWR			
Water Needs (ac-ft)	0	30,000	30,000
Public Use Days			
Consumptive	--	3,600	3,600
Non-Consumptive	--	--	--
Total	--	3,600	3,600
Benefit Value (c)			
Consumptive	$ --	$ 23,400	$ 23,400
Non-Consumptive	--	--	--
Total	$ --	$ 23,400	$ 23,400
Public Use Days/Acre-Foot			
Consumptive	--	0.12	0.12
Non-Consumptive	--	--	--
Total	--	0.12	0.12
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 0.78	$ 0.78
Non-Consumptive	--	--	--
Total	$ --	$ 0.78	$ 0.78
GRAY LODGE WMA			
Water Needs (ac-ft)	8,000	44,000	36,000
Public Use Days			
Consumptive	20,800	32,500	11,700
Non-Consumptive	83,300	168,000	84,700
Total	104,100	200,500	96,400

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 4
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
Benefit Value (c)			
Consumptive	$135,200	$ 211,250	$ 76,050
Non-Consumptive	458,150	924,000	465,850
Total	$593,350	$ 435,250	$541,900
Public Use Days/Acre-Foot			
Consumptive	2.6	0.74	-1.86
Non-Consumptive	10.41	3.08	-6.59
Total	13.01	4.56	-8.45
Benefit Value/Acre-Foot			
Consumptive	$ 16.90	$ 4.80	$ -12.10
Non-Consumptive	57.27	21.00	-36.27
Total	$ 74.17	$ 25.80	$ -48.37
GRASSLAND RCD			
Water Needs (ac-ft)	50,000	180,000	130,000
Public Use Days			
Consumptive	60,000	80,000	20,000
Non-Consumptive	31,000	56,000	25,000
Total	91,000	136,000	45,000
Benefit Value (c)			
Consumptive	$390,000	$520,000	$130,000
Non-Consumptive	201,500	308,000	106,500
Total	$591,500	$828,000	$236,500
Public Use Days/Acre-Foot			
Consumptive	1.2	0.44	-0.76
Non-Consumptive	0.62	0.31	-0.31
Total	1.82	0.7	-1.07
Benefit Value/Acre-Foot			
Consumptive	$ 7.80	$ 2.89	$ -4.91
Non-Consumptive	4.03	1.71	-2.32
Total	$ 11.83	$ 4.60	$ -7.23

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 4
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
VOLTA WMA			
Water Needs (ac-ft)	10,000	16,000	6,000
Public Use Days			
Consumptive	3,900	7,400	3,500
Non-Consumptive	3,100	5,600	2,500
Total	7,000	13,000	6,000
Benefit Value (c)			
Consumptive	$ 25,350	$ 48,100	$ 22,750
Non-Consumptive	17,050	30,800	13,750
Total	$ 42,400	$ 78,900	$ 36,500
Public use Days/Acre-Foot			
Consumptive	0.39	0.46	0.07
Non-Consumptive	0.31	0.35	0.04
Total	0.70	0.81	0.11
Benefit Value/Acre-Foot			
Consumptive	$ 2,54	$ 3.01	$ 0.47
Non-Consumptive	1.71	1.92	0.21
Total	$ 4.25	$ 4.93	$ 0.68
LOS BANOS WMA			
Water Needs (ac-ft)	6,200	25,000	18,800
Public Use Days			
Consumptive	2,200	4,200	2,000
Non-Consumptive	11,600	35,000	23,400
Total	13,800	39,200	25,400
Benefit Value (c)			
Consumptive	$ 14,300	$ 27,300	$ 13,000
Non-Consumptive	63,800	192,500	128,700
Total	$ 78,100	$219,800	$141,700
Public Use Days/Acre-Foot			
Consumptive	0.35	0.17	-0.18
Non-Consumptive	1.87	1.40	-0.47
Total	2.22	1.57	-0.65

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 4
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
Benefit Value/Acre-Foot			
Consumptive	$ 2.31	$ 1.09	$ -1.22
Non-Consumptive	10.29	7.70	-2.59
Total	$ 12.60	$ 8.79	$ -3.81
KESTERSON NWR			
Water Needs (ac-ft)	3,500	10,000	6,500
Public Use Days			
Consumptive	1,800	1,900	100
Non-Consumptive	300	1,600	1,300
Total	2,100	3,500	1,400
Benefit Value (c)			
Consumptive	$ 11,700	$ 12,350	$ 650
Non-Consumptive	1,650	8,800	7,150
Total	$ 13,350	$ 21,150	$ 7,800
Public Use Days/Acre-Foot			
Consumptive	0.51	0.19	-0.32
Non-Consumptive	0.09	0.16	0.07
Total	0.60	0.35	-0.25
Benefit Value/Acre-Foot			
Consumptive	$ 3.34	$ 1.24	$ -2.10
Non-Consumptive	0.47	0.88	0.41
Total	$ 3.81	$ 2.12	$ -1.69
SAN LUIS NWR			
Water Needs (ac-ft)	0	19,000	19,000
Public Use Days			
Consumptive	--	4,100	4,100
Non-Consumptive	--	31,000	31,000
Total	--	35,100	35,100
Benefit Value (c)			
Consumptive	$ --	$ 26,650	$ 26,650
Non-Consumptive	--	170,500	170,500
Total	$ --	$197,150	$197,150

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 4
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
Public Use Days/Acre-Foot			
Consumptive	--	0.22	0.22
Non-Consumptive	--	1.63	1.63
Total	--	1.85	1.85
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 1.40	$ 1.40
Non-Consumptive	--	8.96	8.97
Total	$ --	$ 10.37	$ 10.37
MERCED NWR			
Water Needs (ac-ft)	0	16,000	16,000
Public Use Days			
Consumptive	--	900	900
Non-Consumptive	--	9,300	9,300
Total	--	10,200	10,200
Benefit Value (c)			
Consumptive	$ --	$ 5,850	$ 5,850
Non-Consumptive	--	51,150	51,150
Total	$ --	$ 57,000	$ 57,000
Public Use Days/Acre-Foot			
Consumptive	--	0.06	0.06
Non-Consumptive	--	0.58	0.58
Total	--	0.64	0.64
Benefit Value/Acre-foot			
Consumptive	$ --	$ 0.37	$ 0.37
Non-Consumptive	--	3.19	3.19
Total	$ --	$ 3.56	$ 3.56
MENDOTA WMA			
Water Needs (ac-ft)	18,500	29,650	11,150
Public Use Days			
Consumptive	12,200	15,800	3,600
Non-Consumptive	2,600	6,700	4,100
Total	14,800	22,500	7,700

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 4
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
Benefit Value (c)			
Consumptive	$ 79,300	$102,700	$ 23,400
Non-Consumptive	14,300	36,850	22,500
Total	$ 93,600	$139,550	$ 45,950
Public Use Days/Acre-Foot			
Consumptive	0.65	0.53	-0.12
Non-Consumptive	0.14	0.23	0.09
Total	0.79	0.76	-0.03
Benefit Value/Acre-Foot			
Consumptive	$ 4.29	$ 3.46	$ -0.83
Non-Consumptive	0.77	1.24	0.47
Total	$ 5.06	$ 4.70	$ -0.36
PIXLEY NWR			
Water Needs (ac-ft)	0	6,000	6,000
Public Use Days			
Consumptive	--	6,500	6,500
Non-Consumptive	300	3,800	3,500
Total	300	10,300	10,000
Benefit Value (c)			
Consumptive	$ --	$ 42,250	$ 42,250
Non-Consumptive	1,650	20,900	19,250
Total	$ 1,650	63,150	$ 61,500
Public Use Days/Acre-Foot			
Consumptive	--	1.08	1.08
Non-Consumptive	--	0.63	0.63
Total	--	1.71	1.71
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 7.04	$ 7.04
Non-Consumptive	--	3.48	3.48
Total	$ --	$ 10.52	$ 10.52

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 4
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
KERN NWR			
Water Needs (ac-ft)	0	25,000	25,000
Public Use Days			
Consumptive	--	3,100	3,100
Non-Consumptive	300	12,400	12,100
Total	300	15,500	15,200
Benefit Value (c)			
Consumptive	$ --	$ 20,150	$ 20,150
Non-Consumptive	1,650	68,200	66,550
Total	$ 1,650	$ 88,350	$ 86,700
Public Use Days/Acre-Foot			
Consumptive	--	0.12	0.12
Non-Consumptive	--	0.50	0.50
Total	--	0.62	0.62
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 0.81	$ 0.81
Non-Consumptive	--	2.73	2.73
Total	$ --	$ 3.54	$ 3.54

(a) Supply Level 1: Existing firm water supply
(b) Supply Level 4: Optimum management
(c) Values from U.S. Forest Service Publication, RPA Update, 1985, adjusted for 1987 costs

construction impacts would be limited. The regional impacts and the impacts of providing water to the refuges as compared to other potential water users will be evaluated in the Water Contracting EISs.

Wildlife-use days for each of the water supply levels were estimated by refuge managers. The estimated wildlife-use days were used to evaluate the overall impacts of various alternatives. All of the alternative plans would benefit waterfowl and riparian species at the refuges to some degree, as discussed in Chapter IV. However, flooding of upland areas may adversely impact habitat for some upland wildlife and plants. The alternative plans that would allow longer seasons for water conveyance by the local irrigation districts may also maintain riparian habitat along the unlined conveyance canals.

4. Social Analyses

The social analyses are primarily related to regional impacts of providing water to the refuges as compared to other water users. Other social impacts are related to increased public use and construction of the selected plans. Public use would increase under most of the alternative plans. The construction activities would probably be completed within one season by construction workers who reside in the general area of the refuges.

5. Public Involvement

The Refuge Water Supply Study is being conducted in cooperation with the Service, the California Waterfowl Association, DWR, DFG, as well as numerous water and irrigation districts which would be affected by refuge water deliveries. Public interest in the development of dependable refuge water supplies is very high based on the number of inquiries and the participation in study activities by individuals, environmental and wildlife organizations, and representatives of state and Federal legislatures.

Since the initiation of this study in October 1985, numerous meetings have been held with cooperating agency staff and management, environmental and wildlife organizations, and water and irrigation districts to discuss study objective, issues and concerns, and planning procedures. Two public information documents have been released to provide information on the progress of the study and to solicit public input on alternative water delivery plans and pertinent issues. Response has generally been favorable and supportive of the study.

The role of the public in the study has been primarily to provide input to the planning team through meetings and responses to newsletter requests for submittal of comments.

A newsletter, dated January 1986, was prepared by Reclamation and distributed to agencies, organizations, and interested individuals.

The letter delineated the necessity for the study and the efforts to bring all the interested parties into the planning process. A figure showing the breakdown of the core group of agencies involved in planning the study was presented along with a map depicting the location of all the refuges and their water needs. A comment sheet was provided to allow the public an opportunity to submit comments on their concerns and significant issues that needed to be studied.

A second newsletter was released in July 1987 which presented alternative plans and indicated, among other things, the interest this study generated by showing a picture of the representatives of the California Waterfowl Association and the Grassland Water District presenting a check for $30,000 to Reclamation Regional Director David Houston as a contribution to the study. The public was also provided a comment sheet in this letter.

A draft plan of study was prepared in January of 1986 to provide a framework for studies and to delineate the goals of the study. This plan was then used as a guideline in developing alternatives to provide adequate water supplies for the refuges. A preliminary findings memorandum was prepared in March 1987 updating the study findings to date and recommending the continuance of the study and the preparation of a draft planning report.

In January 1987, Reclamation held a workshop in Los Banos, California, on the refuge water supply investigations. The purpose of the workshop was to discuss potential water sources and delivery and removal systems and the possibility of offstream storage for those private, State and Federal wetlands within the Grassland Resource Conservation District. The 22 participants represented Federal and State agencies; water, drainage, and irrigation districts; and wildlife and land management organizations.