

Volta Wildlife Area

Water Management Plan

Data, including estimated habitat acreages and water requirements for optimal production and maintenance, included in this document and associated tables are referenced from the San Joaquin Basin Action Plan/Kesterson Mitigation Plan Report (1989) and Report on Refuge Water Supply Investigations (1989), developed by the Bureau of Reclamation, Fish and Wildlife Service, and the Department of Fish and Game. Precipitation data was drawn from local weather stations and may be unrepresentative given the expansive distribution of the CVPIA wetlands. Evaporation and seepage data were derived from gross estimates and are unrepresentative of actual conditions given the high variability in vegetation and soil type. Furthermore, estimated applied acre feet per wetland acre data was calculated based on the aforementioned assumptions and water delivery estimates. Given the inherent numerous assumptions utilized to generate the data included in this document and associated tables, this information is not intended for any other purpose and should not be used without the written consent of the author agencies.

Draft submitted December 30, 2010

Final submitted June 17, 2011

Section A - Background

1. Identify the staff member responsible for developing and implementing the Plan. Provide their contact information

Name William Cook Title Wildlife Habitat Supervisor II
 Address 18110 Henry Miller Road
 Telephone 209-826-0463 Fax 209-826-1761
 E-mail wcook@dfg.ca.gov

2. Year refuge established 1952

Define year-type used consistently throughout plan <u>March 1 through February 28</u>

3. Water supplies

List each annual entitlement of surface water under each water right and/or contract

Supplier	Water source	Contract #	Contract restrictions	Acre-feet/year
Federal level 2	USBR	8-07-20-L6886		All available*
Federal level 4	USBR	8-07-20-L6886		All available*
State				
Appropriative				
Other, riparian				

* This July 8, 1997 MOA includes use of any Accretion Water and Project operational spill water available in the wasteway. CVPIA Level 2 and Level 4 water is provided by USBR contract 01-WC-20-1756 (DFG Contract #P0080103) signed January 19, 2001 to provide firm water supplies to State WA's south of the Delta. The total amount of CVPIA water allocated to Volta Wildlife Area is 16,000 acre-feet per annum (13,000 Level 2, and 3,000 Incremental Level 4). The contract also identifies 3,000 AFY of Level 4 "replacement" water which was provided to Volta WA prior to CVPIA, and is "to be replaced to the Project when available and acquired from willing sources." NOTE: The verbal operating agreement between DFG and USBR is that up to 13,000 AFY can be put to beneficial use, and that use of the 3,000 Incremental Level 4 water will not be required.

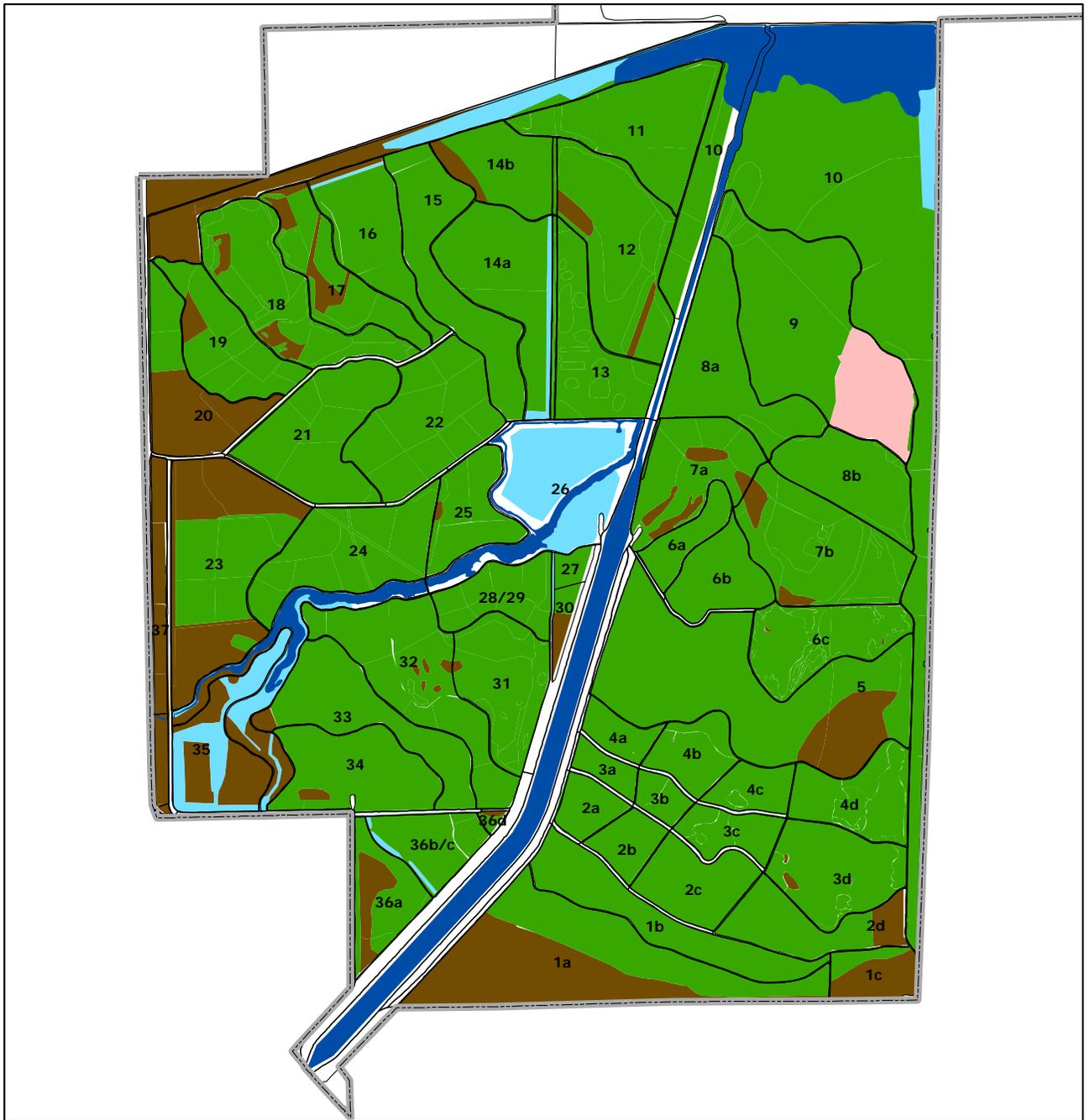
4. Provide a narrative on pre-CVPIA refuge water supplies and water management

The Refuge had a firm contract with Reclamation for 10,000 acre-feet of Central Valley Project (CVP) water. The water management plan for the Refuge requires flooding to begin on July 15. This early flooding provides feeding and resting areas for early arriving waterfowl. The Refuge is the first and usually the only area in GRCD to be flooded early in the year (CDFG, 1986b). The Refuge needs additional dependable water supplies to provide optimum management levels. Groundwater was not used.

5. Land use history--Identify habitat types specific to this refuge.

Attach a refuge map showing habitat location and size

List refuge habitat-types with 5% or more of total acreage

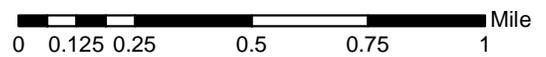


Volta Wildlife Area Habitat Map



- Seasonal Wetlands
- Uplands
- Shrublands
- Semi-permanent Wetlands

- Permanent Water
- Wildlife Area Boundary



<i>Habitat type</i>	<i>Original size</i>	<i>1992 acres</i>	<i>1997 acres</i>	<i>2010 acres</i>
<i>Seasonal wetland – timothy (not irrig)</i>	NA	NA	651	1226
<i>Seasonal wetland – timothy (irrigated)</i>	NA	NA	491	511
<i>Seasonal wetland – smartweed</i>	NA	NA	0	55
<i>Seasonal wetland - watergrass</i>	NA	NA	30	30
<i>Permanent wetland</i>	NA	NA	217	217
<i>Semi-permanent wetland/brood pond</i>	NA	NA	0	0
<i>Reverse cycle wetlands</i>	NA	NA	0	0
<i>Riparian</i>	NA	NA	0	0
<i>Irrigated pasture</i>	NA	NA	0	0
<i>Upland</i>	NA	NA	0	1282
<i>Upland (not irrigated)</i>	NA	NA	406	744
<i>Upland (managed)</i>	NA	NA	0	0
<i>Upland (grains)</i>	NA	NA	0	0
<i>Other (>5%)</i>	NA	NA	615	615
<i>Misc. habitat (<5%)</i>	NA	NA	0	0
<i>Sub-total – habitat acres</i>	NA	NA	2500	3321
<i>Roads, buildings, etc.</i>	NA	NA	389	389
<i>Total (size of refuge)</i>	NA	NA	2889	3787

Describe refuge habitat-type water use characteristics

<i>Habitat type</i>	<i>AF/ac</i>	<i># of irrigations</i>	<i>Floodup date</i>	<i>Draw down date</i>
<i>Seasonal wetland</i>	5.0	1	7/15-10/30	3/1-4/1
<i>Seasonal wetland - timothy</i>				
<i>Seasonal wetland - watergrass</i>	8.0	1-2	7/15-10/30	4/1-5/1
<i>Permanent wetland</i>	12.0			
<i>Semi-permanent wetland/brood pond</i>	10.0		December	8/15
<i>Riparian</i>				
<i>Irrigated pasture</i>				
<i>Upland (not irrigated)</i>				
<i>Upland (managed)</i>				
<i>Upland (grains)</i>				
<i>Other (>5%)</i>				
<i>Misc. habitat (<5%)</i>				

Section B - Water Management Related Goals and Objectives

- 1. Describe the refuge mission relative to water management. (i.e. crop depredation, legislative mandates, service to landowners)*

Beginning in 1949, a series of meetings were held throughout California to discuss acquisition of wetlands for State-owned waterfowl management areas. Three purposes for acquisition were stated during these meetings: the economic necessity to protect agricultural crops from waterfowl depredation, the recognition of a need to protect waterfowl wintering habitat, and a desire to accommodate public waterfowl hunting. Participants included several elected representatives from the State Assembly and the U.S. Congress. During the course of these meetings the concept of the Volta Wildlife Area (VWA) was put forward and approved.

The VWA is owned by the U.S. Department of the Interior, Bureau of Reclamation (BOR) and managed by the California Department of Fish and Game through lease agreement pursuant to the act of Congress approved June 17, 1902 (32 Stat. 388) and acts amendatory thereof or supplementary thereto, and the act of August 27, 1954 (68 Stat. 879), all collectively referred to as Federal Reclamation law. The lease agreement was initiated in 1952 and has been renegotiated several times since. The lease agreement obligates the Department to manage the 2,887 acre Volta Wasteway and reservoir containing seasonal and semi-permanent wetlands as waterfowl habitat, and to provide public recreation.

The VWA has primarily been managed as a seasonally flooded wetland to provide the habitat needs of migratory waterfowl and associated species. Approximately 1,970 acres of the area are managed as seasonally and semi-permanently flooded wetlands. In recent years research has indicated there can be positive benefits to wildlife by maintaining some of this seasonally flooded wetland during seasons other than fall and winter. Management at VWA has begun to evolve to reflect this new management paradigm. These flooded areas need not be large to be effective habitat components. Also by carefully managing depth, location, and topography, normal habitat manipulations can still be accommodated in the major portion of each cell, while one or more edges remain flooded.

Volta WA habitat management contributes to meeting objectives of the Central Valley Habitat Joint Venture and the North American Waterfowl Management Plan.

VWA's major management goals reflect the DFG's commitment to these guidelines as stated by the 1987 Operations Manual:

1. Provide suitable habitat and living space for the preservation of native species, including non-game and endangered animals and plants.
2. Protect surrounding agricultural lands from waterfowl depredation by providing feeding and resting areas for waterfowl.
3. Provide access to public lands for hunting and fishing opportunities.
4. Provide for multiple use of the area when this use will not unduly interfere with the primary use of the land.

2. Describe specific habitat management objectives. Include pertinent information from refuge management plans

The wildlife area prepares annual Work Plans which identify habitat management efforts for the coming year. The Work Plans follow the Wildlife Area Habitat Committee guidelines for specific habitat management. In addition, the wildlife area is also guided by the San Joaquin Basin Action Plan. The current Wildlife Area Habitat Committee objectives are as follows:

Permanent Wetlands:

Permanent wetlands are wetlands which remain flooded year-round. Typical permanent wetland habitat includes ditches, deep ponds, and sloughs. Area management plans must identify permanent wetland habitat, ideally ranging in size from two to 20 acres and no less than three percent of total wetland acreage. Permanent wetlands should be spaced at a maximum of one-mile intervals.

Semi-permanent Wetlands (Spring/Summer Wetlands):

Habitat must be flooded from February 1 to September 15 annually, but may be drained as early as August 15 when habitat management is needed. Semi-permanent wetlands typically provide key brood habitat for

waterfowl and shorebird populations as well as summer water essential to resident wildlife. The management goal is to provide no less than three percent of the total wetland acreage in this habitat type. Semi-permanent wetlands should range in size from two to 20 acres, have shallow edges, and be scattered at approximately ½ -mile intervals throughout the wildlife area.

Diverse Moist Soil Vegetation:

This habitat is managed primarily for production of plant species which produce desirable seed and sustain invertebrates important to waterfowl and other wetland wildlife species. At least three major vegetation species, which may include but are not restricted to swamp timothy, watergrass, and smartweed, must be provided for in the area plan. Each of the three species should account for a minimum of 25 percent of the total seasonal wetland acreage and, ideally, the three species should cumulatively provide a high level of nutrition and forage availability. The species should compliment one another in such a way as to provide for a balance of nutritional and cover qualities. The selection moist soil vegetation should also take into account the abundance and availability of other moist soil habitats within the surrounding geographic area.

Fall flooding and moist soil habitat which creates what is known as "seasonal wetlands" and provides an important resting and food source for wildlife should be timed to meet the needs of wildlife. Staged flooding should begin in early August as migratory shorebirds and waterfowl begin to move into California and continue through early December. Up to 25 percent of managed moist soil habitat should be flooded by September 15. Drawdown should occur during late-winter to late-spring, depending on target species' germination requirements.

Special Ecological Communities:

These include communities identified by area managers or recognized by the Natural Diversity Data Base (NDDDB) as occurring on or within the vicinity of a wildlife area. The objective is to protect existing habitat types with no net loss of acreage and to enhance, where possible, their quality.

Riparian Habitat:

Riparian habitat on wildlife areas has been most commonly associated with the water management system of the area (e.g., delivery ditches, natural sloughs, creek banks). The standard is to maintain existing habitat and to expand its acreage by 50 percent over the next 10 years.

Managed Nesting Habitat:

The goal for management of upland nesting cover is to optimize such habitat for resident breeding birds such as short-eared owls, northern harriers, ducks, and pheasants. The objective is to manage the structure of the habitat (height, density, species composition, and soil moisture) to optimize nesting density and success. The standard is to maintain a minimum of 25 percent of the total upland habitat managed as dense nesting habitat with a minimum plot size of five acres.

Upland Foraging Areas:

These areas are managed primarily for grazing and upland foraging wildlife species such as raptors, greater and lesser sandhill cranes, and geese. Where appropriate, the standard is to manage a total 25 percent of the total upland habitat as upland foraging areas with a minimum plot size of 50 acres.

Cereal Grain Plantings:

The standard for cereal grain plantings is a minimum of 10 percent of the total upland habitat. Ideally, plots of five to 20 acres will be managed for pheasants and other species (raptors), and 50-acre minimum size plots will be managed for geese and Sandhill cranes. Cereal grains planted early in the fall (prior to December 1) can be considered as both managed nesting habitat and upland forage areas.

3. *Describe the strategies used to attain objectives listed above*

An Annual Management Work plan is prepared each year to implement the overall management goals and objectives in the Wildlife Area Management Plan.

On an annual basis, the wildlife area staff review/assess the current habitat management plan and makes changes as necessary to meet the habitat objectives.

4. *Describe constraints that prevent attainment of objectives and explain the effect on operations*

Every year, we seek in our annual Work Plans to accomplish more than can be currently implemented given current budgetary and personnel levels. Eighty percent of water utilized on the Wildlife Area must be pumped from the Volta Wasteway – a considerable expense. A further constraint may be mosquito abatement regulations which constrain our ability to flood certain portions during summer and fall months of the wildlife area. To address Mosquito abatement/wetland issues the Central Valley Joint Venture has published a technical guide to provide information on habitat management strategies to reduce mosquito production on managed wetlands. (Technical Guide to Best Management Practices for Mosquito Control in Managed Wetlands, June 2004)

Policies by DFG regarding the maintenance of inland wetlands have a significant bearing on the management of VWA. One of the primary purposes for the lease agreement with BOR has been to provide seasonally flooded wetland habitat for migratory waterfowl and associated species. With that in mind, the DFG is constrained to manage as much as possible of the VWA acreage as wetland habitat. The DFG is also obligated to manage habitat in such a way as to not cause a negative impact to any rare, threatened, or endangered species of plant or animal. Wherever possible, it is the DFG's policy to enhance these species' habitat to improve the status of the populations, with the ultimate objective of delisting listed species.

Title easements which may constrain DFG management activities include subsurface mineral rights reservations over most of the property. In the event that a holder of subsurface mineral rights should wish to exercise those rights, the Department is legally obligated to accommodate reasonable surface access. This legal obligation in no way releases the subsurface mineral rights holder from complying with CESA, Federal Endangered Species Act (FESA), or other laws and regulations pertaining to negative environmental impacts. Any negative impacts which might occur as a result of action taken by the holder of subsurface mineral rights would have to be mitigated. Environmental Services staff from DFG's San Joaquin Valley - Southern Sierra Region would stipulate at that time what mitigation measures would be required before any party could be granted a permit for extraction of subsurface minerals. Given these circumstances it is questionable whether subsurface mineral rights reservations constitute a significant constraint upon Departmental management activities at VWA.

A social constraint affecting management of the VWA pertains to public hunting. One of the original objectives for the creation of this wildlife area was to provide public waterfowl hunting opportunity. During the time the State has operated public waterfowl hunting areas, public access to hunting opportunities has plummeted. Consequently, it has become critical that areas acquired to provide public hunting opportunity be managed effectively to that end. The VWA has been, and should continue to be, managed with a major emphasis on providing public hunting opportunity for waterfowl and any other game species which can reasonably be hunted without a significant impact to waterfowl hunting and listed species.

5. *Describe the strategies used to remedy the constraints listed above*

Additional funding and personnel would help meet several of the constraints. Seek Project Power for low-lift pump operation to maximize operation and maintenance budget. Continue to seek solutions with water delivery agencies to deliver water in a more consistent fashion.

Section C - Policies and Procedures

1. Describe the refuge policies/procedures on accepting agricultural drainage water as supply
 There is no Agriculture drain water available or used on Volta Wildlife Area.

2. Describe the refuge policies/procedures on water pooling, transfers, reallocations or exchanges
 The January 2001 USBR/DFG refuge water supply contract addresses pooling in Article 6, and transfers, reallocations, and exchanges of water in Article 7. The Los Banos Wildlife Area has no additional policies or procedures on pooling, transfers, reallocations, or exchanges.

3. Describe the refuge water accounting policies/procedures for inflow, internal flow and outflow
 Inflows are measured by the agencies wheeling the water. Internal flows are monitored daily for purposes of tracking movement through the system to the proper place of use on the wildlife area. Outflow at some points is monitored by area staff as time permits.

4.- Attach a copy of the refuge’s shortage policies, drought plan, or any similar document.
 Based on established refuge purposes (see B1) and the projected water supply, we will determine critical habitat needs and analyze existing water use records by both refuge unit and habitat type to determine the amount, distribution and timing of each habitat to be flooded during water shortages.

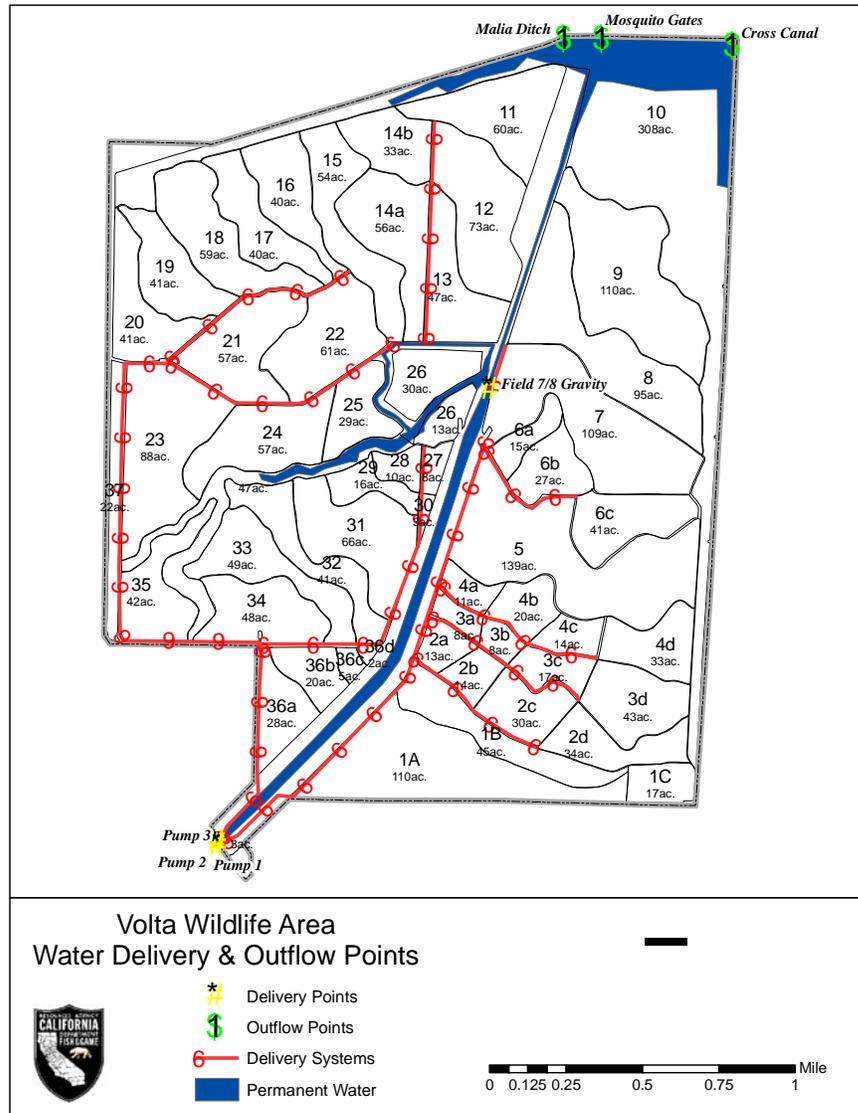
5. (GRCD only) Describe water policies as they pertain to:
- _____ a. water allocation policy to customers (attach);
 - _____ b. lead time for water orders (attach sample water order form);
 - _____ c. policies for wasteful use of water (attach policy), and
 - _____ d. pricing and billing policies (attach sample bills)

<i>Fixed Charges</i>			
<i>Charges (\$ unit)</i>	<i>Charge units (\$/acre), (\$/customer) etc.</i>	<i>Units billed during year (acres, customer) etc.</i>	<i>\$ collected (\$ times units)</i>

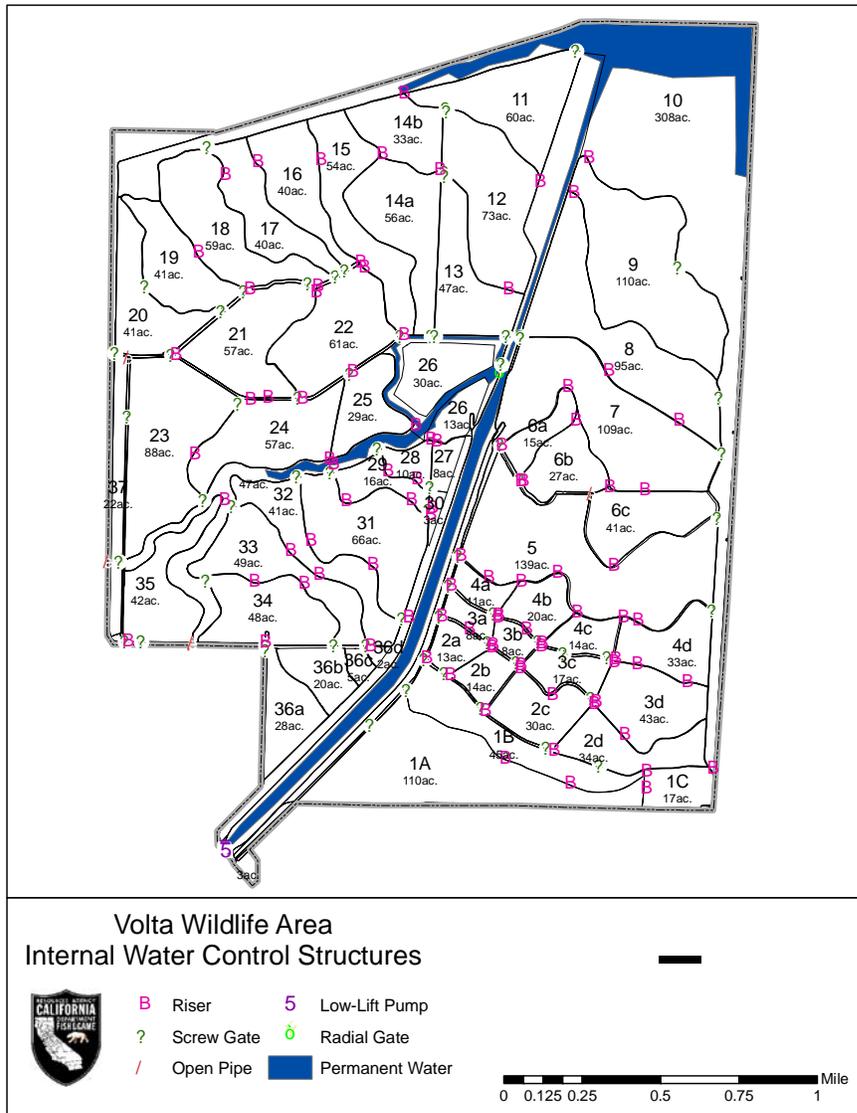
<i>Volumetric charges</i>			
<i>Charges (\$ unit)</i>	<i>Charge units (\$/AF), (\$/HCF), etc.</i>	<i>Units billed during year (AF, HCF) etc.</i>	<i>\$ collected (\$ times units)</i>

Section D - Inventory of Existing Facilities

1. Mapping
 The following map(s) show points of delivery, turnouts (internal flow), and outflow (spill) points, measurement locations, conveyance system, storage facilities, operational loss recovery system, wells, and water quality monitoring locations.



Water delivery and exit points on the Volta Wildlife Area. See items 2 and 3 below for more information.



Internal turn-outs and wells on the Volta Wildlife Area. See item 2 for details.

2. Water measurement
 a. Inflow/deliveries

Total # of inflow locations/points of delivery 3

Total # of measured points of delivery 3

Percentage of total inflow (volume) measured during report year 100% of the total delivered amount is currently measured by Delta-Mendota Water Authority.

Delivering agency	Conveyance facility	Measuring point	Refuge distribution facility	% of total inflow	Type of measurement	Measuring agency
SLDMWA	Volta Wasteway	Westside pump	Westside ditch	40	Mag Meter	SLDMWA
SLDMWA	Volta	Eastside	Eastside ditch	40	Pump rating	SLDMWA

	Wasteway	pumps				
SLDMWA	Volta Wasteway	gravity flow at radial gate	Field 7/8 ditch	20	Gate measurement	SLDMWA

b. Internal flow at turnouts

Total # of refuge water management units (units) 55
 Total # of refuge water management unit turnouts 150
 Total # of measured turnouts 0 (monitored daily, but not measured)
 Estimated % of total internal flow (volume) during report year that was measured at a turnout 0
 Number of turnouts supplying more than one unit or not directly off delivery system 6

Measurement type	Number of devices	Acres served	Accuracy (avg or range)	Reading frequency	Calibration frequency (months)	Maintenance frequency (months/days)
Orifices						
Propeller						
Weirs						
Flumes						
Venturi						
Alfalfa valves						
Metered gates						
Other, stop-log and screwgates	150	3,787	NA	Daily (but not measured) when in use	NA	NA

c. Outflow

Outflow (AF/yr) unknown
 Total # of outflow locations/points of spill 4
 Total # of measured outflow points 1
 Percentage of total outflow (volume) measured during report year 30%

Outflow point	Measuring point	Type of measurement	Percent of total outflow (estimated)	Measuring agency	Acres drained
Mosquito Ditch			60%		
Cross Canal		Sontek	30%	GWD	
Malia Ditch			10%		
This system acts as a drainage point for Volta and a delivery point to lands to the north (see map).					1500 of Wildlife Area wetlands

3. Identify the type and length of the refuge internal distribution system

Miles unlined canal	Miles lined canal	Miles piped	Miles – other
6.0	0	0	2.5 (Natural)

Describe the location and types of identified leaks and areas of higher than average canal seepage, and any relation to soil type.

Wildlife area staff has not identified any significant leaks or areas of higher than average canal seepage, but we continue to assess water systems and improve efficiency when possible. Past water system improvements, including pump rehabilitation and upgrading water control structures, have improved the water delivery efficiency of the wildlife area.

4. Describe the refuge operational loss recovery system

Pump #	Location	HP
NONE		

5. Groundwater

Describe groundwater availability, quality and potential for use

Groundwater has not been used on the refuge (Reclamation et al. 2001b; Refuge staff 2002). No well infrastructure currently exists. No wells are used for refuge domestic supply. See USBR July 2004 “Evaluation of Groundwater Potential for Incremental Level 4 Refuge Water Supply” for more details.

Salt accumulation and inadequate drainage have reportedly resulted in highly saline shallow groundwater throughout much of the area. Boron, molybdenum, and arsenic are potential constituents of concern in the region; however, no known water quality testing has been conducted on the refuge (Refuge staff 2002).

Groundwater plan No X Yes (please attach or provide web link).

Groundwater basin(s) that underlie the refuge

Name of basin underlying refuge	Size (sq. mi.)	Usable capacity (AF)	Safe yield (AF/Y)	Management agency	Relevant reports
San Joaquin / Delta-Mendota Subbasin	1,170	50,000,000	unknown	None	CH2M Hill

Identify refuge-operated ground water wells

#	Location	Status	HP	2003 (AFY)	Future plans
NONE					

Section E Environmental Characteristics

1. Topography - describe and discuss impact on water management

The topography is mostly flat, with the general fall going from south to north and more localized fall towards Los Banos Creek. Most levees are built on a one foot or less contour. This enables a fairly high level of control of water depths which enables us to manage wetlands for a diversity of water-dependent species with different water depth needs.

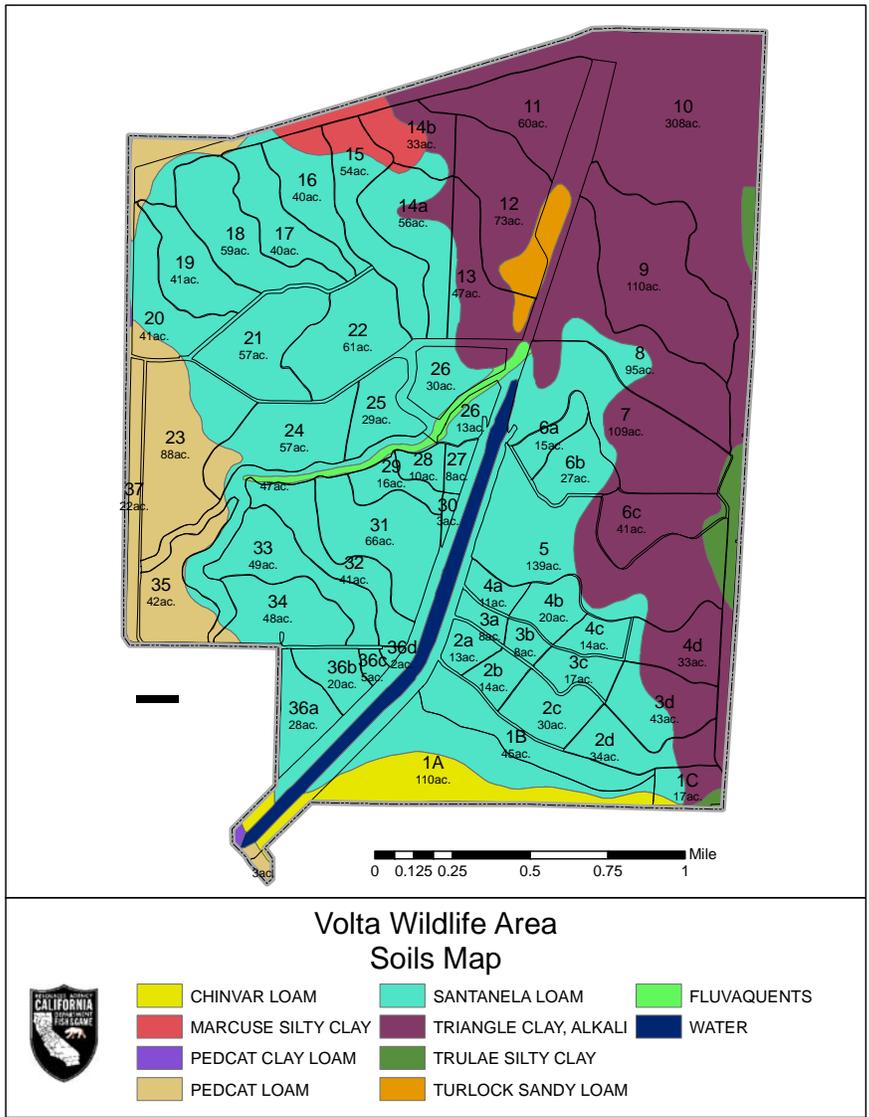
2. Soils - describe and discuss impact on water management (see attached map)

Triangle clay is found in the northeastern quarter and stretches to the far southeast along the eastern border. Large cracks form to several feet in depth when dry. This soil is saline-sodic. The western half of the refuge is covered by Santanela loam, which stretches from the west to the south-central areas of the refuge. The clay and loam soils are deep and very poorly drained (USDA 1990).

Permeability of both soils is very slow, and water capacity varies from low to high. Runoff over both soil types is ponded (USDA 1990).

Data from wells monitored by DWR show shallow groundwater conditions in the area. Along the west and southwest refuge boundaries, depth to groundwater ranges 5 to 10 feet below ground surface (bgs). Directly east of the refuge at SR 165, groundwater depths average between 30 and 40 feet. Shallow groundwater elevations appear to have recovered to conditions prior to the drought in the 1970s (DWR 2003b).

Little to no subsidence has occurred in the immediate vicinity of the refuge (DWR 2003b). Given the soil conditions and that the deep aquifer is confined in the Volta area, subsidence may be possible with a substantial increase in groundwater use.



3. Climate

National Weather Service – Merced(KMCE) 1998-2008

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
avg precip	2.8	2.28	1.35	0.48	0.02	0.0	0.0	0.0	0.8	0.81	.83	1.69	10.7
avg. temp	44.9	49.4	54.2	58.5	67.7	74.3	78.8	77.0	72.3	63.3	52.8	45.6	61.6
max temp	53.3	60.1	66.9	72.2	83.2	90.8	95.6	94.1	88.9	78.1	64.2	55.0	75.2
min temp	36.5	38.7	41.5	44.7	52.1	57.7	61.9	60.0	55.8	48.5	41.3	36.3	47.9
ET _o	1.24	2.24	3.72	5.70	7.44	8.10	8.68	7.75	5.70	4.03	2.10	1.24	57.9

Discuss the impact of climate, and any microclimates, on water management

Summers are hot and dry with low humidity. Daytime highs are from mid nineties to one hundred ten degrees Fahrenheit. Nighttime lows are in the mid sixties. The days are typically calm and clear which lends to stagnant and polluted air. Spring and Fall weather is mild with sunny skies and some clouds. Temperatures typically range from nighttime lows in the forties to daytime highs in the seventies. Fall is typically hazy and Spring is generally windy. Winter daytime highs are in the fifties and sixties with nighttime lows in the low

thirties, although it has been recorded as low as sixteen degrees. Dense ground fog regularly forms through the winter months.

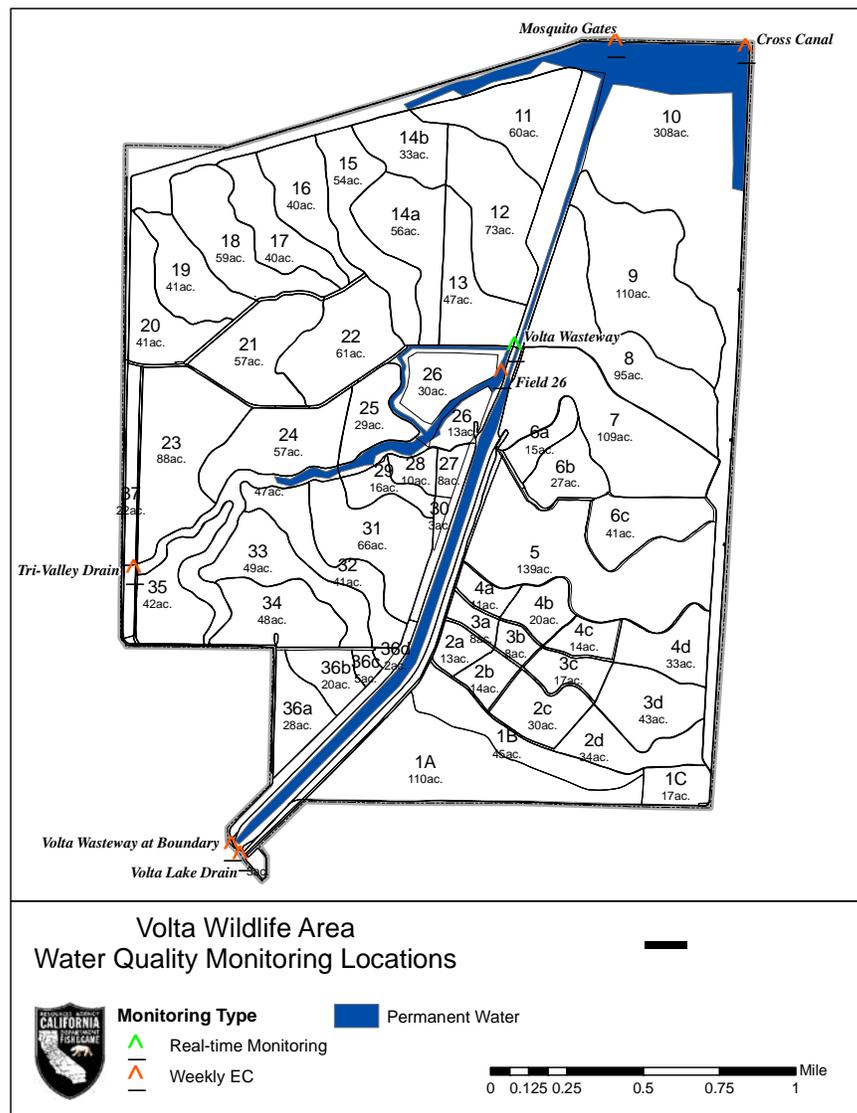
There are no known microclimates that affect water management on the area.

4. Water quality monitoring (attach water quality test result forms)

If the refuge has a water quality monitoring program complete this table

Analyses performed	Frequency range	Concentration range	Average
EC readings	Once weekly	800-3500	1200
Flow & EC	Real Time	800-1500	1000

These reading are taken from 6 points on the wildlife area by DFG staff. Real Time monitoring conducted though partnership with Grassland Water District.



Discuss the impact of water quality on water management

When water with high EC levels is known to be coming through delivery areas, we greatly reduce or eliminate our take of this poor quality water. Due to high salinity in groundwater, we also avoid groundwater pumping unless we can dilute it with higher quality water.

Section F Transfers, Exchanges and Trades

Provide information on any transfers, exchanges and/or trades into or out of the refuge

From whom	To whom	Report year (AF)	Use
NONE			
	<i>TOTAL</i>		

Section G Water Inventory

See Tables

Section H Critical Best Management Practices

Describe the 5-year implementation plan and the proposed 3-year funding budget.

- 1. *Management programs*
 - a. *Education*

<i>Program</i>	<i>Estimated cost (in \$1,000s)</i>		
Public outreach- Grasslands Environmental Education Center Environmental Education Coordinator (1/4 time on water issues)	\$15K	\$15K	15K
Annual Refuge Management Workshop	\$1.5K	\$1.5K	\$1.5 K

Describe the specifics of each program (number of participants, topics, purpose, etc.) and attach program materials, if available.

The **Environmental Education Coordinator** conducts fieldtrips on the wildlife area and surrounding wetlands as well as visiting classrooms for over 5,500 children and adults in the past two years. A portion of the curriculum focuses on the importance of wetlands to water quality and flood control as well as the importance of clean water to the wetlands themselves.

Annual Refuge Management Workshop We attend annual wetland workshop training, when feasible, to train staff in water and wetland management techniques.

The Grasslands Environmental Education Center is located at Los Banos Wildlife Area and is operated through partnerships with Grassland Water District, Central Valley Joint Venture, Ducks Unlimited and California Waterfowl Association.

Annual wetland management workshops are coordinated efforts of CDFG, USFWS and NRCS.

- b. *Water quality monitoring*

<i>Type of water</i>	<i>Existing Estimated cost (in \$1,000s)</i>		
	<i>2011</i>	<i>2012</i>	<i>2013</i>
<i>Surface – USBR and riparian</i>	\$2.5K	\$2.5K	\$2.5K

<i>Upslope drain</i>			
<i>Groundwater</i>			
<i>Outflow</i>	\$2.5K	\$2.5K	\$2.5K

Short description of existing or planned program – i.e., required by which agency, coordinated with whom, constituents monitored and frequency

Wildlife area staff currently monitor salinity and water flow rates at 3 points weekly on the wildlife area (cost: \$5,000/year, see above table). We would like to expand the program, but are waiting to determine the factors that will need to be monitored to meet our requirements under the Central Valley Regional Water Quality Control Board conditional waiver to waste discharge requirements.

c. Cooperative efforts

We are currently a partner with PG&E and Fresno State for pump testing. DFG partners with the Westside San Joaquin Watershed Coalition to implement the Central Valley Regional Water Quality Control Board Agricultural Waiver. We are also currently a partner (along with Grassland Water District and Lawrence-Livermore Laboratories) on a CALFED-funded project that examines real-time changes in water quality at points throughout the Grasslands. We provide access for real time water quality monitoring stations on several wildlife areas in the Grasslands.

d. Pump evaluations (mobile labs)

Total number of groundwater pumps on refuge 0

Total number of surface water (low-lift) pumps on refuge 3

<i>Groundwater pumps</i>	<i>Estimated cost (in \$1,000s)</i>		
	<i>2011</i>	<i>2012</i>	<i>2013</i>
<i># of groundwater pumps tested</i>			
<i># of pumps to be fixed or replaced</i>			
<i># of low-lift pumps to be tested</i>		2@\$1K	
<i># of pumps to be fixed or replaced</i>			2@\$10K

e. Policy evaluation

If CVP power could be obtained, it would greatly enhance our ability to both pump and distribute water onto the wildlife area.

f. (GRCD only) ~~Provide Customer Services—Facilitate physical/structural improvements for member units; provide management services and technical advice to raise funds for BMP Implementation and provide customers with water efficiency education programs.~~

2. *(GRCD only) ~~Pricing structure~~*

3. *(GRCD only) ~~Plan to measure deliveries~~*

4. *Water management coordinator*

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Section I Exemptible Best Management Practices

Describe the 5-year implementation plan and the proposed 3-year funding budget.

1. Improve management unit configuration

Unit name	Current acres	Reason for change	Proposed acres	Estimated cost (in \$1,000s)		
				2011	2012	2013
9/10	417	Repair internal Levees and improve water management/drainage	417	\$60K		

(GRCD only) Assist customers to improve management unit configurations.

2. Improve internal distribution system

a. New control structures within distribution system

Proposed location	Type of structure	Reason for new structure	Estimated cost (in \$1,000s)		
			2011	2012	2013
5-10 Annually	Concrete	Replace damaged or leaking structures	\$10K	\$10K	\$10K

b. Line/pipe sections of distribution system

Proposed reach/sect.	Reason for new structure	Estimated cost (in \$1,000s)		
		2011	2012	2013
NA	Distribution considered part of Habitat. No unusually leaky areas.			

c. Independent water control for each unit

Proposed control point	Reason for new control point	Estimated cost (in \$1,000s)		
		2011	2012	2013
	See detail below.			

Water control configurations are determined/alterd each year in the annual planning process. Independent water control structures are not planned for 2011 due to the existing flow-through design which maximizes water distribution across the largest area of targeted wetland acreages possible. Since this is determined annually, the Annual Update will include any plans for the coming year.

d. New internal distribution sections (pipe, canal) to provide water to existing and new habitat units

Proposed new section	Units served	Reason for new section	Estimated cost (in \$1,000s)		
			2011	2012	2013
		See detail below.			

Any changes to internal distribution sections are determined each year in the annual planning process. A major rehabilitation of the Westside ditch (includes increased capacity and new turnouts) took place in 2005; the efficiency of this distribution system was greatly increased upon completion of this project. This water conveyance system is treated/cleaned each year and it's overall condition evaluated. Since this is determined annually, the Annual Update will include any plans for the coming year.

(GRCD only) ~~Provide assistance to member units to improve internal distribution~~

3. *Develop a Water Use Schedule*

Plan element	Completion date	Estimated development/update cost (in \$1,000s)		
		2011	2012	2013
<i>Flood up dates by unit</i>	Completed Annually	\$1K	\$1K	\$1K
<i>Drawdown dates by unit</i>	Completed Annually	\$1K	\$1K	\$1K
<i>Irrigation dates by unit</i>	Completed Annually	\$1K	\$1K	\$1K

4. *Plan to measure outflow*

Identify locations, prioritize, determine best measurement method/cost, submit funding proposal

	Estimated cost (in \$1,000s)		
	2011	2012	2013
<i>Identify locations</i>	Done		
<i>Estimate outflow quantity/rank</i>	Done		
<i>Develop plan</i>	Done		
<i>Estimate construction start date</i>		TBD	
<i>Estimate construction completion date</i>		TBD	

5. (GRCD only) ~~Incentive pricing~~

6. *Construct and operate operational loss recovery systems*

Proposed location	Reason for improvement	Estimated cost (in \$1,000s)		
		2011	2012	2013
NA	no available power, water is used in other wetlands down slope.			

We do not anticipate seeking grant funding for operational loss recovery systems at the Volta Wildlife Area due to the existing lack of power, and the distance (several miles) involved with pumping water back up to the head of the Wasteway. The cost/benefit ratio of both constructing and operating a recovery system compared to the potential amount of recovered water (Table 4 estimates 2,565 acre feet) appears to be very low.

7. *Optimize conjunctive use of surface and groundwater*

Proposed production/injection well	Anticipated yield	Estimated cost (in \$1,000s)		
		2011	2012	2013
NA – no usable groundwater				

8. *Facilitate use of available recycled urban wastewater that otherwise would not be used beneficially, meets all health and safety criteria, and does not cause harm to wildlife management goals.*

NA – No recycled urban wastewater is available in this area

9. *Mapping*

<i>GIS map layers</i>	<i>Estimated cost (in \$1,000s)</i>		
	<i>2011</i>	<i>2012</i>	<i>2013</i>
Map 1 – Distribution system	Complete		
Map 2 – Drainage system	Complete		

10. CALFED Quantifiable Objectives

Describe any past, present, or future plans that address the goals identified for this refuge

If reducing nonproductive ET involves removing invasive plants, complete the following:

<i>Invasive unwanted species name</i>	<i>Estimated acres</i>			<i>Estimated cost (in \$1,000s)</i>		
	<i>2011</i>	<i>2012</i>	<i>2013</i>	<i>2011</i>	<i>2012</i>	<i>2013</i>
Perennial Pepper Weed	150	150	125	\$30K	\$30K	\$20K

North Grassland, Volta, and Los Banos WA's

1. Describe actions that reduce selenium concentration in the Grassland Marshes. Reduce selenium concentration to 5 ug/L in the Grassland Marshes. (TB 95)

We currently accept only water with a selenium level of less than 2 ppm (Federal EPA standard).

2. Describe actions that reduce San Joaquin River selenium and boron concentrations. Reduce San Joaquin River selenium concentration to 5 ug/L and boron concentration to 2 mg/L from March 15 to September 15 and to 2.6 mg/L September 16 to March 14. (TB 98)

We currently accept only water with a selenium level of less than 2 ppm (Federal EPA standard) and less than 6 ppm boron (based on Grassland Water District standards).

3. Describe actions that reduce salinity in the Grassland Marshes and Mud and Salt Sloughs. Reduce salinity in the Grassland Marshes and Mud and Salt Sloughs. (TB 102, 103)

We currently accept water with a salinity level of less than 1,500 ECs (standard based on local historical knowledge).

4. Describe actions that reduce nonproductive ET. Reduce unwanted ET. (TB 107)

We control invasive weeds on canal banks and wetland units. In addition, we mow the sides of canals.

Table 1

Water Supply

2010	Federal Wtr	Federal	Local Water	Refuge	Up Slope	other	Total
	Level 2	Wtr Level	Supply	Groundwt	Drain Wtr	(riparian)	
	(acre-feet)	4	(acre-feet)	r	(acre-feet)	(acre-feet)	(acre-feet)
Method							
Jan-2010	295	0	0	0	0	0	295
February	1,023	0	0	0	0	0	1,023
Mar-2009	0	0	0	0	0	0	0
April	167	0	0	0	0	0	167
May	0	0	0	0	0	0	0
June	70	0	0	0	0	0	70
July	294	0	0	0	0	0	294
August	1,966	0	0	0	0	0	1,966
September	2,667	0	0	0	0	0	2,667
October	2,566	0	0	0	0	0	2,566
November	1,656	0	0	0	0	0	1,656
December	504	0	0	0	0	0	504
TOTAL	11,208	0	0	0	0	0	11,208

*March 1, 2009 - February 28, 2010

Measurement Method Definiti

- M1 Measured sum
- M2 Measured sum
- M3 Measured sum
- C1 Calculated (mc
- C2 Calculated usin
- C3 Calculated usin
- E1 Estimated usin
- E2 Estimated usin
- E3 Estimated usin
- O1 Other (attach a

Table 2

Internal Distribution System

Year	2010								
Canal, lateral	Length (feet)	Width (feet)	Surface Area (square feet)	Precip. (acre-feet)	Evaporation (acre-feet)	Seepage (acre-feet)	Operational losses (acre-feet)	Measure method see Cell K5	Total (acre-feet)
Unlined Canal	31,680	8	253,440	4.82	27.66	0	0	E3	(23)
Pipeline	0	0	0	0.00	0.00	0	0		0
Natural Sloughs	17,200	20	344,000	6.55	37.54	0	0	E3	(31)
			0	0.00	0.00				0
			0	0.00	0.00				0
			0	0.00	0.00				0
			0	0.00	0.00				0
			0	0.00	0.00				0
			0	0.00	0.00				0
			0	0.00	0.00				0
			0	0.00	0.00				0
			0	0.00	0.00				0
TOTAL	48,880		597,440	11	65	0	0		(54)

14 acres

Table 3

Managed Lands Water Needs

Year									
2010	Area	Habitat Water Needs	AF/ac water	Delivered Water	Precip	Shallow Groundwtr	Evap	Cultural Practices	Seepage
Habitat Type	habitat acres	(AF/ac)	(AF/ac)	(Total AF)	(AF/Ac)	(AF/Ac)	(AF/Ac)	(AF/Ac)	(AF/Ac)
Seasonal wetlands: timothy	1,697	5.00	4.60	7,806	0.73	0.00	1.63	1.50	1.25
Seasonal wetlands: smartweed	55	6.00	4.00	220	0.73	0.00	1.63	1.50	1.50
Seasonal wetlands: watergrass	30	8.00	6.00	180	0.73	0.00	1.63	1.50	2.00
Permanent wetlands	217	12.00	12.00	2,604	0.83	0.00	4.75	3.00	3.00
Semi-perm wetlands/brood pond	40	10.00	10.00	400	0.83	0.00	1.63	2.00	2.50
Riparian	0	12.00	4.00	0	0.83	0.00	4.75	0.00	0.00
Irrigated pasture	0	5.00	5.00	0	0.31	0.00	3.93	0.00	0.00
Upland (Irrigated)	0	2.00	2.00	0	0.31	0.00	3.93	0.00	0.00
Grain Crops	0	2.00	2.00	0	0.00	0.00	0.00	0.00	0.00
(define)				0	0.00	0.00	0.00	0.00	0.00
Total Habitat Acres	2,039	5.91	5.50	11,210					

Table 4

Refuge Water Inventory

Year	2010	Reference		
Total Water Supply		Table 1		11,208
Precipitation		Table 2	plus	11
Evaporation		Table 2	minus	65
Seepage		Table 2	minus	0
Operational Losses		Table 2	minus	0
			Deliveries to Managed Lands	11,154
Managed Land needs		Table 3	minus	12,059
Difference		(calculated)		(905)
			Balance (outflow?) (Table 3)	2,304
			Water Inventory Balance	1,399

Table 5

Annual Water Quantities Delivered Under Each Right or Contract

Year	Federal Wtr Level 2 (acre-feet)	Federal Wtr Level 4 (acre-feet)	Local Water Supply (acre-feet)	Refuge Groundwater (acre-feet)	Up Slope Drain Wtr (acre-feet)	Riparian (acre-feet)	Total (acre-feet)
2001	9,286	0	0	0	0	0	9,286
2002	11,749	0	0	0	0	0	11,749
2003	11,824	0	0	0	0	0	11,824
2004	11,402	0	0	0	0	0	11,402
2005	11,063	0	0	0	0	0	11,063
2006	12,003	0	0	0	0	0	12,003
2007	11,900	0	0	0	0	0	11,900
2008	12,088	0	0	0	0	0	12,088
2009	11,208	0	0	0	0	0	11,208
2010	11,208	0	0	0	0	0	11,208
Total	113,731	0	0	0	0	0	113,731
Average	11,373	0	0	0	0	0	11,373