RECLAMATION

Managing Water in the West

Environmental Assessment

Firebaugh Canal Water District 1st Lift Canal Lining Phase II – Shaw Avenue to Delta-Mendota Canal & Check 2 Modernization Project

CALFED Water Use Efficiency Grant
Grant No. R13AF20004

Agricultural Water Conservation and Efficiency Grant
Grant No. R13AF20005

U.S. Department of the Interior
Bureau of Reclamation
Mid-Pacific Regional Office
Sacramento, CA

September 2013

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Table of Contents

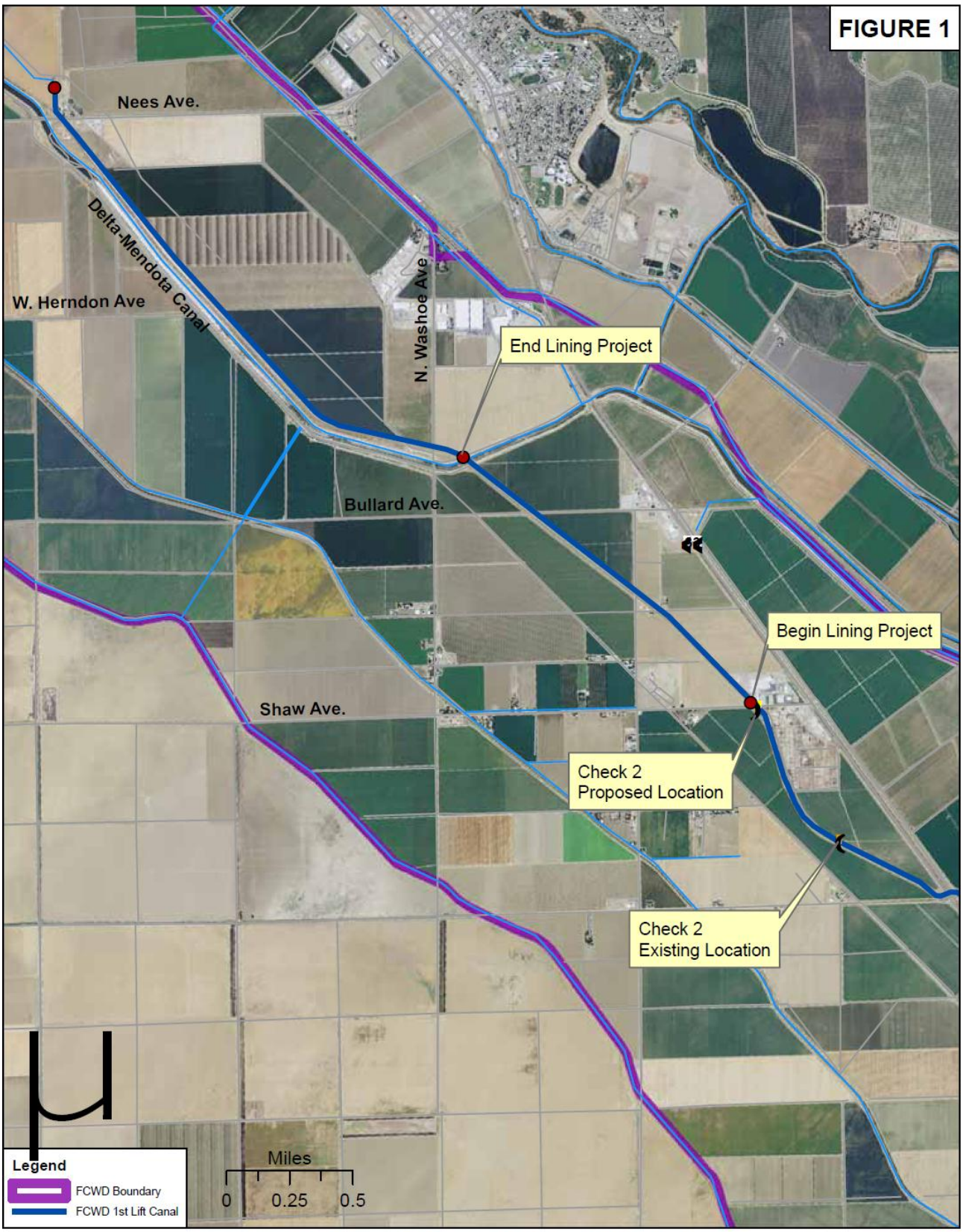
List of Acronyms and Abbreviations

NO_x	Nitrous oxides
VOC	volatile organic compounds
APE	Area of Potential Effect
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standards
CFR	Code of Federal Regulations
CO	Carbon monoxide
CVRWQCB	Central Valley Regional Water Quality Control Board
DMC	Delta-Mendota Canal
DOI	Department of the Interior
EA	Environmental Assessment
EPA	Environmental Protection Agency
FCWD	Firebaugh Canal Water District
GBP	Grassland Bypass Project
GDA	Grassland Drainage Area
GGS	Giant garter snake
ITA	Indian Trust Assets
NAAQS	National Ambient Air Quality Standards
NHPA	National Historic Preservation Act
NO_2	Nitrogen dioxide
NRHP	National Register of Historic Places
O_3	Ozone
PM_{10}	Particulate matter between 2.5 and 10 microns in diameter
$PM_{2.5}$	Particulate matter less than 2.5 microns in diameter
Project	1st Lift Canal Lining Phase II –Shaw Avenue to Delta-Mendota Canal and Check 2 Modernization Project
Reclamation	Bureau of Reclamation
ROG	reactive organic gases
SCADA	Supervisory Control and Data Acquisition system
Service	U.S. Fish and Wildlife Service
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SJKF	San Joaquin kit fox
SJVAB	San Joaquin Valley Air Basin
SO_2	Sulfur dioxide

Section 1 Introduction

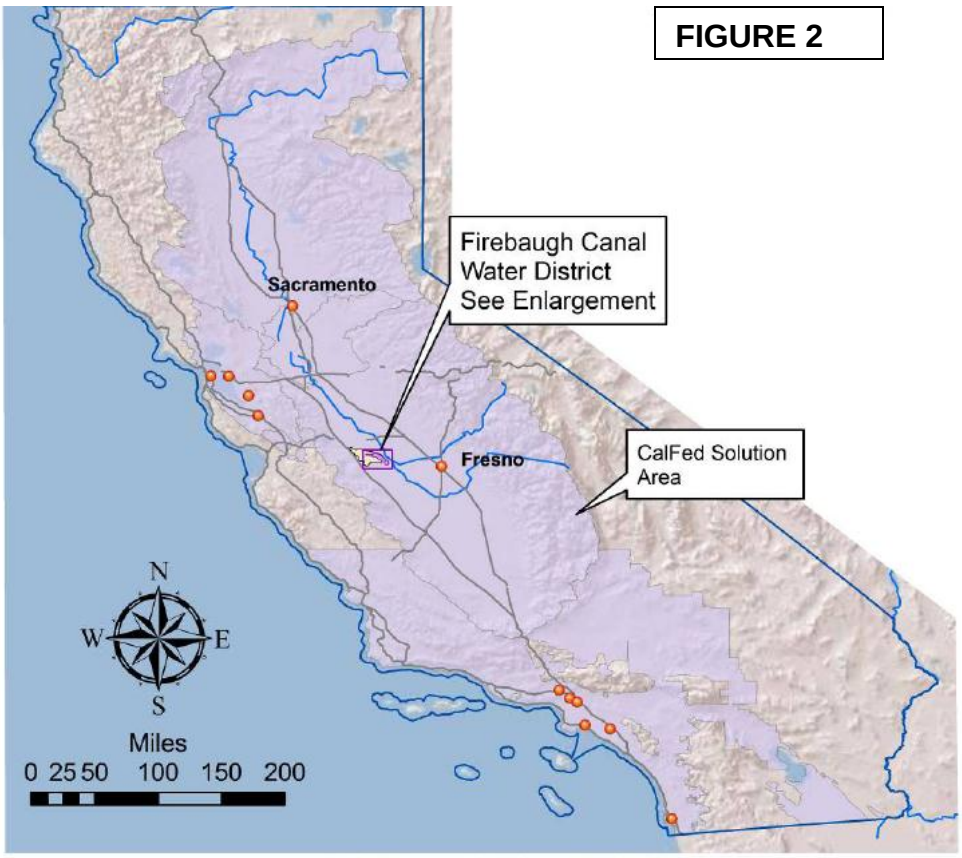
This Environmental Assessment (EA) has been prepared by the Bureau of Reclamation (Reclamation) to examine the potential direct, indirect, and cumulative impacts to the affected environment associated with providing federal grant funding to Firebaugh Canal Water District (FCWD) for their 1st Lift Canal Lining Phase II –Shaw Avenue to Delta-Mendota Canal (DMC) Project and Check 2 Modernization Project (Project). The FCWD has approximately 40 miles of canals and 36 miles of laterals. The water use within the District boundaries is entirely for agricultural irrigation and is obtained through an exchange contract with Reclamation via the Delta-Mendota Canal. There are 22,000 acres developed into irrigated crop land within the FCWD and there are approximately 35 water users.

The Project areas are located within FCWD's service area boundary in Fresno County, California (see Figures 1 & 2). Currently the unlined canal loses approximately 278 acre feet per year (afy) through seepage to a perched saline sink. This amounts to approximately 0.3 percent of the FCWD's total annual water deliveries. FCWD lies within the Grassland Drainage Area (GDA) and is a participating agency in the Grassland Bypass Project (GBP), through which subsurface drain water generated within the region is discharged to the San Joaquin River. The GDA lies within the CalFed Solution Area and most of it is underlain with a saline perched water table, which is managed with on-farm tile systems and regional deep drains. Deep percolation from irrigation and seepage from unlined canal systems is collected by the tile systems and regional drains, where it is managed and eventually discharged to the San Joaquin River. To manage these discharges, FCWD participated in the development of an In-Valley Drainage Solution such that no subsurface drain water leaves the GDA boundary. Because the regional perched water table is high in salts, boron, and selenium, it is not usable for irrigation.



Firebaugh Canal Water District
1st Lift Canal Lining Project Phase 2 and Check 2 Modernization Project

FIGURE 2



Firebaugh Canal Water District
Location Map
1st Lift Canal - Check 2 Modernization Project

1.1 Need for the Proposal

FCWD needs to reduce seepage losses and their contribution to the local perched water table and subsurface drainage to be managed by the GBP, and improve their water management capabilities in order to make the conversion to high-efficiency irrigation systems more feasible for the District's growers.

The GBP operates under a Waste Discharge permit, which regulates the load of selenium that can be discharged by the GBP. Implementation of the Proposed Action would reduce seepage losses by approximately 278 afy, which results in a reduction of an estimated 45 pounds of selenium, 5,600 pounds of boron, and 1,400 tons of salt discharged to the San Joaquin River and Bay-Delta each year. The concrete lining would deny root anchorage and substantially decrease aquatic weed growth, the need for in-stream chemical applications, and channel maintenance. The 278 afy of conserved water would remain in the canal and available for other uses, allowing the system to remain charged with water and available for on-demand irrigation flexibility, especially during times of drought.

Automating the check structure on the 1st Lift Canal would specifically improve operational efficiency and flexibility on the entire 1st Lift Canal service area, including 5,200 acres and potentially 10,000 afy in irrigation deliveries (see Figure 3). Water management of the 10,000 afy it delivers would be improved with remote monitoring and operation through the District's Supervisory Control and Data Acquisition (SCADA) system. If funding assistance from the Natural Resources Conservation Service (NRCS) becomes available, in addition to the District's funding assistance program, 2,200 acres of the District's two remaining growers within the service area may convert to high-efficiency irrigation systems.

1.2 Resources Analyzed in Detail

The range of potential impacts assesses whether lining approximately two miles of the 1st Lift Canal and modernizing Check 2 might cause potentially adverse effects on the human environment. This EA will analyze the affected environment of the Proposed Action and No Action Alternative in order to determine the potential impacts and cumulative effects to the following environmental resources:

- Water Resources
- Air Quality
- Biological Resources
- Cultural Resources
- Cumulative Impacts

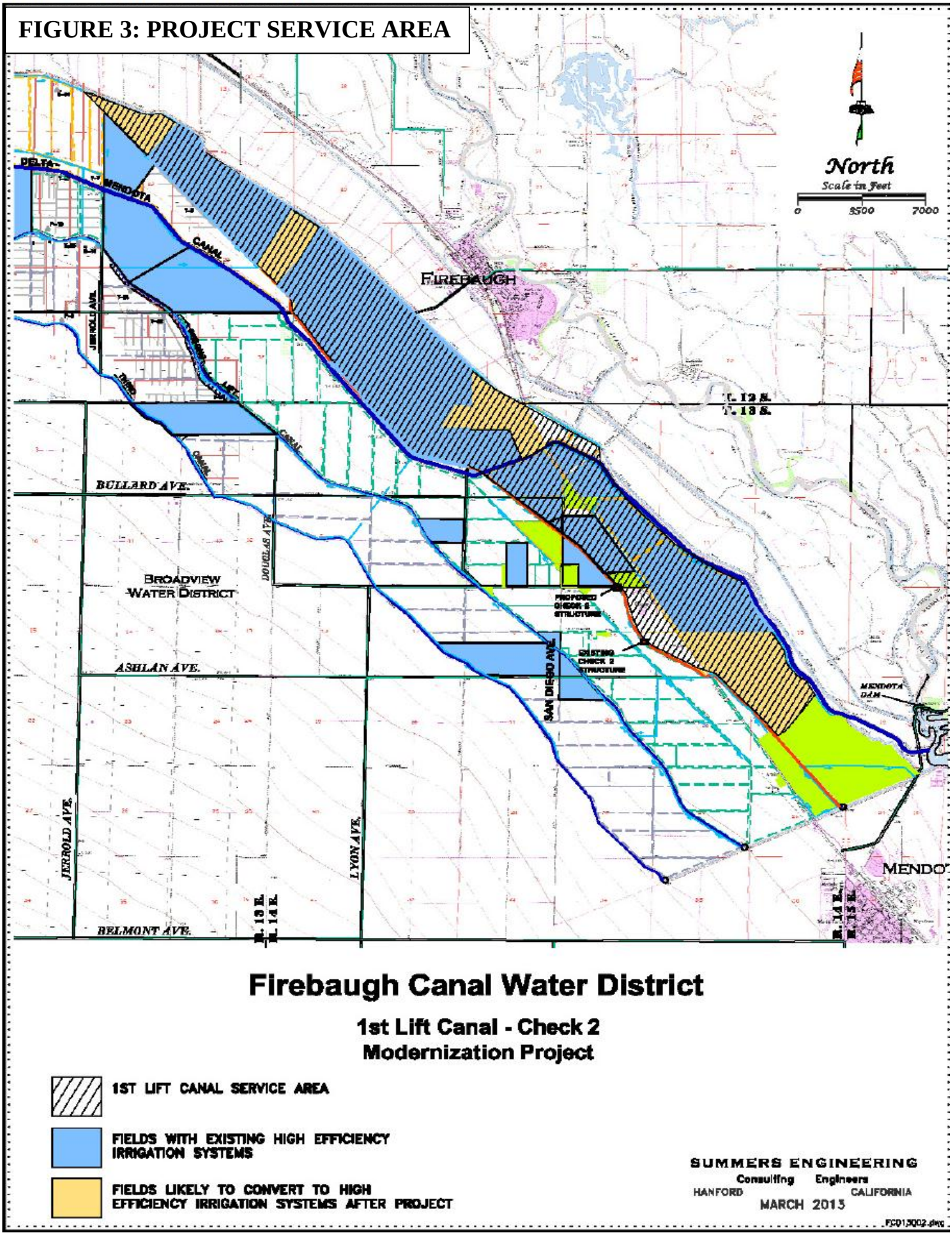
Impacts to the following resources were considered and found to be minor and/or absent. Brief explanations for their elimination from further consideration are provided below:

- Indian Sacred Sites: The Proposed Action is not on federal lands, and will not affect and/nor prohibit access to and ceremonial use of Indian sacred sites.

- Indian Trust Assets (ITA): There are no Indian reservations, rancherias, or allotments in the project area. The nearest ITA is Table Mountain, approximately 45 miles distance from the Project location. The Proposed Action does not have the potential to affect ITA.

- Environmental Justice: No significant changes in agricultural communities or practices would result from the Proposed Action, other than potential changes to individual irrigation systems. These changes are not likely to have effects to any individuals or populations within the action area. Accordingly, the Proposed Action would not have disproportionately negative impacts on low-income or minority populations within the Project area.

FIGURE 3: PROJECT SERVICE AREA



Firebaugh Canal Water District

1st Lift Canal - Check 2
Modernization Project

SUMMERS ENGINEERING
Consulting Engineers
HANFORD CALIFORNIA
MARCH 2013

Section 2 Proposed Action and Alternatives

2.1 No Action Alternative

The No Action Alternative would consist of Reclamation not providing grant funding to facilitate water conservation measures at FCWD. Although it is possible that FCWD may find alternative sources of funding for the Proposed Action, for the purposes of this EA, the consequence of Reclamation not funding the Proposed Action would be no construction of the Proposed Action. The irrigation system currently in place would continue to operate. FCWD would continue to provide irrigation service to the FCWD and its users via the unlined 1st Lift Canal. Leakage to the groundwater basin and loading of selenium, boron, and salts to the San Joaquin River via the GBP would continue at current levels.

2.2 Proposed Action

Reclamation proposes to award a Department of the Interior (DOI) Bay-Delta Restoration Program: CalFed Water Use Efficiency grant and Agricultural Water Conservation and Efficiency grant to the FCWD to fund a portion of the Project. The Project would involve lining approximately two miles of FCWD's unlined, earthen 1st Lift Canal with concrete from the Shaw Avenue crossing to the DMC (see Figure 4). In addition to the lining, Check 2 on the 1st Lift Canal, an antiquated, obsolete timber weir (see Figure 5), would be relocated and modernized with an automated reinforced concrete check structure installed with stainless steel sluice gates and motorized operators that would be integrated into the District's SCADA system, just upstream of Shaw Avenue. The Proposed Action would not result in a change to the acreage served by the FCWD facilities nor would the system's capacity be increased.

FIGURE 4: 1st Lift Canal from DMC Crossing– facing upstream

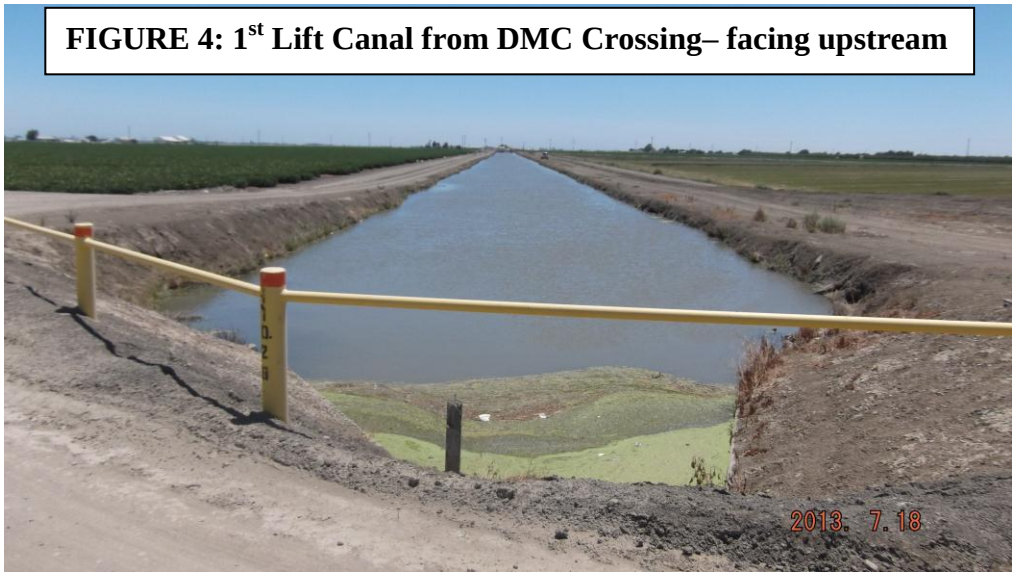


FIGURE 5: Check 2 Timber Weir – facing upstream

Construction Activities would include (see Appendix A for engineer drawings):

- **1st Lift Canal Lining Phase II**:

    - Pre-Project Work: Prior to canal lining installation, the existing canal will be dewatered, and dredged. This is a maintenance activity which would occur even without the project. However, it is necessary to remove the accumulated silt well before the start of construction so that it can dry out. This work will be performed with up to three excavators and one grader, and will take approximately three weeks. This work will be separate from the Project. Construction stakes will be placed along the alignment.

    - Site Cleanup: Site cleanup work includes removal of all debris, rip-rap, and existing turnout structures for the canal alignment. Two turnouts on the canal located between the DMC crossing and Bullard Avenue will be removed completely. Two or three excavators will be used to remove these materials, which will be deposited into two or three dump-trucks and hauled to the District's yard. Once these materials have been removed, the existing canal prism will be grubbed and shaped in preparation for the soil stabilization work.

    - Soil Stabilization: Soils within the District are poorly drained expansive clays and groundwater level is typically within five feet of ground surface, resulting in a saturated and unstable subgrade in its natural condition. To address this, the subgrade immediately below the canal lining will be treated with a lime/soil-cement combination to form a stable base upon which embankment can be placed and compacted. The existing soil condition will be evaluated to determine the best mix of additives after which, the appropriate amount of lime/soil-cement will be mixed into the native soil and excavated silt. Two special mixing vehicles will be used for this process.

- Compacted Embankment: After the soil stabilization process is complete, the treated soil will be placed in the existing canal prism with two to four excavators and compacted with one to three sheep's-foot compactors to the final design grade. Backfill will be performed in lifts to ensure proper soil density and moisture levels. Surveyed construction stakes will be placed along the project alignment and final grade will be checked against those stakes. The total compacted embankment placed is estimated to be in the vicinity of 20,000 cubic yards.

- Canal Prism Excavation: The canal prism will be excavated with a special trimmer to approximately 10' bottom-width and 6' deep with 1 ½ :1 side slopes giving it a total width of 28'. In spots the new bottom will be approximately two feet deeper than the existing bottom Excavated material will be deposited on the canal banks and graded to form the canal road. A water truck may also be used to maintain soil moisture during this process. After successful prism construction, concrete lining will be installed.

- Placement of Concrete Lining: Once the canal prism has been trimmed to design cross-section and grade with 1 ½ : 1 slopes, concrete lining will be placed along the alignment. A slip-form sled built to match the design cross-section will be dragged along the alignment by a tractor and will be fed concrete from ready-mix trucks which follow on both sides. The sled spreads the concrete to a uniform thickness and provides rough finish to the lining. A crew of laborers follows the sled and use trowels and floats to produce a smoother final finish. Prism excavation and lining placement may be done in sections to prevent the excavated prism from drying out or becoming oversaturated due to rain.

- Turnout Installation: Four new turnout structures will be reinstalled and re-connected to grower irrigation systems. At each turnout location, the newly placed lining will be broken out, a turnout structure will be placed and backfilled, and new lining will be placed to connect the structure with the canal. The structures will be pre-cast concrete boxes (approximately 4' wide x 6' tall x 6' deep) with standard canal gates to control flow. A 24" PVC pipe will connect the structure with the grower's irrigation system. An excavator will be used to break out the concrete lining, excavate the hole and trench for the turnout, place the structure, and backfill.

- Transition Lining: Approximately 10 feet upstream and downstream of each road crossing, 4" thick, hand placed concrete lining will be used to transition from the design canal prism to the crossing structure. This lining will be field-fit according to the geometry and alignment of the crossing compared to the canal design prism. An excavator will be used to shape and compact the transition area and concrete lining will be hand placed by three to five laborers.

- Barstow Avenue Crossing Headwalls: Where the Barstow Avenue alignment crosses the 1st Lift Canal, there is a 48" concrete double-barrel pipe culvert with

FIGURE 6: Barstow Ave. Sinkhole

an approximately 2 ½ ft. sinkhole at the middle edge of the crossing (see Figure 6). As part of the proposed Project, new headwalls will be constructed on the upstream and downstream face of the crossing, also requiring excavation of approximately 28' wide to match the canal top width. This will involve excavating and shaping for the headwalls, placement of timber forms and reinforcement, pouring concrete, stripping of forms and backfill and compaction. The excavating and backfill work will be performed by an excavator and all other work will be performed by two to four laborers. The concrete placement will likely be done in two pours, with the footings being poured first followed by the headwalls.

- **<u>Check 2 Modernization</u>**:

  - <u>Removal of Existing Check</u>: The existing Check 2 is a timber weir located on the 1st Lift Canal approximately 0.8 miles upstream of Shaw Avenue. This structure will be demolished by an excavator and removed from the site by a dump truck. This work is expected to take one day.

  - <u>Cleanout and Shaping of New Check Site</u>: The new Check 2 will be located on the 1st Lift Canal, just upstream of Shaw Avenue crossing (at the beginning of the Phase II lining). Prior to construction, the new site will be cleaned of rip-rap, silt and debris. There are two turnout structures just downstream of the new check location near the Shaw Avenue culvert that will be relocated upstream of the new location (see Figure 7), and an abandoned sill wall will be removed. The base will be over-excavated approximately 12" and backfilled with suitable subgrade. This work will be performed by an excavator over two days. Debris will be hauled off by a dump truck and silt will be spread along the canal banks with a roller.

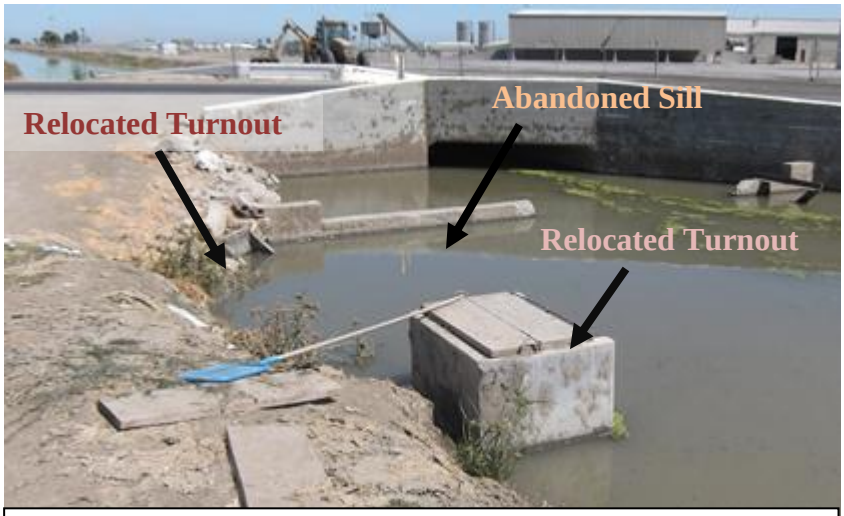


FIGURE 7: Structures at Shaw Ave to be Relocated/Removed Upstream of New Check

  - <u>Placement of Forms and Reinforcement</u>: Placement of forms will include construction of wood formworks to shape the various structure components. Once

timber forms are constructed, reinforcement according to the design requirements will be placed and tied. After the forms and reinforcement are placed, concrete will be poured, vibrated, and allowed to cure (typically three to five days) before the forms are stripped. This process will likely repeat itself three times, beginning with the footings, then the walls, and finally the top deck. Estimated total volume of concrete is 60 cubic yards.

- Gate Installation: Once the concrete has been cured and forms stripped, the two flow control gates will be installed. These will be 6' stainless steel fabricated undershot gates, which will be anchored to the upstream face of the structure. The gates will be connected to a motorized actuator, which will be integrated with the District's SCADA system, allowing remote monitoring and control. Gate installation will involve a backhoe to hold and support the gate during installation, and three to five laborers for installation, wiring, and programming.

- Transition Lining: Hand-placed lining will be installed approximately 10 feet upstream of the structure for erosion protection. On the downstream face, hand-placed lining will be installed from the new check location to the Shaw Avenue crossing. Approximately 900 square feet of lining is expected to be installed.

- SCADA: The existing SCADA system will be relocated to just upstream and downstream of the new Check 2 location.

Ground disturbance for installation of the concrete lining, replaced turnouts, and modernized check structure would be limited to the canal prism. All of the work involved with the Project would be performed in previously disturbed contexts, regularly-maintained canal infrastructure, and/or concrete structures. Construction activities would take approximately four months, between October and January 2013-2014, to complete.

Section 3 Affected Environment and Environmental Consequences

3.1 Water Resources

3.1.1 Affected Environment

The FCWD's water supply is almost entirely surface water from the Delta via the DMC and Mendota Pool. The FCWD is also underlain by a shallow saline aquifer which is high in dissolved salts, boron, and selenium, all of which are considered constituents of concern by the Central Valley Regional Water Quality Control Board (CVRWQCB). This shallow water table is managed through on-farm subsurface (tile) drainage systems and regional deep drains that intercept seepage from irrigation and unlined canal systems. Under the current conditions the 1st Lift Canal contributes to the shallow water table in the form of seepage. The tile systems within the District contribute an average 4,000 AF of saline subsurface drain water to the GBP annually. FCWD lies within the GDA and is a participating agency in the GBP. Subsurface drain water is

currently discharged to the San Joaquin River and eventually to the Sacramento – San Joaquin River Delta (Delta) via the GBP. Each AF of drainage contains an average 0.25 lbs of selenium, 18 lbs of boron, and 3.3 tons of salt.

Currently the 1st Lift Canal contributes approximately 278 afy of subsurface irrigation water to the groundwater supply through seepage. This estimate was derived from a seepage study performed in October 2011 on the FCWD's 1st Lift Canal for canal lining Phase I, which have similar conditions to Phase II (see Appendix B). The results of this study were used to determine the current seepage rate and to estimate the water conserved by the Project for future marketing.

The FCWD pumps approximately 4,000 afy from shallow groundwater wells primarily to reduce the production of subsurface drainage within the watershed, and the pumped groundwater is marketed to other districts as supplemental water supplies.

3.1.2 Environmental Consequences

No Action

Under the No Action Alternative, water resources would continue to be utilized consistent with the current conditions.

Proposed Action

The Proposed Action would line approximately two miles of existing earthen channel with concrete from Shaw Avenue to the DMC to reduce seepage. The reduction in the amount of seepage to the local perched water table would reduce the production of subsurface drain water, and ultimately the amount of water containing selenium, boron, and salt that is discharged to the Delta. Implementation of the Proposed Action would reduce seepage losses and potentially result in a reduction of an estimated 45 pounds of selenium, 5,600 pounds of boron, and 1,400 tons of salt each year that currently moves through the watershed.

In addition, the Check 2 modernization portion of the Proposed Action would improve the operational efficiency and flexibility on the entire 1st Lift Canal service area of 5,200 acres. The installation of automated flow control gates into the existing SCADA system allows for both motorized and manual control, enabling District staff to manage approximately 10,000 afy with remote monitoring and operation. This action could lead to the conversion to high-efficiency irrigation systems for the FCWD's two remaining growers within the service area that do not have these systems.

3.2 Air Quality

Section 176(c) of the Clean Air Act (CAA) (42 U.S.C. 7506(c)) requires that any entity of the federal government that engages in, supports, or in any way provided financial support for, licenses or permits, or approves any activity to demonstrate that the action conforms to the applicable State Implementation Plan (SIP) required under Section 110(a) of the Clean Air Act (CAA) (42 U.S.C. 7401(a)) before the action is otherwise approved. In this context, conformity means that such federal actions must be consistent with a SIP's purpose of eliminating or reducing the severity and number of violations of the National Ambient Air Quality Standards

(NAAQS) and achieving expeditious attainment of those standards. Each federal agency must determine that any action that is proposed by the agency and that is subject to the regulations implementing the conformity requirements will, in fact, conform to the applicable SIP before the action is taken.

3.2.1 Affected Environment

The Proposed Action lies within the San Joaquin Valley Air Basin (SJVAB), the second largest air basin in the State. Air basins share a common "air shed", the boundaries of which are defined by surrounding topography. Although mixing between adjacent air basins inevitably occurs, air quality conditions are relatively uniform within a given air basin. The SJVAB experiences episodes of poor atmospheric mixing caused by inversion layers formed when temperature increases with elevation above ground, or when a mass of warm, dry air settles over a mass of cooler air near the ground.

The SJVAB lies within the management area of the San Joaquin Valley Air Pollution Control District (SJVAPCD). Despite years of improvements, the SJVAB does not meet all State and Federal health-based air quality standards. NAAQS and California Ambient Air Quality Standards (CAAQS) have been established for the following criteria pollutants: carbon monoxide (CO), ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), inhalable particulate matter between 2.5 and 10 microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), and lead. The CAAQS also set standards for sulfates, hydrogen sulfide and visibility.

The SJVAB has reached NAAQS and CAAQS attainment status for all criteria pollutants except for O_3, PM_{10} (CAAQS only), and $PM_{2.5}$. As a result, the emissions of most concern are O_3 (which includes precursors such as volatile organic compounds [VOC] and nitrogen oxides ([NO_x]), PM_{10} and $PM_{2.5}$. Table 3-1 below shows the attainment status and *de minimis* threshold for general conformity for the criteria pollutants of most concern.

Table 3-1. SJVAB Attainment Status and *De Minimis* Thresholds for Federal Conformity Determinations

Pollutant	Attainment Status[a]	(tons/year)
VOC (as ozone precursor)	Nonattainment[d]	10[b]
NO_x (as an ozone precursor)	Nonattainment[d]	10[b]
PM_{10}	Nonattainment (CAAQS) Attainment (NAAQS)	15[c]
$PM_{2.5}$	Nonattainment	100 15[c]

[a] Source: http://www.arb.ca.gov/desig/adm/adm.htm
[b] 40 CFR 93.153 [c] SJVAPCD Threshold
[d] The SJVAB is designated as Extreme for O_3 NAAQS

3.2.2 Environmental Consequences

No Action

Under the No Action Alternative there would be no effect on conditions and trends in air quality within the SJVAB.

Proposed Action

Construction emissions would vary from day to day and by activity, depending on the timing and intensity of construction, and wind speed and direction. Generally, air quality impacts from the Proposed Action would be localized in nature and decrease with distance. Ground disturbing activities would result in the temporary emissions of fugitive dust and vehicle combustion pollutants during the following activities:

- Earthwork (site preparation, soil stabilization, structure removal, channel grading, trenching, compacting and stockpiling)
- Construction equipment and haul truck engine emissions

Standard best management practices (BMP), such as road-watering and vehicle maintenance will be employed to minimize these impacts. All construction work will occur on an existing facility which is surrounded by irrigated agriculture. Calculated emissions from the Proposed Action were estimated using the 2011 CalEEMOD software (version 2011.1.1), which incorporates emission factors for reactive organic gases (ROG), NO_x, CO, SO_2, and both fugitive and exhaust PM_{10}, and $PM_{2.5}$. Total project emissions are presented in Table 3-2 below.

Table 3-2. Estimated Project Emissions[a]

Pollutant	Construction (tons/year)
ROG/VOC	0.07
NO_x	0.54
PM_{10}	2.05
$PM_{2.5}$	0.23
Carbon dioxide equivalents	70.18 (MT/year)

[a] Source: CalEEMOD version 2011.1.1

As shown in Table 3-2, the Proposed Action has been estimated to emit less than the *de minimus* thresholds for NO_x, ROG/VOC as O_3 precursors, $PM_{2.5}$, and PM_{10}; therefore, a Federal general conformity analysis report is not required. Notwithstanding this observation, the Proposed Action would comply with the SJVAPCD's Regulation VIII (SJVAPCD 2012) control measures for construction emissions of PM_{10}. One of these control measures includes the use of water with all "land clearing, grubbing, scraping, excavation, land leveling, grading, cut and fill, and demolition activities" for fugitive dust suppression. However, if dust suppression measures are not implemented, the estimated emissions for $PM_{2.5}$ (0.24 tons/year) and PM_{10} (2.10 tons/year) would still be well below the respective thresholds.

3.3 Biological Resources

3.3.1 Affected Environment

For the purpose of this EA, biological resources include vegetation, wildlife, and waters of the United States. The FCWD encompasses approximately 22,000 acres on the Westside of the San Joaquin Valley in Fresno, California. The majority of the crops grown within the FCWD consist of cotton, alfalfa, tomatoes, wheat, barley, melons, pomegranates, pistachios, asparagus and onions. Development of land to irrigate crops has been the historic land use within the FCWD. Currently the Proposed Action area is annually excavated, graded, and sprayed for maintenance. In addition, irrigation, maintenance and harvesting occur throughout the surrounding area on an annual basis.

Potential Federally Listed Species in the Proposed Action Area

On July 9, 2013, a list of federally listed, proposed and candidate species potentially occurring within the Proposed Action area and surrounding areas was obtained from the Service's website. The following Table 3-3 includes federally listed species potentially occurring within the Firebaugh and its surrounding Mendota Dam, Tranquillity, Coit Ranch, Broadview Farms, Oxalis, Poso Farm, and Firebaugh NE USGS 7.5-minute Quadrangles. Also included is a brief identification of each species habitat, their status, a determination of effects from the Proposed Action as required by ESA section 7, and a summary of the rationale supporting the determination.

Table 3-3: Federally Listed Species Identified as Potentially Occurring in the Firebaugh USGS 7.5-minute Quadrangle

Scientific Name	Common Name	Federal Status	Effects	Potential habitat utilized by species in Proposed Action Area
INVERTEBRATES				
Lepidurus packardi	Vernal pool tadpole shrimp	E	NE	**Absent**. No vernal pool habitat in the Proposed Action area. No vernal pool habitat would be disturbed. Water quality of vernal pools would not be affected.
Desmocerus californicus dimorphus	Valley elderberry longhorn beetle	T	NE	**Absent**. No suitable habitat in the Proposed Action area. No elderberry shrubs would be disturbed.
AMPHIBIANS				
Ambystoma californiense	California tiger salamander, central population	T	NE	**Absent.** No vernal pool habitat or other suitable wetland habitat in the Proposed Action area. No disturbance to wetland habitat or change to water quality of their habitat.

Scientific Name	Common Name	Federal Status	Effects	Potential habitat utilized by species in Proposed Action Area
Rana draytonii	California red-legged frog	T	NE	**Absent.** Species absent from San Joaquin Valley floor and from vicinity of the Proposed Action area. No suitable habitat in the Proposed Action area. No change to wetland or riparian habitat.
REPTILES				
Gambelia sila	Blunt-nosed leopard lizard	E	NE	**Absent**. No suitable habitat in the Proposed Action area. No suitable habitat would be disturbed.
Thamnophis gigas	Giant garter snake (GGS)	T	NE	**Absent**. No disturbance to aquatic habitat would occur. The vast majority of the potential habitat within 200 feet of the First Lift Phase 2 Alignment was deemed to be unsuitable for and/or incapable of supporting Giant garter snake (GGS). There are no records of GGS within the Proposed Action area, with the closest occurrences between 10 and 20 miles of the Project. There is no suitable upland habitat for denning, and the action would occur during the inactive period for GGS.
MAMMALS				
Dipodomys ingens	Giant kangaroo rat	E	NE	**Absent**. No suitable habitat in the Proposed Action area. No suitable habitat would be disturbed.
Dipodomys nitratoides exillis	Fresno kangaroo rat	E	NE	**Absent**. Possibly extirpated; no records for this subspecies recorded since 1992. No suitable habitat in the Proposed Action area. No disturbance of suitable habitat.
Vulpes macrotis mutica	San Joaquin kit fox (SJKF)	E	NLAA	**Absent.** Two records in Proposed Action Area. The closest record is approximately 2.11 miles away; however, it is 23 years-old and nothing more recent in the area is in the database. No suitable habitat, burrows, or dens detected in or adjacent to the Project site during biological survey performed on July 28, 2013. The possibility exists that SJKF could use the area as a movement corridor and avoidance measures would be implemented during construction to avoid potential effects to SJKF.

Key:

(PE) Proposed Endangered – Proposed in the Federal Register as being in danger of extinction
(PT) Proposed Threatened – Proposed as likely to become endangered within the foreseeable future
(E) Endangered– Listed in the Federal Register as being in danger of extinction
(T) Threatened – Listed as likely to become endangered within the foreseeable future
(C) Candidate – Candidate which may become a proposed species
(NE) No Effect – Proposed Action will have no effect on the species
(NLAA) Not Likely to Adversely Affect – Proposed Action may affect the species, but is not likely to adversely affect.

Species Protected Under the Migratory Bird Treaty Act

Swainson's hawks (*Buteo swainsoni)* are known to nest within the vicinity of the action area, which also contains suitable foraging habitat. The California Natural Diversity Database contains three records of Swainson's hawk all within approximately 2.5 miles from the Project site, and a new site was discovered within 0.65 miles of the site during a biological survey conducted on July 28, 2013. There is also potential for other raptors protected by the MBTA to nest in trees within the action area, mostly within the residential/commercial areas.

3.3.2 Environmental Consequences

No Action

Under the No Actin Alternative, biological resources would not change from their current conditions in the FCWD.

Proposed Action

The Proposed Action would involve the placement of compacted embankment and excavation of earth to trim the canal to the required cross-section, as well as the destruction of a timber weir and installation of a new automated check structure just upstream of Shaw Avenue. All work would be performed within the footprint of the existing canal and no current land use or FCWD's operations would be altered. Lands surrounding the Proposed Action are either actively farmed or contain farm support facilities (such as shops and farm houses). The Proposed Action would not disturb or impact any wetlands or habitat and there would not be any discharges to water bodies during the Proposed Action activities. The Proposed Action area is annually excavated, graded, and sprayed for maintenance purposes resulting in the absence of sufficient habitat required to support special-status species that historically might have utilized and/or inhabited the Proposed Action area. Based on the habitat requirements of the listed species that could potentially occur within the Proposed Action area, the Proposed Action does not provide suitable habitat for the Vernal pool fairy shrimp, Valley elderberry longhorn beetle, blunt-nosed leopard lizard, California red-legged frog, Delta smelt, Central Valley steelhead, Giant kangaroo rat, and the Fresno kangaroo rat. Therefore, these species are not discussed in this section.

Though occurrences of neither listed sensitive species nor migratory birds have been observed during the implementation of previous projects within the FCWD area, an analysis of potential impacts and associated avoidance measures for GGS, San Joaquin kit fox (SJKF), and Swainson's hawk are discussed below due to the Proposed Action area providing a potential migratory corridor or nesting sites in surrounding areas that could conceivably be utilized by these species.

Giant Garter Snake

GGS inhabits agricultural wetlands and other waterways such as irrigation and drainage canals, sloughs, ponds, small lakes, low gradient streams, and adjacent uplands in the Central Valley (USFWS 1999). Habitat requirements for GGS consist of (1) adequate water during the snake's active season (early-spring through mid-fall) to provide food and cover; (2) emergent, herbaceous wetland vegetation, such as cattails and bulrushes, for escape cover and foraging habitat during the active season; (3) grassy banks and openings in waterside vegetation for basking; and (4) higher elevation uplands for cover and refuge from flood waters during the snake's dormant season in the winter (USFWS 2009). Although the Proposed Project area does not contain suitable GGS habitat, it could be a movement corridor for snakes. Potential impacts to the GGS could be a disruption in their migration if the Proposed Action were to be constructed during the migratory season. However, construction would occur during the non-migratory season (October-January) when GGS are dormant and would not be migrating. Limiting work to the inactive period significantly reduces the potential for impact. In addition, there are no wetlands within the Proposed Action area that would attract GGS. The vast majority of the potential habitat within 200 feet of the Project site (namely, the First Lift Canal itself) was deemed to be unsuitable for and/or incapable of supporting GGS as a result of a field survey performed for GGS (Hansen). The approximately 0.6 acre of the DMC falling within 200 feet of the northwestern end of the Project site was classified at the bottom end of the marginal range and, likewise, is unlikely to support GGS. Although six historical GGS records fall within 10 miles of the Project site, none have been verified as extant since 1976 despite repeated surveys at each of these locations in 1995. Of the six historical GGS records falling between 10 and 20 miles of the Project site, only two have been verified as extant in the last five years, and GGS appear to be very scarce at these sites. Given the general character of the landscape surrounding the Project site (row crops and other land uses incapable of supporting GGS), which has changed dramatically in recent decades with a 60 percent reduction in rice acreage since 1988, GGS snake presence at the Project site is highly unlikely. The Proposed Action area would be restored to pre-project conditions and, therefore, no indirect effects would occur as a result of the Proposed Action. Reclamation has determined that the Proposed Action would have no effect on GGS.

San Joaquin Kit Fox

Kit fox are an arid-land-adapted species and typically occur in desert-like habitats in North America. Such areas have been characterized by sparse or absent shrub cover, sparse ground cover, and short vegetative structure. The subspecies historically ranged in alkali scrub/shrub and arid grasslands throughout the level terrain of the San Joaquin Valley floor from southern Kern County north to Tracy in San Joaquin County, and up into more gradual slopes of the surrounding foothills and adjoining valleys of the interior Coast Range. Within this range, the kit fox has been associated with areas having open, level, sandy ground that is relatively stone-free to depths of about 3 – 4.5’. The SJKF utilizes subsurface dens, which may extend to 6’ or more below ground surface, for shelter and for reproduction. Kit fox subspecies are absent or scarce in areas where soils are shallow due to high water tables, impenetrable hardpans, or proximity to parent material, such as bedrock. The kit fox also does not den in saturated soils or in areas subjected to periodic flooding. Reproductive success appears to be correlated with prey abundance.

Terrestrial habitat in the FCWD is intensively managed for agriculture and the landscape is highly disturbed (e.g. through land preparation, planting, irrigation and harvesting). Areas that are not cropped are kept barren and free of weeds, limiting areas for potential prey species. These conditions limit invertebrate prey, which are relatively scarce in crop fields. There are few opportunities for rodents to burrow in fields and for burrows to persist because of frequent irrigation practices. Because burrowing mammals are not present in the area, the availability of shelter within the Proposed Action area is unlikely. The Proposed Action area does not provide suitable habitat for potential prey (such as kangaroo rats) due to the high intensity agriculture practices within the FCWD and surrounding lands. In addition, the Proposed Action area would be restored to pre-project conditions and, therefore, no indirect effects would occur as a result of the Proposed Action.

Although the Proposed Project area does not contain suitable habitat for SJKF, it could potentially be utilized as a movement corridor. Avoidance and minimization measures would be implemented by FCWD if there is detection of the species utilizing the Proposed Action area as a migratory corridor.

Avoidance and Minimization Measures for SJKF

As part of the Proposed Action, preconstruction surveys for SJKF will be completed per the Service's 2011 *Standardized Recommendations* no less than 14 days and no more than 30 days prior to the onset of any ground or vegetation-disturbing activity during the life of the project. Service-approved biologists will survey the areas subject to surface disturbance for the presence of kit fox dens. In addition, the following measures (derived in part from the Service's 2011 *Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance*) will be implemented by FCWD to avoid and/or minimize potential affects to SJKF:

- All project-related vehicle traffic will be restricted to established roads, construction areas, and other designated areas. In order to reduce impacts by project-related vehicles, workers will observe the following:
    - Maintain a daytime speed of 20-mph throughout the site
    - Construction is limited to daytime hours, defined as no earlier than 30 minutes after sunrise and no later than 30 minutes before sunset.
- Inadvertent entrapment will be prevented via the following activities:
    - Cover all excavated, steep-walled holes or trenches more than two feet deep with plywood or similar materials at the close of each working day.
    - Construct one or more escape ramps of earthen-fill or wooden planks if the trenches cannot be closed.
    - Thoroughly inspect all construction pipes, culverts, or similar structures with a diameter of four inches or greater that are stored at a construction site for one or more overnight periods before the pipe is subsequently buried, capped or otherwise used or moved in any way. If a kit fox is discovered inside a pipe, the kit fox shall not be harassed and that section of the pipe shall not be moved until the kit fox has vacated the pipe and left the area.

- All food-related trash items will be disposed of in securely closed containers and removed at least once a week from the project site.

An employee education program will be conducted by a qualified biologist consisting of a brief presentation in kit fox biology and legislative protection to explain endangered species concerns to contractors, their employees, and agency personnel involved in the project. The program will include a description of the SJKF and its habitat needs, an explanation of the status of the species and its protection under the Endangered Species Act, and a list of measures being implemented to avoid and minimize the chance of impacts to the species during project construction and implementation. A fact sheet conveying this information will be provided to project personnel.

Although the Proposed Action area does not contain the necessary habitat for the SJKF, it is conceivable that they could utilize the FCWD as a movement corridor. With implementation of the previously described avoidance and minimization measures for the SJKF, Reclamation has determined that the Proposed Action may affect, but is not likely to adversely affect the SJKF.

Swainson's Hawk

Project-related noise from ground-disturbance and equipment engines could have indirect impacts on Swainson's hawks and other raptors. Noise impacts could cause adults to abandon the nests too early and leave any eggs or chicks vulnerable. However, the project construction timeframe is October – January, outside both the period Swainson's hawks are typically found in the Central Valley and the active nesting season. If construction activities must occur between February 1 and August 31, a qualified biologist will conduct pre-construction surveys for active raptor nests on and adjacent to the action area, where appropriate, within 30 days of ground disturbing activities. Surveys for Swainson's hawk nests would extend out to 1/4 mile from the action area. If an active nest is located within 1/4 mile of the action area, then FCWD will consult with the California Department of Fish and Wildlife to identify a suitable construction-free buffer around the nest. The buffer(s) will be identified on the ground with flagging, fencing or by other easily visible means, and will be maintained until a biologist has determined that the young have fledged. With construction activities occurring outside of the nesting period and pre-construction surveys being taken if construction runs into February, potential impacts to Swainson's hawk and other raptors protected by the MBTA would be avoided and not reach the level of take.

The Proposed Action would not result in a significant change in the surrounding environment and would not result in short-term or long-term adverse impacts to biological resources. However, by reducing the seepage contribution to the local perched water table, the Proposed Action would reduce the production of subsurface drain water which is currently discharged to the San Joaquin River and eventually to San Joaquin/Sacramento Delta thus providing possible habitat benefits in the surrounding area. In addition, the FCWD has completed multiple canal lining projects within the district. These previous projects objectives were successful and no impacts to species were documented.

3.4 Cultural Resources

Cultural resources is a broad term that includes prehistoric, historic, architectural, and traditional cultural properties. The National Historic Preservation Act (NHPA) of 1966 is the primary Federal legislation that outlines the Federal Government's responsibility to cultural resources. Section 106 of the NHPA requires the Federal Government to take into consideration the effects of an undertaking on cultural resources listed on or eligible for inclusion in the National Register of Historic Places (NRHP). Those resources that are on or eligible for inclusion in the NRHP are referred to as historic properties.

The Section 106 process is outlined in the Federal regulations at 36 Code of Federal Regulations (CFR) Part 800. These regulations describe the process that the Federal agency (Reclamation) takes to identify cultural resources and the level of effect that the proposed undertaking will have on historic properties. In summary, Reclamation must first determine if the action is the type of action that has the potential to affect historic properties. If the action is the type of action to affect historic properties, Reclamation must identify the area of potential effects (APE), determine if historic properties are present within that APE, determine the effect that the undertaking will have on historic properties, and consult with the State Historic Preservation Office, to seek concurrence on Reclamation's findings. In addition, Reclamation is required through the Section 106 process to consult with Indian Tribes concerning the identification of sites of religious or cultural significance, and consult with individuals or groups who are entitled to be consulting parties or have requested to be consulting parties.

3.4.1 Environmental Consequences

No Action

Under the No Action Alternative, there would not be an undertaking as defined by Section 301 of the NHPA. The condition of cultural resources would be the same as under the existing conditions. No impacts to cultural resources are associated with this No Action Alternative.

Proposed Action

The Proposed Action would allow the expenditure of Federal funds to FCWD. There will be no new construction and there are no proposed activities resulting in new ground disturbance. The implementation of the Proposed Action has no potential to cause effects to historic properties pursuant to 36 CFR Part 800.3(a)(1). Because the Proposed Action has no potential to cause effects to historic properties, the project will have no impact on cultural resources.

In the unlikely event that cultural resources or human remains are identified during the implementation of this project there may be additional considerations pursuant to Section 106 of the NHPA. If inadvertent discoveries of cultural resources or human remains occur during project implementation, work shall temporarily stop and Reclamation cultural resources staff shall be contacted immediately.

3.5 Cumulative Impacts

According to the CEQ regulations for implementing the procedural provisions of NEPA, a cumulative impact is defined as *the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions*. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.

Greenhouse gas (GHG) impacts are considered to be cumulative impacts since any increase in GHG emissions would add to the existing inventory of gases that could contribute to climate change. The estimated GHG emission due to temporary Project construction activities is 70.18 metric tons of carbon dioxide equivalents. There are no on-going operational emissions from the Project.

There are no other known past, present, and reasonably foreseeable future actions that would cumulatively result in significant impacts to the human environment when taking into consideration the actions analyzed within this EA

Section 4 Consultation and Coordination

4.1 Public Review Period

Reclamation intends to sign a Finding of No Significant Impact for this project, and will make the EA available for a two week period beginning September 26, 2013. All comments will be addressed in the FONSI. Additional analysis will be prepared if substantive comments identify impacts that were not previously analyzed or considered.

4.2 Endangered Species Act (16 USC § 1531 et seq.)

Section 7 of the ESA requires Federal agencies, in consultation with the Secretary of the Interior, to ensure that their actions do not jeopardize the continued existence of endangered or threatened species, or result in the destruction or adverse modification of the critical habitat of these species.

In a memo dated July 16, 2013, Reclamation requested written concurrence from the Service that the Proposed Action is not likely to adversely affect the SJKF. A response has not been received to date.

4.3 National Historic Preservation Act (16 USC § 470 et seq.)

The NHPA of 1966, as amended (16 USC 470 et seq.), requires that federal agencies give the Advisory Council on Historic Preservation an opportunity to comment on the effects of an

undertaking on historic properties, properties that are eligible for inclusion in the NRHP. The 36 CFR Part 800 regulations implement Section 106 of the NHPA. Section 106 of the NHPA requires federal agencies to consider the effects of federal undertakings on historic properties, properties determined eligible for inclusion in the NRHP.

Reclamation will initiate consultation with the California State Historic Preservation Officer (SHPO) on the finding of no adverse effect to historic properties by September 26, 2013. Pursuant to 36 CFR §800.5(c), the SHPO has 30 days from receipt of a project to review an agency finding. If after 30 days the SHPO has not responded, §800.5(c)(1) states that "…the agency official may proceed after close of the 30 day review period if the SHPO/THPO has agreed with the finding or has not provided a response…and the agency official shall then carry out the undertaking in accordance with paragraph (d)(1) of this section."

Section 5 References

California Emissions Estimator MODel (CalEEMOD). 2011. Windows Version 2011.1.1. July 24, 2013.

Hansen, Eric. Memo to Summers Engineering, Sacramento, CA. 22 Jul 2013.

SJVAPCD. 2012. Rules and Regulations. Regulation VII. Website: http://www.valleyair.org/aqinfo/attainment.htm. Accessed: July 24, 2013.

U.S. Fish and Wildlife Service (USFWS). 1997. Appendix C Standard Avoidance and Minimization Measures During Construction Activities in Giant Garter Snake (*Thamnophis gigas)* Habitat. Sacramento, CA.

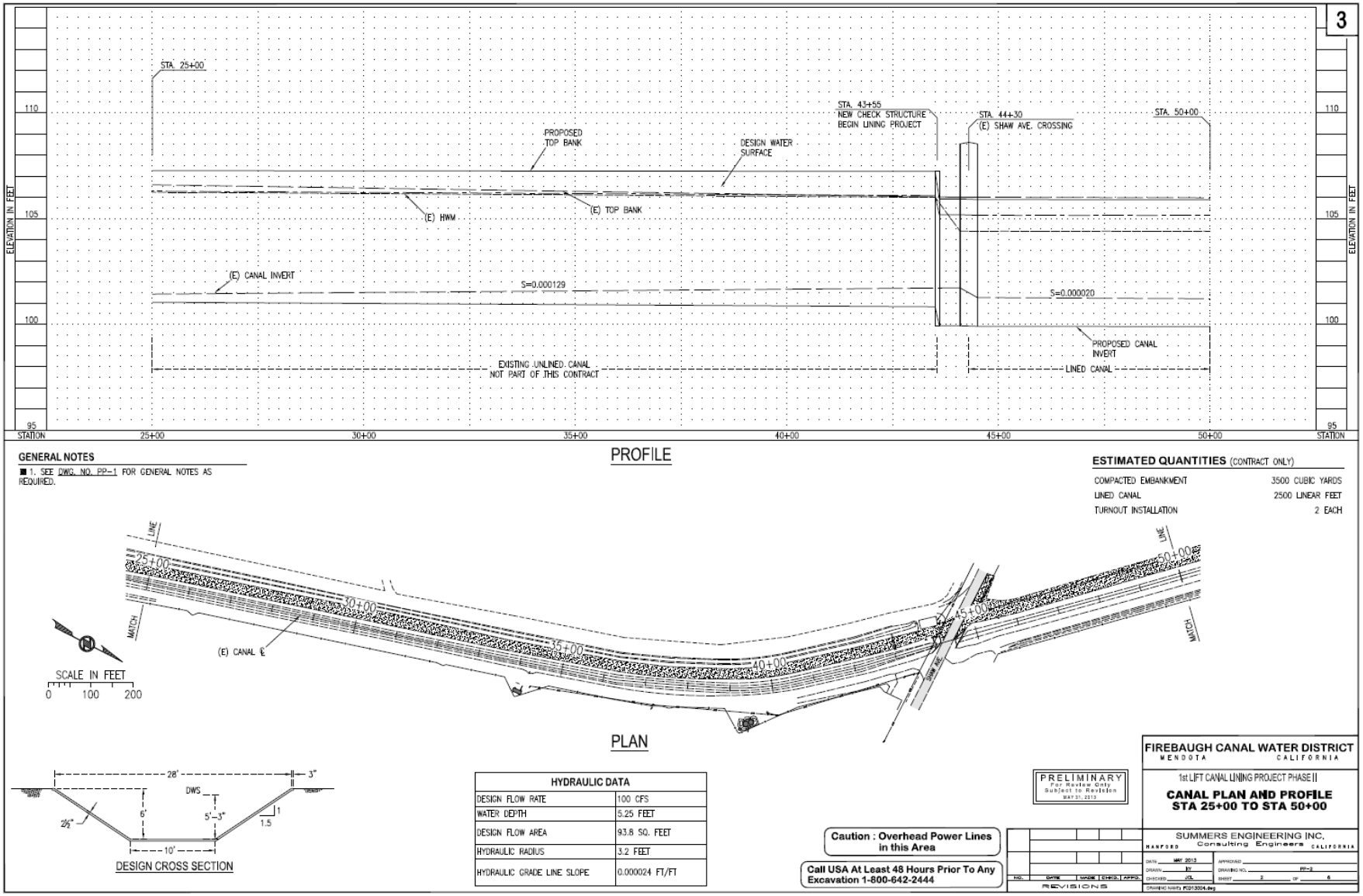
USFWS. 1999. Draft Recovery Plan for the Giant Garter Snake (*Thamnophis gigas*). Portland, Oregon. Ix+ 192 pp.

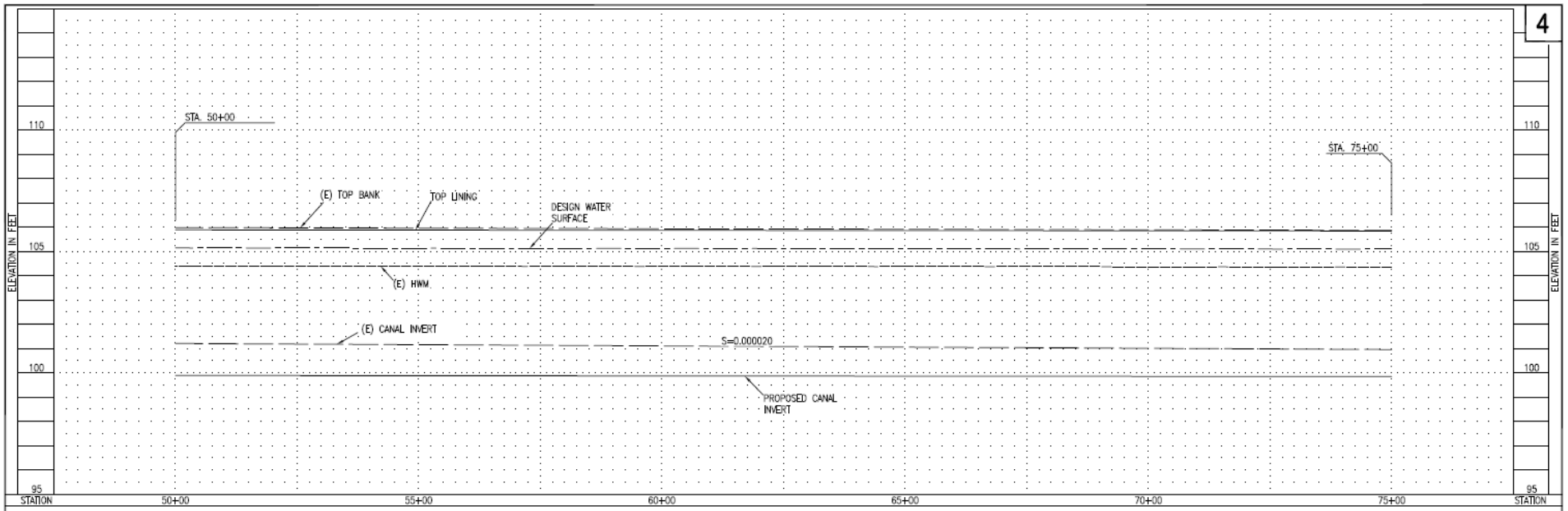
USFWS. 2009. Species Account. Giant Garter Snake. U.S. Fish and Wildlife Service. May 13, 2009.

USFWS. 2011. Standardized Recommendations for Protection of the San Joaquin Kit Fox Prior to or During Ground Disturbance. Sacramento, CA.

USFWS. 2013. Sacramento Fish and Wildlife Office. Endangered Species List. http://www.fws.gov/sacramento/. Accessed: July 23, 2013.

Appendix A – Engineer Drawings

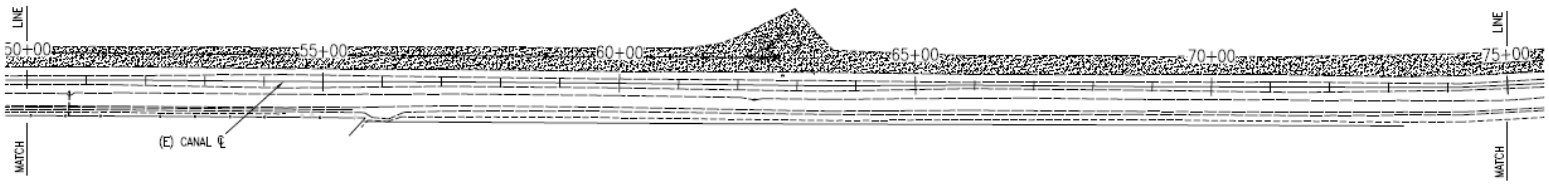




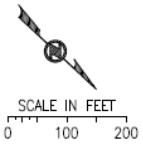
PROFILE

GENERAL NOTES

■ 1. SEE DWG. NO. PP-1 FOR GENERAL NOTES AS REQUIRED.



PLAN



PRELIMINARY
For Review Only
Subject to Revision
MAY 31, 2013

Caution : Overhead Power Lines in this Area

Call USA At Least 48 Hours Prior To Any Excavation 1-800-642-2444

REVISIONS

NO.	DATE	MADE	CHKD.	APPD.

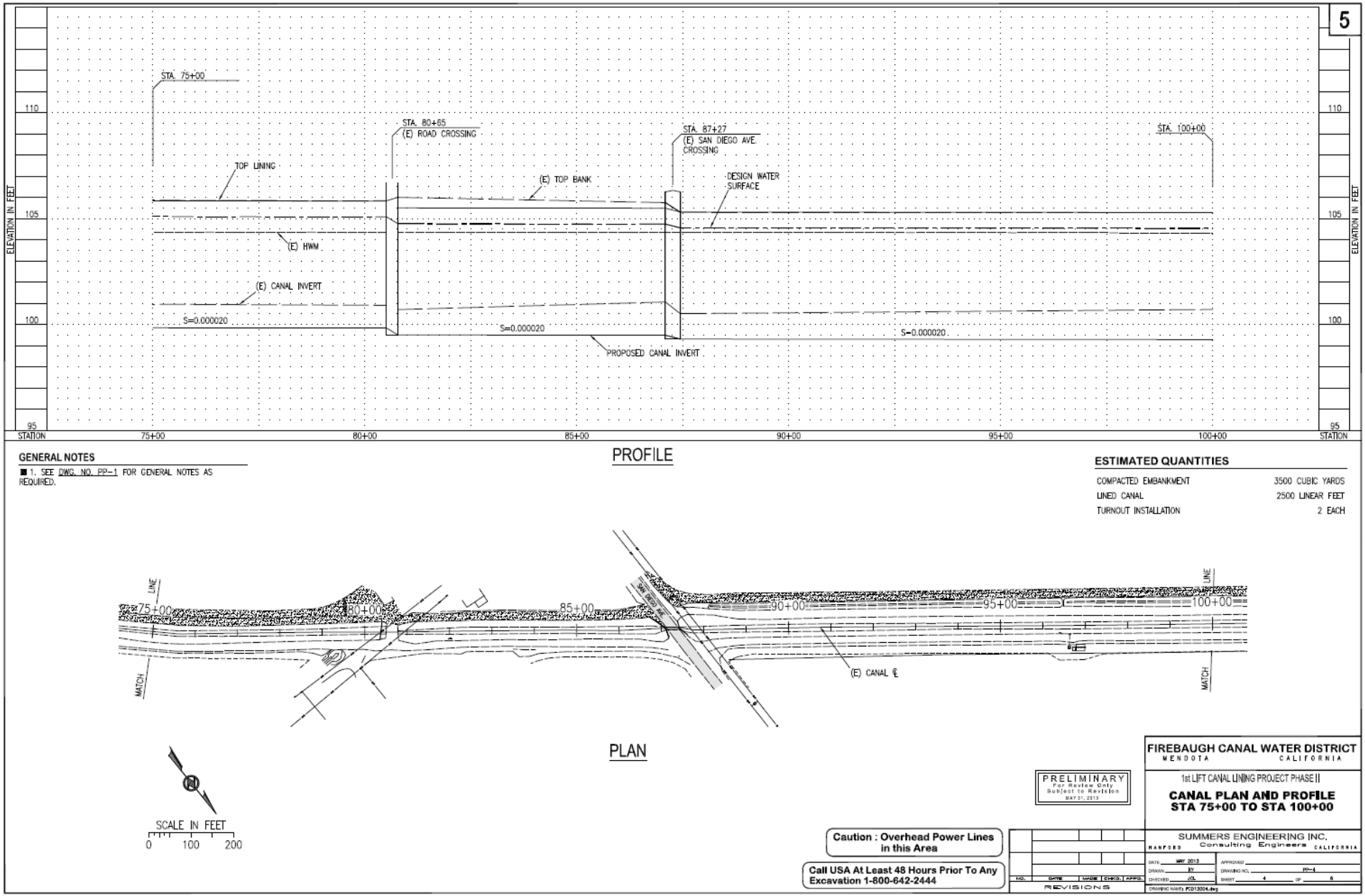
FIREBAUGH CANAL WATER DISTRICT
MENDOTA CALIFORNIA

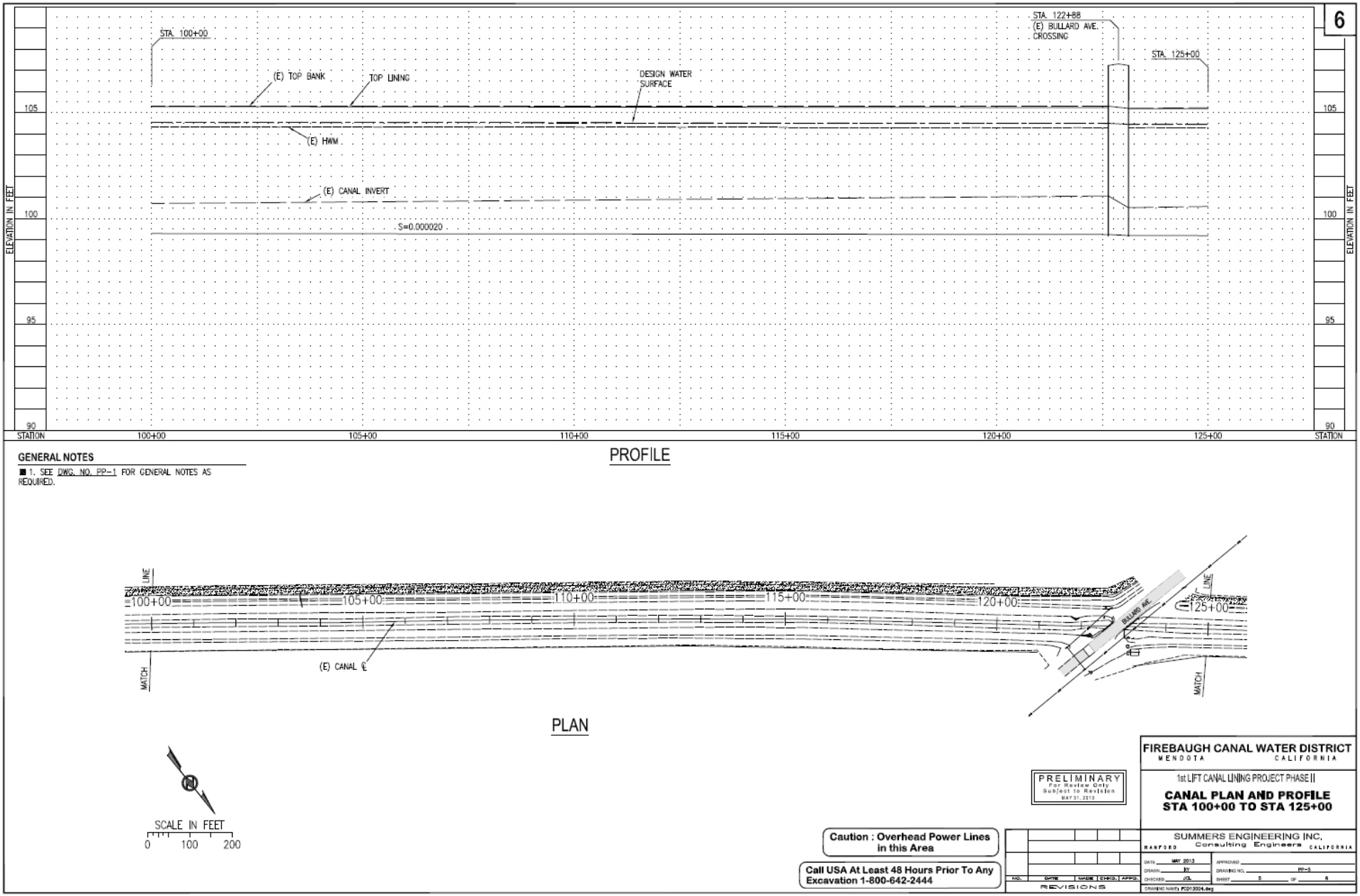
1st LIFT CANAL LINING PROJECT PHASE II

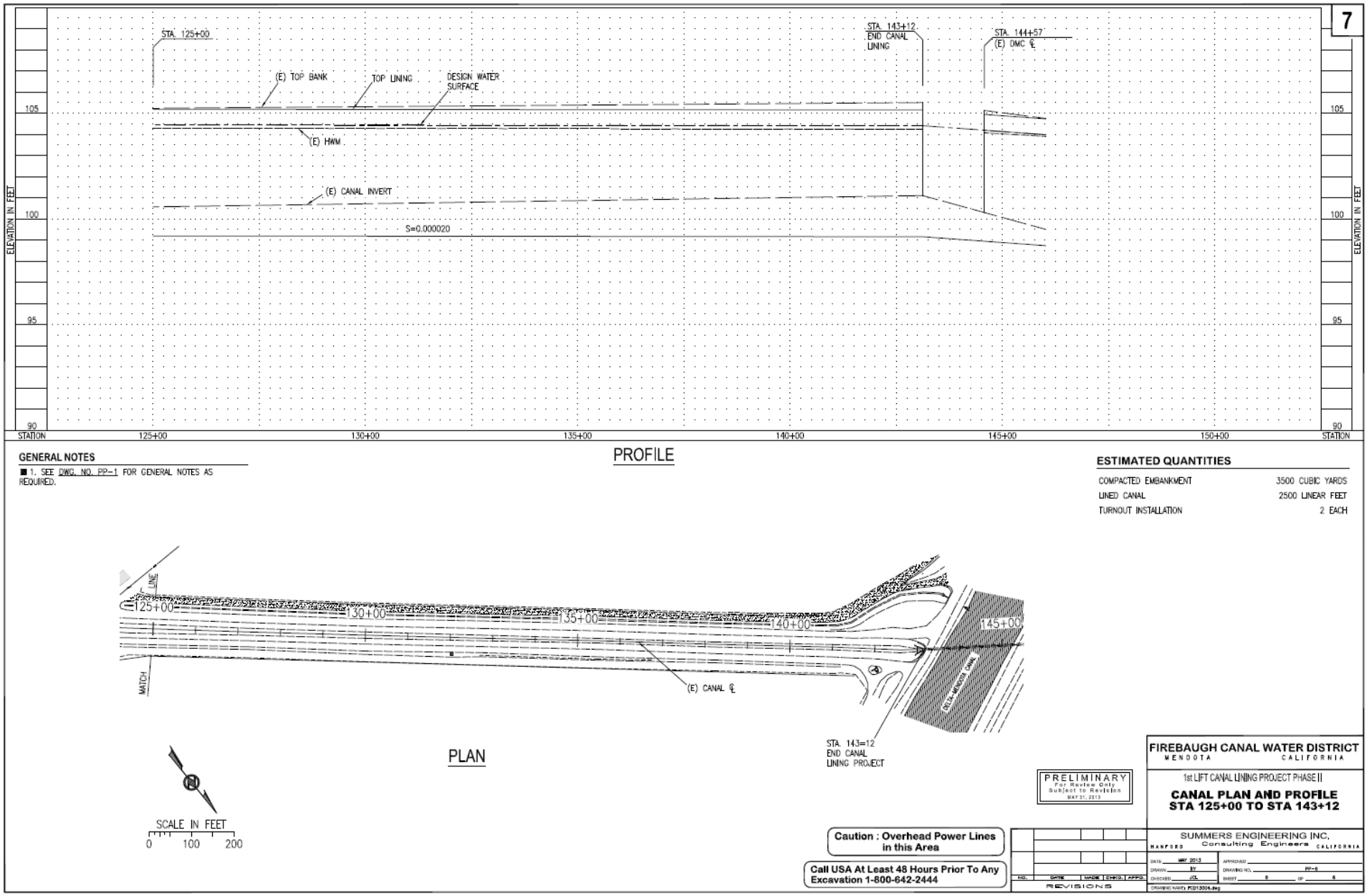
CANAL PLAN AND PROFILE
STA 50+00 TO STA 75+00

SUMMERS ENGINEERING INC.
HANFORD Consulting Engineers CALIFORNIA

DATE: MAY 2013 APPROVED:
DRAWN: BY DRAWING NO. PP-3
CHECKED: JCL SHEET 3 OF 6
DRAWING NAME: FCD13004.dwg


5
STA. 75+00
STA. 80+65
(E) ROAD CROSSING
STA. 87+27
(E) SAN DIEGO AVE.
CROSSING
STA. 100+00
TOP LINING
(E) TOP BANK
DESIGN WATER
SURFACE
(E) HWM
(E) CANAL INVERT
S=0.000020
S=0.000020
S=0.000020
PROPOSED CANAL INVERT
ELEVATION IN FEET
110
105
100
95
STATION
75+00
80+00
85+00
90+00
95+00
100+00
PROFILE
GENERAL NOTES
1. SEE DWG. NO. PP-1 FOR GENERAL NOTES AS REQUIRED.
ESTIMATED QUANTITIES
COMPACTED EMBANKMENT 3500 CUBIC YARDS
LINED CANAL 2500 LINEAR FEET
TURNOUT INSTALLATION 2 EACH
LINE
MATCH
(E) CANAL ℄
PLAN
SCALE IN FEET
0 100 200
PRELIMINARY
For Review Only
Subject to Revision
MAY 31, 2013
Caution : Overhead Power Lines in this Area
Call USA At Least 48 Hours Prior To Any Excavation 1-800-642-2444
REVISIONS
FIREBAUGH CANAL WATER DISTRICT
MENDOTA CALIFORNIA
1st LIFT CANAL LINING PROJECT PHASE II
CANAL PLAN AND PROFILE
STA 75+00 TO STA 100+00
SUMMERS ENGINEERING INC.
HANFORD Consulting Engineers CALIFORNIA


6
STA. 100+00
(E) TOP BANK
TOP LINING
DESIGN WATER SURFACE
STA. 122+88
(E) BULLARD AVE. CROSSING
STA. 125+00
(E) HWM
(E) CANAL INVERT
S=0.000020
ELEVATION IN FEET
105
100
95
90
STATION
100+00
105+00
110+00
115+00
120+00
125+00
PROFILE
GENERAL NOTES
1. SEE DWG. NO. PP-1 FOR GENERAL NOTES AS REQUIRED.
LINE
MATCH
(E) CANAL ℄
BULLARD AVE.
PLAN
SCALE IN FEET
0 100 200
PRELIMINARY
For Review Only
Subject to Revision
MAY 31, 2013
Caution : Overhead Power Lines in this Area
Call USA At Least 48 Hours Prior To Any Excavation 1-800-642-2444
REVISIONS
FIREBAUGH CANAL WATER DISTRICT
MENDOTA CALIFORNIA
1st LIFT CANAL LINING PROJECT PHASE II
CANAL PLAN AND PROFILE
STA 100+00 TO STA 125+00
SUMMERS ENGINEERING INC.
HANFORD Consulting Engineers CALIFORNIA
DATE MAY 2013
DRAWN JV
CHECKED JCL
APPROVED
DRAWING NO. PP-5
SHEET 5 OF 6


7
STA 125+00
STA 143+12
END CANAL
LINING
STA 144+57
(E) DMC ℄
(E) TOP BANK
TOP LINING
DESIGN WATER
SURFACE
(E) HWM
(E) CANAL INVERT
S=0.000020
ELEVATION IN FEET
105
100
95
90
STATION
125+00
130+00
135+00
140+00
145+00
150+00
PROFILE
GENERAL NOTES
1. SEE DWG. NO. PP-1 FOR GENERAL NOTES AS REQUIRED.
ESTIMATED QUANTITIES
COMPACTED EMBANKMENT 3500 CUBIC YARDS
LINED CANAL 2500 LINEAR FEET
TURNOUT INSTALLATION 2 EACH
℄ LINE
MATCH
(E) CANAL ℄
NEW MENDOTA CANAL
STA 143+12
END CANAL
LINING PROJECT
PLAN
SCALE IN FEET
0 100 200
PRELIMINARY
For Review Only
Subject to Revision
MAY 31, 2013
FIREBAUGH CANAL WATER DISTRICT
MENDOTA CALIFORNIA
1st LIFT CANAL LINING PROJECT PHASE II
CANAL PLAN AND PROFILE
STA 125+00 TO STA 143+12
Caution : Overhead Power Lines in this Area
Call USA At Least 48 Hours Prior To Any Excavation 1-800-642-2444
SUMMERS ENGINEERING INC,
HANFORD Consulting Engineers CALIFORNIA
DATE MAY 2013
DRAWN BY
CHECKED JOL
APPROVED
DRAWING NO. PP-6
SHEET 6 OF 6
NO. DATE MADE CHKD. APPD.
REVISIONS
DRAWING NAME: FCD13004.dwg

Appendix B – Seepage Analysis

SUMMERS ENGINEERING
887 N. Irwin St. – PO Box 1122
Hanford, CA 93232

MEMORANDUM

TO: Firebaugh Canal Water District

FROM: Chris Linneman

DATE: February 6, 2012

SUBJECT: 1st Lift Canal Lining Project – Pre-project Seepage Study.

In October 2011, Firebaugh Canal Water District (District) performed a seepage study on a portion of the 1st Lift Canal near Bullard Avenue. The intent of the seepage test was to estimate to volume of water lost to seepage and subsequently conserved through the lining of a 2.6 mile stretch of the 1st Lift Canal downstream from the seepage test location.

The seepage study was initiated on October 3rd and completed on November 1st. Measurements of water level and evaporation pan were measured twice daily. The water level in the test pool was initially set near the normal canal operating level. At the completion of the test, the collected data was compiled and an estimated seepage rate was calculated to be approximately 0.38 acre feet per mile per day (corrected for evaporation and precipitation).

During the course of the test, the pond was not maintained at the canal's operating level which may have resulted in under-predicting the seepage rate. However, absent more accurate data, the results of this test provide a reasonable estimate of the seepage rate.

The first phase of the 1st Lift Canal Lining Project was largely completed in February 2012, and the project went into service immediately following construction. The canal lining was successfully installed and post-project seepage is assumed to be insignificant (consistent with other lining projects).

The 1st Lift Canal operates year-round and based on a 365 day irrigation run, the conserved water from this project amounts to approximately 361 acre feet per year.

Test calculations are attached.

Firebaugh Canal Water District
First Lift Canal Seepage Study
Washoe To Nees [end #1 ca]

Date	Time	ΔHours	Cummulative Hours	Staff	Evap. Pan	ΔEvap. Pan (ft)	Precip. (in)	Precip. (ft)	Water (Ac-ft)	Evap. (Ac-ft)	Precip. (Ac-ft)	Seepage (Ac-ft)
10/3/2011	2:00 PM	0.00	0.00	3.30	5 3/8"	0.000	0	0.000	0.48	0.0000	0.0000	0.0000
10/4/2011	8:05 AM	18.08	18.08	3.23	5 5/16"	0.005	0	0.000	0.47	0.0009	0.0000	0.0121
10/4/2011	2:50 PM	6.75	24.83	3.18	5 5/16"	0.000	0	0.000	0.46	0.0000	0.0000	0.0078
10/5/2011	9:17 AM	18.45	43.28	3.16	5 9/16"	-0.021	0.65	0.054	0.46	-0.0036	0.0094	0.0035
10/5/2011	2:14 PM	4.95	48.23	3.12	5 9/16"	0.000	0	0.000	0.45	0.0000	0.0000	0.0199
10/6/2011	8:30 AM	18.27	66.50	3.08	5 9/16"	0.000	0.1	0.008	0.45	0.0000	0.0014	0.0069
10/6/2011	2:20 PM	5.83	72.33	3.02	5 9/16"	0.000	0	0.000	0.44	0.0000	0.0000	0.0118
10/7/2011	7:45 AM	17.42	89.75	2.97	5 3/8"	0.016	0	0.000	0.43	0.0027	0.0000	0.0087
10/7/2011	2:30 PM	6.75	96.50	2.92	5 3/8"	0.000	0	0.000	0.42	0.0000	0.0000	0.0060
10/8/2011	8:45 AM	18.25	114.75	2.88	5 3/16"	0.016	0	0.000	0.41	0.0027	0.0000	0.0069
10/8/2011	3:30 PM	6.75	121.50	2.83	5 3/16"	0.000	0	0.000	0.40	0.0000	0.0000	0.0060
10/9/2011	9:00 AM	17.50	139.00	2.78	5 1/16"	0.010	0	0.000	0.39	0.0018	0.0000	0.0087
10/9/2011	2:30 PM	5.50	144.50	2.74	5"	0.005	0	0.000	0.39	0.0009	0.0000	0.0051
10/10/2011	8:00 AM	17.50	162.00	2.69	4 15/16"	0.005	0	0.000	0.38	0.0009	0.0000	0.0078
10/10/2011	3:15 PM	7.25	169.25	2.64	4 7/8"	0.005	0	0.000	0.37	0.0009	0.0000	0.0078
10/11/2011	8:26 AM	17.18	186.43	2.58	4 3/4"	0.010	0	0.000	0.36	0.0018	0.0000	0.0095
10/11/2011	2:45 PM	6.32	192.75	2.55	4 3/4"	0.000	0	0.000	0.35	0.0000	0.0000	0.0034
10/12/2011	7:49 AM	17.07	209.82	2.50	4 1/2"	0.021	0	0.000	0.35	0.0036	0.0000	0.0087
10/12/2011	3:30 PM	7.68	217.50	2.44	4 7/16"	0.005	0	0.000	0.34	0.0009	0.0000	0.0068
10/13/2011	8:11 AM	16.68	234.18	2.40	4 3/16"	0.021	0	0.000	0.33	0.0036	0.0000	0.0060
10/13/2011	3:00 PM	6.82	241.00	2.35	4 1/8"	0.005	0	0.000	0.32	0.0009	0.0000	0.0050
10/14/2011	10:00 AM	19.00	260.00	2.31	4 1/16"	0.005	0	0.000	0.31	0.0009	0.0000	0.0060
10/14/2011	3:10 PM	5.17	265.17	2.26	4 1/16"	0.000	0	0.000	0.30	0.0000	0.0000	0.0078
10/15/2011	9:35 AM	18.42	283.58	2.20	3 7/8"	0.016	0	0.000	0.29	0.0027	0.0000	0.0104
10/15/2011	2:30 PM	4.92	288.50	2.15	3 7/8"	0.000	0	0.000	0.28	0.0000	0.0000	0.0060
10/16/2011	10:03 AM	19.55	308.05	2.11	3 11/16"	0.016	0	0.000	0.28	0.0027	0.0000	0.0069
10/16/2011	2:45 PM	4.70	312.75	2.07	3 5/8"	0.005	0	0.000	0.27	0.0009	0.0000	0.0042
10/17/2011	8:40 AM	17.92	330.67	2.01	3 7/16"	0.016	0	0.000	0.26	0.0027	0.0000	0.0095
10/17/2011	4:00 PM	7.33	338.00	1.96	3 3/8"	0.005	0	0.000	0.25	0.0009	0.0000	0.0060
10/18/2011	11:00 AM	19.00	357.00	1.91	3 1/4"	0.010	0	0.000	0.24	0.0018	0.0000	0.0078
10/18/2011	2:00 PM	3.00	360.00	1.86	3 1/4"	0.000	0	0.000	0.23	0.0000	0.0000	0.0069
10/19/2011	10:00 AM	20.00	380.00	1.82	3 1/8"	0.010	0	0.000	0.23	0.0018	0.0000	0.0069
10/19/2011	3:00 PM	5.00	385.00	1.75	3"	0.010	0	0.000	0.22	0.0018	0.0000	0.0103
10/20/2011	8:30 AM	17.50	402.50	1.70	2 7/8"	0.010	0	0.000	0.21	0.0018	0.0000	0.0069
10/20/2011	3:00 PM	6.50	409.00	1.65	2 7/8"	0.000	0	0.000	0.20	0.0000	0.0000	0.0069
10/21/2011	10:00 AM	19.00	428.00	1.60	2 3/4"	0.010	0	0.000	0.19	0.0018	0.0000	0.0087
10/21/2011	2:00 PM	4.00	432.00	1.56	2 3/4"	0.000	0	0.000	0.18	0.0000	0.0000	0.0051
10/22/2011	7:30 AM	17.50	449.50	1.51	2 1/2"	0.021	0	0.000	0.17	0.0036	0.0000	0.0087
10/22/2011	2:00 PM	6.50	456.00	1.45	2 1/2"	0.000	0	0.000	0.16	0.0000	0.0000	0.0068
10/23/2011	8:20 AM	18.33	474.33	1.41	2 5/16"	0.016	0	0.000	0.16	0.0027	0.0000	0.0069
10/23/2011	2:00 PM	5.67	480.00	1.36	2 1/4"	0.005	0	0.000	0.15	0.0009	0.0000	0.0060
10/24/2011	10:00 AM	20.00	500.00	1.30	2 3/16"	0.005	0	0.000	0.14	0.0009	0.0000	0.0095
10/24/2011	2:00 PM	4.00	504.00	1.24	2 1/8"	0.005	0	0.000	0.13	0.0009	0.0000	0.0095
10/25/2011	8:00 AM	18.00	522.00	1.19	2"	0.010	0	0.000	0.12	0.0018	0.0000	0.0078
10/26/2011	8:00 AM	24.00	546.00	1.15	1 3/4"	0.021	0	0.000	0.11	0.0036	0.0000	0.0051
10/26/2011	3:00 PM	7.00	553.00	1.10	1 11/16"	0.005	0	0.000	0.10	0.0009	0.0000	0.0050
10/27/2011	8:00 AM	17.00	570.00	1.06	1 1/2"	0.016	0	0.000	0.10	0.0027	0.0000	0.0060
10/27/2011	3:00 PM	7.00	577.00	1.00	1 7/16"	0.005	0	0.000	0.09	0.0009	0.0000	0.0077
10/28/2011	8:00 AM	17.00	594.00	0.95	1 3/8"	0.005	0	0.000	0.08	0.0009	0.0000	0.0078
10/28/2011	3:00 PM	7.00	601.00	0.91	1 1/4"	0.010	0	0.000	0.07	0.0018	0.0000	0.0060
10/29/2011	8:00 AM	17.00	618.00	0.86	1 3/16"	0.005	0	0.000	0.06	0.0009	0.0000	0.0069
10/29/2011	3:00 PM	7.00	625.00	0.81	1 1/8"	0.005	0	0.000	0.05	0.0009	0.0000	0.0078
10/30/2011	8:00 AM	17.00	642.00	0.76	1 1/16"	0.005	0	0.000	0.04	0.0009	0.0000	0.0078
10/30/2011	3:00 PM	7.00	649.00	0.71	1"	0.005	0	0.000	0.04	0.0009	0.0000	0.0078
10/31/2011	7:47 AM	16.78	665.78	0.65	7/8"	0.010	0	0.000	0.03	0.0018	0.0000	0.0095
10/31/2011	3:50 PM	8.05	673.83	0.60	13/16"	0.005	0	0.000	0.02	0.0009	0.0000	0.0069
11/1/2011	8:55 AM	17.08	690.92	0.56	3/4"	0.005	0	0.000	0.01	0.0009	0.0000	0.0060

Total Seepage 0.4193

Summary

Pond Length (ft)	Days	Seepage (Ac-ft)	Seepage rate (Ac-ft/year/mile)	Daily Rate
202.00	28.79	0.4193	138.96	0.38

First Lift Canal Length =	2.60	miles
Estimated Seepage loss (Ac-ft) per year =	361	